NATURE

No. 3790 SATURDAY, JUNE 20, 1942 Vol. 149

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Editorial and Publishing Offices
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T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey
Telephone: Merstham 316

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad

Registered as a Newspaper at the General Post Office

THE FUNCTION OF BRITISH RESTAURANTS

BRITISH Restaurants may be said to have started as an improvisation and to continue as a compromise ; how they will develop in the near and distant future is uncertain. Their original object was to supply a solid meal to those who, owing to bombing, could not get their meals in their customary way ; but other objects have been grafted on. First, they serve the same purpose as works canteens, they supply meals to workers in factories that are not covered by the Factory Canteens Order, and to others who work far from home. Then there is the economy motive ; they reduce waste of foodstuffs ; less labour is needed for preparing and cooking food when a hundred or more are fed in a restaurant than when they eat in groups of three and four at home. Women are better able to go to work in factories if they are relieved of the task of preparing the main meal of the day. Finally, there is the motive that has been behind the expansion of the school meals service—improvement of the standard of nutrition ; the British Restaurants insure that anyone can get a nutritious meal at a low price.

As the knowledge that meals in British Restaurants are good and cheap has spread, more and more people have gone to them ; so that now, besides factory and clerical workers and shop assistants, professional men and women, students, bishops and tramps now eat together in a friendly and sociable atmosphere. All of which is excellent ; but the time has come to think about the consequences and the whole purpose of these communal meals. As it is, they encroach on the business of private caterers ; they threaten to disturb the business of food retailers ; and if they come to serve a large proportion of the population they will upset the system of rationing, particularly of meat. In January of this year Lord Woolton assured a deputation from various caterers' associations that if a local authority wished to open a British Restaurant and the local caterers think it unnecessary, an official will be sent to investigate before approval is given by the Ministry. This may mean much or little ; all depends on the criteria on which the Ministry's decision is based. Some day it will be necessary to decide who it is that the British Restaurants are intended to serve, and what purpose they are intended to play in our system of food control. It may be assumed that they are intended to provide for those workers who cannot go home for their midday meal. It might seem desirable to carry the system to its extreme and to supply the whole population with a solid meal in a British Restaurant. As we shall see later, it is doubtful how far this could be justified, even on the grounds of economy ; but in any event expansion is limited by other factors.

The present British Restaurants, particularly the older ones in London, must be improved if they are to continue to supply satisfactory meals under favourable conditions. The shortage of equipment is being overcome ; small tables with green linoleum tops are taking the place of trestle tables, and chairs

are supplied in place of benches. The newer restaurants are so arranged that customers pass a series of hatches from which they can take their food; but in the older restaurants they wander from one serving table to another. The worst trouble is overcrowding; customers who come, and must come, at the rush times have to wait in long queues; in the dining-rooms there is no space between the backs of the diners' adjoining tables. Partly because of the time wasted in the queue, partly from a feeling that they must finish and make room for others, diners hurry over their meals. This overcrowding results, in the main, from the need to improvise restaurants in any buildings available, however unsuitable or small. One may contrast the British Restaurant in Dunmow, in which the kitchen is on an upper floor, and the dining-room (the sorting room of the old Post Office, with a glass roof) is bright and airy, with one near Red Lion Square, London, in which the food is cooked and eaten in the same overcrowded room. No other building can be found in the neighbourhood; most that might have served have been destroyed by bombing. As no extensive building is allowed at present it will be difficult to relieve this overcrowding unless some private premises are commandeered. Even with more and better buildings it may not be possible to staff them. As more women are drawn into the Services or into industry it becomes more and more difficult to find both paid cooks and voluntary helpers. It is, therefore, hard enough to cope with the present number of diners; and, as the demand increases, it will be necessary to select the patrons in some way if no further provision is made for the meals service.

Agreeing that one of the purposes of the British Restaurants is to raise the level of nutrition, how far can they be used as media for education in the better use of food, and how far can they be improved? At present most of the meals consist of the traditional meat and two vegetables, followed by pudding. It is suggested, for example, that meals of the Oslo type might be introduced. However, this education needs a personal approach. If the diners are merely supplied with strange food they may eat it, but they will not come again. The personal approach is possible in schools and in some factory canteens; but it is out of the question when diners enter in a queue of a hundred or more, and eat hurriedly in a crowded room; certainly none of the staff has time for discussion during meal times. A nucleus of diners ready to set an example by eating different food may influence the rest; but with a small staff and large numbers to serve, it is not possible to prepare the special dishes needed.

Critics of the meals provided should realize that there is much sound physiology behind the traditional dinners. The meals have been stigmatized as 'too starchy'. But starch is the main source of energy of the people of the world. A few only of the more favoured, whose energy expenditure was not large, may have been able to get a fair proportion of their daily calories from protein and fat; but in the present days of shortage this is not possible. The rations even to canteens for heavy workers, allow only some 200 mega-calories per meal from meat, cheese and butter. If the meals supply, as is intended, about one third of the day's energy requirement, the greater part must be derived from starchy foods. Actually Miss Abrahams reported to the Nutrition Society's Conference on May 30 (see p. 685 of this issue) that only a few of the meals that she measured supplied 1,000 mega-calories—one third of the 3,000 mega-calories that are commonly accepted as an average day's requirements. It would be better if the starchy food, bread, were supplied free in all restaurants, in order to ensure that sufficient energy should be furnished by the dinner. Also critics should be sure that their criticisms are sound. Most manageresses have been told that a large proportion of vitamin C dissolves out of potatoes if they are peeled and left in water overnight; that they should, therefore, be peeled in the morning before cooking. Anyone who has had practical experience of the difficulty of the extraction of ascorbic acid from raw potatoes, even when they are ground up, would suspect the first statement; actually experiments have shown that it is untrue. No methods by which the staff could peel some hundredweights of potatoes in the morning in time to be cooked were ever suggested. Because of the practical difficulties involved in its application this particular piece of advice has been remembered when better things have been forgotten, and most manageresses are left with the belief, however politely concealed, that dietitians are armchair faddists. Similarly, it is not possible, with limited equipment and with limited time, to put green vegetables into the boiling water in small instalments. However, as the experiences related at the Conference showed, the preparation of vegetables in some kitchens is unsatisfactory, and improvements, with the object of conserving vitamin C, are possible.

Two methods whereby the meals might be improved may be suggested. First, arrangements might be made for visits by manageresses to restaurants in other districts, so that they might exchange experiences. A conference of restaurant staffs might help; it is a matter for regret that only one speaker at the Conference of the Nutrition Society put the view of a manageress. Second, an experimental team might visit those restaurants in which there is room and demonstrate new methods of using food; this would certainly be possible with the Oslo type of meal. In the meantime, studies on the nutritional value of the meals, as served, should continue.

There are two possible changes that do not directly concern the staff of the restaurant. First, the working-class adolescent is, as usual, forgotten. He or she needs extra protein just as much as a schoolchild. True, he *may* get 1½ pints more milk per week than an adult, but this supplies only 4 gm. of protein per day; and, as an adolescent is not (and if female, never will be) regarded as a 'working man'; he (and still more she) is not likely to get his or her full share of the family meat ration. There is a good case for doubling the meat allowance for all who are under the age of eighteen, as shown by their identity cards. Also it should be possible to make a reduction in cost

for the under-eighteens; otherwise the meals will take up too large a fraction of what is left of their wages, after unavoidable expenses are met. Actually, in many restaurants the proportion of the diners who are under eighteen is very small, possibly because they find the cost too high.

Another change that should improve the quality of the meals is an alteration in the system of buying. The principle has been to use the normal channels of trade. Most British Restaurants get their supplies of meat, fish, dairy products and vegetables from local retailers at full retail prices, or less a small discount only. The system of central buying should reduce the cost and, particularly with regard to vegetables, improve the supply. The risk of deficiency of vitamin C during the early months of the year, now that imported fruit is almost unobtainable, was discussed at the Conference. Attention was focused on the conservation of the vitamin C of vegetables, either by better cooking or by no cooking at all. No mention was made of another aspect of the food situation; vitamin A from animal sources (milk, butter, margarine, cheese and eggs) is limited by rationing by an average of some 1,000 international units per day; the rest of the requirements must be made up from the carotene of roots and, particularly, of green vegetables. The supply of carotene falls off in March, just as much as that of vitamin C. True, stores of vitamin A can be accumulated in the body when the intake is high, but there is little likelihood of a liberal supply of vitamin A at any time of the year. The situation with regard to vitamin A would not be affected by changes in methods of cooking; but an ample supply of green vegetables would satisfy requirements of both vitamin C and vitamin A.

At present the vegetables grown on a large scale are mainly those that travel well, for example, cauliflowers and the compact type of cabbage with a white heart; both of these contain relatively little carotene. Winter hardy greens, such as curly kale, and sprouting broccoli, that comes early in spring, are neglected. There is a contrast between country schools that grow their own vegetables, and country British Restaurants that buy from a shop; and between British Restaurants in town and those in the country, since the best supplies go straight to town. One British Restaurant in a small town had a difficulty in getting green vegetables during the second week in May of this year. The difficulties of provincial British Restaurants could be overcome if local authorities grew their own vegetables or contracted directly with local growers, and arranged what should be grown. Some such local organization would do much to prevent the waste and expense of the distribution of vegetables that were exposed in the debate in the House of Lords on June 3. But if the experience of this year, when for three weeks in March little green stuff except brussels sprouts at 10*d.* or more per lb. could be bought, is to be avoided next year, something must be done at once.

Another improvement which a central organization of the food supply would make possible is the introduction of central factory kitchens as described by Mr. Le Gros Clark at the Conference. This would relieve the staffs of restaurants of a considerable fraction of the work of preparing food and allow a greater variety of dishes at any restaurant.

If British Restaurants are continued after the War ends, they may cater for a small proportion of the population, as at present, or they may be extended until they replace the family system. It cannot be assumed that such an extension is justified on grounds of economy alone. At first sight it seems obvious that fuel is saved and labour better used if many small cooking units are replaced by one large unit. But actually domestic economy is an integrated whole. If one part is taken away the system works less economically. The kitchen fire not only cooks the dinner but also heats the house, besides water and other meals. If it is not used to cook dinner its use for other purposes becomes wasteful. In the same way the housewife spends her time in many other household jobs besides cooking dinner, and she may have to look after children. If the labour of a mother with young children is used outside her home, someone else must at least look after her children while she is away. This means crèches or nursery schools, premises to accommodate them and qualified women to look after the children. Even then there remain jobs to be done before and after working-hours—washing children and attending to clothes, cleaning the house, and getting other meals. If a woman does this as well as an ordinary day's work, it is not an economy of labour, but sweated labour. A general system of communal meals, with employment of married women outside their homes, can be justified on grounds of economy of labour only as part of a complete system of communal life, with homes reduced to dormitories rather than living places.

In the U.S.S.R. communal meals have been encouraged for much the same reasons as have led to the introduction of British Restaurants; there was also the factor that they fitted the Bolshevik outlook; they, together with the type of housing adopted, were part of a communal system. However, Le Gros Clark and Brinton in 1935 found a tendency to revert to eating at home. It would be interesting to know how the matter stood in 1939. Communal restaurants were started in Germany and Austria in the large towns during the War of 1914–18, and remained open after the War. In Vienna they were still running up to the time of the *Anschluss*. They were mainly found in the central part of the city and fed a larger number than do the British Restaurants in the central parts of London. They catered mainly for the working population of the city centre (which included few factory workers) and people who preferred to eat away from home. A good three-course meal with a choice of dishes cost one schilling (equivalent to about 10*d.*); a large *eintopf* dish was still cheaper. It was not possible to prepare similar meals so cheaply at home.

This is the type of service that the British Restaurants will, in all probability, offer after the War. As building becomes possible better premises should be provided and various meals at different prices be introduced. We may hope that in the end the

Restaurants will not only insure a good level of nutrition by supplying good meals at low prices, but will also provide amusement and entertainment, much as in J. B. Priestley's vision of "Smoketown". Whether they come to form part of a complete system of communal life it remains for the future to decide*.

* For a general account of British Restaurants, Works and School Canteens see "Community Feeding in Wartime" by Barbara Drake (Fabian Society) and, for organization, a pamphlet with the same title published by H.M. Stationery Office.

LIFE AND LABOUR

Fighting for What?

By Sir John Orr. Pp. xiv+90. (London : Macmillan and Co., Ltd., 1942.) 2*s*. 6*d*. net.

"A THIRD of the population in the United Kingdom and about an equal proportion in the United States do not enjoy food and shelter on the standard needed for health. In most other countries, the proportion of the population which has never been adequately fed or adequately housed is even higher. Among the native races, for whose welfare Britain is responsible, only a relatively small proportion of the population have houses in which they can live in decency and food on the health standard."

These are Sir John Orr's words ; and they are an indictment by science against society preferred to a world jury at a critical epoch in the history of civilization. As the result of many investigations carried out in recent years at a number of scientific institutions, the minimum and optimum nutritional needs of human beings have been determined, and general agreement has been reached as to dietary standards necessary to maintain health and growth. When the constituents of a diet are wrongly balanced, as measured by these standards, or when the supply of foodstuffs is inadequate, there is an increase in the incidence of deficiency diseases and a weakening of resistance to others, as well as stunted growth and general physical disability. Over-feeding, like other forms of intemperance, brings its own penalties upon the body and mind, and is a type of malnutrition due to self-indulgence rather than to lack of knowledge of dietary requirements.

Dietary habits can be improved by increasing the interest of public health authorities in the modern science of human nutrition and its everyday applications. No educational agencies of this kind can, however, be of much value unless the foodstuffs required for dietary standards are within the reach of all who need them. To advise people what they should eat to maintain health and strength, and not to ensure that they can obtain the food they require, is to make a mockery of knowledge. It is comparable to the naïve suggestion related in French history that if a starving people could not obtain bread they should eat cake. The position to-day is that there is close agreement between scientific investigators and official bodies as to standard food requirements of human beings. It has also been established that, with the approach of diets to this standard, health and physical fitness are improved and the further the diets fall below the standard the worse these bodily conditions become.

An apocryphal story relates that after Galileo had shown to Pope Urban VIII that the earth revolved around the sun and not the sun around the earth, the Pope replied : "That is all very well, Galileo, but what are you going to do about it ?" Similarly, as science has shown clearly what are the primary nutritional needs of man and also enabled them to be supplied in increasing abundance from the earth's store, social justice demands that something should be done to ensure that no member of the community is deprived of the means of healthy living. It may be trite to deplore the prevalence of poverty in the midst of plenty, but dietary poverty is preventable and ought, therefore, to be prevented, if only to save the social arteries from sclerosis.

In order to bring the diet of the whole population up to the health-level defined by the accepted standards of nutrition, additional amounts of protective and other foods would have to be made available for consumption. Whatever is required to reach this standard can be produced, and there cannot be over-production of foodstuffs so long as any human beings are hungry for them. It is possible to estimate with reasonable accuracy the food requirements of any community and to produce whatever is needed for the healthy nourishment of all members of it. To ensure these conditions demands, however, the institution of a food policy based on human needs and not dependent upon the profit-making interests of producers or distributors. Until these needs are satisfied, the problem of over-production cannot arise, and the wanton destruction of foodstuffs will be condemned as a crime against the community.

When the principle is conceded that the whole population should be able to obtain sufficient food to reach at least the minimum dietary standard, various difficulties arise in applying it. In pre-war days Great Britain imported about two thirds of the food she consumed. Both home production and imports would have to be increased in order to supply the necessary food on a free-choice basis. Sir John Orr contemplates a great expansion of agriculture at home and abroad to provide such supplies and suggests what foods should be produced in Great Britain and what should be imported in order to raise the total supplies to the level of consumption required for a health basis. This means a re-orientation of British agricultural practice towards that of Denmark and Holland, to supply foods which can be produced at home as easily and cheaply as they can be produced abroad, and the importation of such foods as wheat, beef, mutton and sugar which cannot be produced as economically here as in some other countries. There must be a great expansion of agriculture at home in order to produce the additional amounts of food required for home consumption, and the increased imports of food and feeding-stuffs would require increased exports of industrial products to pay for them. Increased agricultural and industrial output means increased employment and the creation of new national wealth as well as stability in trade.

The foodstuffs necessary to bring all the members of a community up to the safety-line of health are known just as a farmer knows what he has to produce or purchase to feed or fatten his herds of cattle. We know also that the amounts required can be produced and ought to be made available to the whole population. The principles of Sir John Orr's food policy are based upon these scientific facts. Their recognition makes supply and demand matters of international concern instead of profit and loss accounts of small

or big businesses. With agriculture based on the needs of the population and industry expanding with it, production and trade would tend to become stabilized and the booms and slumps of food markets would be avoided.

A food policy based on the needs of the community and not upon considerations of private profit by business people who control the food industry would eliminate many vested interests and meet, therefore, with much opposition. When, however, the social conscience is convinced that the principles and the aims are right, action is bound to be taken to carry them out. Sir John urges that we should not wait until after the War to produce plans to enable this to be done. He suggests that a Food Planning Commission should be established now, and outlines an organization which might be devised for Great Britain. A National Food Board should be appointed by the Government and the members of it should be financially independent of the food trade. The National Board would be responsible for bringing the national supplies of the main foodstuffs up to the level needed to supply sufficient for everybody and for arranging that sufficient would be available within the purchasing power of everybody. The Board would exercise its functions through a number of Commodity Boards the members of which could include representatives of producers, distributors, consumers, and taxpayers, as well as of people having no financial interests in the food trade. These Commodity Boards would take over the functions of the existing Agricultural Marketing Boards, but would differ from them in not having the power to regulate production and fix prices in their own interests.

When the aim is to enable the whole community to obtain the food required to live, no sectional interests or actions should be tolerated which will prevent its attainment. The new policy involves certain changes in the food trades, but there is no reason why these should deprive producers and distributors from exercising initiative and free business enterprise for services supplementary to those of the Commodity Boards. Scientific inquiries have shown what a dietary standard for human beings signifies, both as to needs and increase of production necessary to satisfy them. There will have to be new economic policies and new international relationships if the necessities of life on a health standard are to be brought within the reach of all mankind. These elements of a new world constitution must be organized by financiers and traders not for their benefit alone but also as worthy service to the community.

Each country has its own problems of this kind to solve in order to bring an adequate diet within the purchasing power of the people in it, and in a world food policy every nation has a similar human responsibility towards poorer nations. This is already recognized in the steps being taken to provide food for peoples who have been deprived of it by conditions of war, and in the preparation of plans for post-war production and supply. Modern contributions to the science of nutrition, and the inquiries into the social economics of rich as well as of poor countries, have shown that a food policy such as that long advocated by Sir John Orr and outlined in the present book should be adopted by the United Nations as the sound and sure foundation of world stability. There are still many people who regard such an outlook as Utopian and unattainable, but the signs of the times are against them. The principles of the Atlantic Charter represent relationships which might well become articles of social faith among all free peoples and inspire a crusade to promote their application.

Since these principles of the cause for which the United States and the United Kingdom are fighting were stated, there has been a tendency to believe that action based upon them would not come above the horizon until after the War, and possibly not then. The announcement made by Mr. Roosevelt and Mr. Churchill on June 10 should remove all doubt as to their joint intention to put into practice the policies expressed in their Charter. In order to promote the most effective use of the combined resources of the United States and the United Kingdom for the prosecution of the War, they have established a Combined Production and Resources Board and a Combined Food Board. The purpose of the Food Board is to co-ordinate and obtain a planned and expeditious utilization of the food resources of the United Nations. All questions of supply, production, distribution and disposal of foods in which the Governments of the United States and the United Kingdom have common concern will be referred to the Board for inquiry and report, and also those relating to agricultural materials from which foods are derived and equipment and non-food materials used in the production of such foods. Moreover, the Board is to work in collaboration with others of the United Nations towards the best utilization of their food resources, and with any interested nation or nations to formulate plans and recommendations for development, expansion, purchase or other effective use of their food resources. The functions of the Board thus follow much the same lines as those of the organization outlined by Sir John Orr. The establishment of the Board gives good reason to expect the realization of his hope that "the Government is prepared to base post-war food policy on human needs and to co-operate with all other Governments to apply such a policy on a world-wide scale".

The two other primary material necessities of life are adequate housing and the opportunity to work. When the provision of the additional food and decent homes for all members of the community is undertaken by public authorities, and every citizen, rich or poor, is made to serve for a period in a National Service Corps, the unemployment problem will approach solution, and for the first time in history man will attain economic freedom. This is the cause for which Sir John Orr and many other social reformers are combining scientific knowledge with prophetic vision. It appeals to men of all creeds in all lands and makes world fellowship possible on a basis of common social needs and faith in the capacity of Nature and the spirit of humanity to remove the fear of want from the lives of all the peoples of the world. It was said long ago that "the poor shall never cease out of the land; therefore I command thee, saying, Thou shalt open thine hand wide unto thy brother, to thy poor and to thy needy in thy land." The "land" of Deuteronomy now extends to the whole earth and "to the children of men" dwelling in all parts of it. Every human being has a right to a just share of the fullness thereof and the obligation to add to his inheritance. Though the poor may always be with us in families and in nations, they should not have to depend upon alms-giving for the primary necessities of life while Nature and man can produce these in full measure and in the spirit of mutual aid. Sir John Orr's book is a stimulating call to all men and women of goodwill to join in a crusade to achieve this end.

R. A. GREGORY.

NEW ATOMS FOR OLD

Mass Spectra and Isotopes

By Dr. F. W. Aston. Second edition. Pp. xii+276+12 plates. (London: Edward Arnold and Co., 1942.) 22*s*. 6*d*. net.

THE atomic theory of Dalton, accepted after many misgivings by nineteenth-century chemists, is now essentially discarded; Prout's hypothesis, rejected by Stas as "nothing but an illusion, a mere speculation definitely contradicted by experience", has returned to favour. One of the main factors in this transformation has been the discovery that the majority of the elements exist in two or more forms, which are chemically identical even though their atomic masses differ. These diverse species of the same element are known as isotopes, and when the word isotopes is mentioned one immediately thinks of Aston.

Although this welcome volume is announced as the second edition of "Mass Spectra and Isotopes", it constitutes in reality the fourth edition of Dr. Aston's pioneer monograph on "Isotopes", first issued in 1922. The change in title made in 1933 did not, as might appear to the casual eye, indicate a broadening of the ground covered. On the contrary, as the author himself specifically pointed out in his preface, the large development of the subject led him then to narrow the scope of the book a little—"it is now concerned less with general theory and more with experimental results, especially with those obtained by mass-spectrum analysis". The present edition very wisely continues this policy of restriction.

No doubt there will be readers who will regret that the book does not contain any discussion of induced radioactivity and artificial isotopes, but if Dr. Aston was justified in allotting a "somewhat disproportionally large space" to inactive isotopes twenty years ago in the hope that the inadequacy of his account of radioactive isotopes might stimulate the production of a separate volume dealing with this field, then it is obvious that it would be an impossible task nowadays to compress even a summary of all the important recent work on synthetic isotopes into a volume describing the stable isotopes in detail. One task at a time is prudent procedure, and Dr. Aston is entitled to feel a considerable amount of satisfaction in the fact that, in one important sense at least, the task to which he has devoted himself almost uninterruptedly for thirty years—the complete tabulation of the stable natural isotopes—has at length been triumphantly concluded. To quote his own words: "All the elements have now been analysed, and my main concern in writing this book is to tell how this has been done".

The tale is a thrilling one, and it is admirably told. The volume is indeed, in a fashion, a detective story of the very first class; Hercule Poirot or Lord Peter Wimsey would envy the skilful way in which one minute clue after another has been first distinguished and then relentlessly followed up until every atom of information has been drained out of it which might lead (and in every case, has led) to the identification of each individual connected with the mystery. No element possessed of a double, or multiple, personality has succeeded in concealing its duplicity, or multiplicity. "*Elementary*, my dear Watson!" might well be the motto on the title-page.

The experimental work involved, bristling with fresh difficulties at each forward step, has been meticulously careful from the very start, and has now attained an almost incredible order of accuracy. A most valuable feature of this edition is the inclusion of an entirely new chapter recording the remarkable recent advances in design of mass spectrographs, particularly the double-focusing types. The increase in exactness obtained by the employment of these formidable instruments may be recognized, in a very simple manner, by a comparison of Aston's original packing fraction curve (p. 81) with Dempster's 1938 model (p. 108). The atomic masses of all the significant natural isotopes of every element and their relative abundance have now been established with such certainty as to warrant the astounding statement (p. 216) that were the vast accumulations of chemical data comprising the grand total of direct atomic weight determinations lost, the table of atomic weights could be reconstructed to-day, entirely from mass spectrum evidence, as complete and, with the possible single exception of the element copper, as accurate as the table we now have.

Especially interesting in this connexion is the history of hydrogen, since it was an infinitesimal disagreement between the chemical and mass-spectrograph atomic weight values for this element that first led Birge and Menzel in 1931 to point out that, to bring the results into accord, hydrogen must contain heavier isotopes. Here the amusing case of a false clue leading to a correct deduction, rare in detective novels but still rarer in scientific work (Prout's hypothesis is an apposite example), is beautifully exemplified. "Fortunately unaware that, as we now know, the error in *each* of the estimates concerned was greater than the *total* discrepancy he was seeking to explain, Urey started his famous painstaking search which resulted in the remarkable discovery of heavy hydrogen, and for which he received the well-merited award of the Nobel Prize in 1934."

The fact that there are still plenty of unsolved problems in the general theory of the subject is well illustrated in Chapter 13, which deals with "Isotope Statistics". A number of interesting rules are cited, but their basis is admittedly still obscure in most instances. For example, why should elements of odd atomic number never have more than two stable isotopes, while elements of even atomic number may have up to nine or ten (p. 204)? Why should elements of even atomic number predominate to a very marked extent not only in the earth's crust, but also in such extra-terrestrial matter as meteorites (p. 207)? And why should there be so little apparent rhyme or reason in the relative abundance of isotopes (p. 210)?

Dr. C. P. Snow has made an excellent revision of the two chapters on the isotope effect in molecular and atomic spectra, which he wrote for the previous edition. In the whole book, I have detected only one error, namely the statement (pp. 259–60) that Lewis and Macdonald's partial separation of the isotopes of lithium was founded upon "the difference in the free migration velocities of ions"; it depended, in fact, upon a difference in their electrode potentials. In return, however, I am prepared to admit that I have corrected quite a number of false impressions in my own mind through the perusal of the volume, and have acquired a veritable mass of new knowledge. I venture to advise all my chemical and physical colleagues to go and do likewise.

JAMES KENDALL.

ECONOMICS IN THE U.S.S.R.

Soviet Economy and the War

By Maurice Dobb. Pp. v+88. (London: George Routledge and Sons, Ltd., 1941.) 3*s*. net.

Dear Joe

Letters from Bill Smith to Joseph Stalin. By E. W. and M. M. Robson. Pp. 96. (London: Martin Secker and Warburg, Ltd., 1942.) 2*s*. 6*d*. net.

THE closer political collaboration between Great Britain and Soviet Russia which has now materialized is as essential to the establishment of order and freedom in Europe when victory has been won as it is to the victory of the United Nations. That collaboration can scarcely be fully effective unless it is based on a mutual understanding and respect, and there is still room for literature which is designed to remove misunderstandings and give something more than a superficial picture of life and thought in the two different societies. Far too much of the mass of literature on Russia in Great Britain is objective, if not undisguisedly biased in one direction or another or frankly propaganda. Mr. Maurice Dobb's "Soviet Economy and the War" is a modest effort at an objective account of the economic system of Soviet Russia with reference to Russia's part in the War, and he stresses the urgent need for a more just appraisal of Soviet economy to-day if the alliance is to bear fruit in a practical policy and lasting co-operation of the two peoples. Mistakes in our foreign policy towards the U.S.S.R. will assuredly be repeated in the absence of accurate and unprejudiced knowledge of the economic and military potential of our ally.

Mr. Dobb makes a definite contribution to that better understanding, and he should at least banish the complacent assumption that the U.S.S.R. can bear the full weight of German war economy. For waging a prolonged war of attrition, he concludes that the U.S.S.R. is weaker than Germany as regards the economic basis of her war effort, if she has to face alone the full onslaught of the German war machine, although in some respects the U.S.S.R. is immeasurably stronger than in the difficult days of the First Five-Year Plan a decade ago. Apart from this, Mr. Dobb gives a clue to the root cause of the very high degree of initiative, as well as of morale and of enthusiasm, which has been shown by the ordinary people in the Red Army or Air Force and as guerilla fighters, or in the factory or ordinary civilian life. The value of the training and organization, under Soviet economy, of the ordinary workers and salaried staffs in industry, to participate in the discussion and concrete criticism of policy before it is made has received striking demonstration.

E. W. and M. M. Robson's book is another attempt at the interpretation of the British order of society with the view of mutual understanding. Written from the British point of view, it is acutely but constructively critical of certain elements of weakness in the Soviet order, and administers a wholesome corrective to some of the fulsome adulation of Soviet ways and ideas which has recently been popular. Unfortunately, much of the book is far from easy reading, and neither the exposition of the ideas or traditions of Anglo-Saxon democracy nor the analysis of those developments in Russia, belonging to the negative side of the revolution, which led to the signature of the pact with Hitler, are by any means so lucid as could be desired. None the less, the glimpse of the possibilities of Anglo-Soviet co-operation, and of renewal of the creative forces in both countries through the positive elements which have inspired such magnificent resistance to aggression, warrants the hope of a further attempt on similar lines with a wider and more popular appeal.

R. BRIGHTMAN.

GEOLOGICAL TEXT-BOOKS

Lake and Rastall's Text-Book of Geology

Revised by Dr. R. H. Rastall. Fifth edition. Pp. viii+491+32 plates. (London: Edward Arnold and Co., 1941.) 25*s*. net.

Introduction to Geology

By Prof. E. B. Branson and Dr. W. A. Tarr. Second edition. Pp. ix+482. (New York and London: McGraw-Hill Book Co., Inc., 1941.) 26*s*.

Field Geology

By Dr. Frederic H. Lahee. Fourth edition, revised and enlarged. Pp. xxxii+853. (New York and London: McGraw-Hill Book Co. Inc., 1941.) 35*s*.

EVER since its appearance more than thirty years ago, "Lake and Rastall" has been recognized as our leading elementary text-book on geology. Now, in its fifth edition, it has been carefully revised and largely rewritten by Dr. Rastall. While the general plan remains unchanged, the balance of the various topics has been improved and the treatment modernized. Some sections have been shortened or omitted (for example, certain details of mineralogy and petrology) to make room for new matter concerned with subjects in which there has been considerable recent progress, as in the chapter on sedimentary rocks. In revising the stratigraphical chapters, the admirable regional handbooks issued by H.M. Geological Survey have been fully utilized.

Here and there revision has perhaps not gone far enough. Neither the intrusive masses of the Cuillins and Red Hills of Skye (p. 247) nor the granite intrusion of the Cheviots (p. 475) should now be considered as laccoliths. In the classification table on p. 263 there is still no indication that plagioclase is an essential mineral of alkali-gabbro. The old interpretation of the nickel ores of Sudbury as segregations of immiscible sulphides (p. 265) is no longer tenable, since the ores are now known to be of later origin than the basic rocks with which they are associated. In connexion with the emplacement of igneous rocks there is some confusion on p. 264 between melting and overhead stoping, while the use of the term "melting" (pp. 13 and 250) hides the fact that granitization involves a change of chemical composition. However, these are minor defects, mostly inherited from earlier editions.

A particularly laudable feature of the book is the refreshing absence of dogmatism and the frank recognition that many of the hypotheses concerning fundamental problems are still little more than speculative. "Lake and Rastall" has always been esteemed for the broadness of its scope, the clarity of its style and the unfailing interest of its treatment. In this new edition its high reputation should be still further enhanced.

Branson and Tarr's "Introduction", which deals with both physical and historical geology, is now, in its second edition, a far more attractive volume than before. The most conspicuous change is to be found in the illustrations; several new ones have been

substituted and all of them are now very much more effectively reproduced. The revision of the text has been confined to bringing the work up to date, simplifying certain sections that were found to present difficulty, and omitting technicalities that are believed to be "beyond the comprehension of elementary students".

In some respects the result is probably too simple for a first-year university course. It is claimed that igneous rocks can be determined by means of a cross classification based on (*a*) colour and mineral composition—light and dark in each case, against (*b*) structure—grained, dense, glassy and fragmental. Fig. 9 brings together all the common modes of occurrence of igneous rocks in a most unnatural and misleading association. Sedimentary and metamorphic rocks are dealt with more adequately and, allowing for the limited scope of the book, the general treatment of the physical agents is good.

The historical chapters, based on the stratigraphy of North America and including sections on the development of life and also on the chief economic products of each system, are necessarily sketchy; nevertheless a broad picture of essentials is gradually built up. The book is not well adapted to the needs of British students, but teachers will find the method of presenting the subject to be of considerable interest.

For a quarter of a century Lahee's "Field Geology" has been a widely appreciated standard manual for field geologists and engineers. The first part of the book is concerned with the recognition and interpretation of geological structures and topographic forms. A particularly valuable feature is the careful discrimination (often well summarized in tables of criteria) between superficially similar phenomena which may be of diverse origins. The second part deals with such topics as methods of surveying, construction and interpretation of maps, geological computations and preparation of illustrations and reports. There are many tables of practical value and the bibliography and index are both excellent.

In the new edition, the fourth, much new material has been incorporated by revision and expansion, notably on the structures of igneous and metamorphic rocks, the analysis and classification of folds and faults, and sub-surface and aerial methods of surveying. The chapters on aeroplane mapping and geophysical surveying have been rewritten and enlarged to embody the chief advances made during the last decade. There is no systematic treatment of groundwater or water-supply problems, but the volume is already so long and so packed with useful information that it will probably seem ungracious to ask for more. The new edition may be cordially recommended to all practical geologists and mining engineers, and it should certainly be acquired for the shelves of every geological library.

PLASTICS AND THEIR USE

Plastics in Industry

By "Plastes". Second edition, revised. Pp. xiii+248+45 plates. (London: Chapman and Hall, Ltd., 1942.) 15*s*. net.

SOON after the close of the War of 1914–18 there began to be talk of the plastics industry. Few knew what this indicated, excepting that it was possible to take certain condensation products made from simple substances and mould them into permanent objects with the aid of heat. The progress made in the last twenty years has been amazing; a yard-stick for its measurement was afforded by successive British Industries Fairs. On the purely chemical side there have been developments of two types: the discovery and manufacture of simple substances to use as condensing agents, and the understanding of the theory and practice of condensing to form large molecules of the desired size. There is now an abundant literature on this subject.

The plastics industry is developing on the lines that one firm makes the condensation products and perhaps their raw materials, while another undertakes the moulding. It is this section which is becoming so widespread as the use of plastic materials increases. The book before us is devoted to the moulding industry and is written to give industrialists in general a picture of what plastics are and what can be done with them. The claim is that they are easily moulded into complicated shapes and can be given properties of outstanding advantage. The synthetic chemist has enriched the world with dyes, drugs, solvents and many organic substances in daily use. In plastics he has made a further step forward in providing materials of construction which compete with wood and metals.

There are two types of plastic based on different raw materials, namely, those which can be re-softened by heat and re-moulded, generally called thermoplastics, and those which remain rigid and hard when once moulded, known as thermosetting. The technique of their fabrication, a purely engineering industry, is becoming complicated. It includes blowing or shaping, extrusion through nozzles or dies, compression moulding and injection moulding.

The book describes the technique in sufficient detail and goes on to deal with the applications of the articles made in the engineering, chemical and electrical industries.

In these days when so much depends on aircraft, there is no need to emphasize the importance of light-weight materials, and plastics have become available for many unstressed and lightly stressed parts at one time made of light alloys. Plastics in aircraft construction have become a science and industry on their own.

What the modern motor-car owes to plastics is well known; more recent is the relation to the textile industry. We have at last, in 'Nylon', a wholly synthetic fibre made from highly complicated condensation products of a nature such that the final substance does have an affinity with protein. The 'Nylon' fibre owes much to the fact that at one stage of its manufacture it is cold drawn—yet another example of the co-operation between engineer and chemist.

The possibilities of plastics in the building and furniture industry are obvious: they will figure largely in the house of the future, provided the masses learn to take more care of what does not immediately belong to them.

The book goes into many other applications with just sufficient detail to illustrate the potentialities and whet the appetite of the reader.

Plastics have one great advantage, their raw materials are largely indigenous, so that the establishment of a virile industry in Great Britain depends on the chemists and the enterprise of the industrialists. It should develop to a very large and remunerative industry giving employment to a skilled person.

E. F. ARMSTRONG.

STARLING MOVEMENTS AND THE SPREAD OF FOOT-AND-MOUTH DISEASE

By DR. W. S. BULLOUGH
University of Leeds

A CONNEXION between the erratic and inexplicable occurrence of foot-and-mouth disease and the movements of wild animals has been suspected for a long time, and in the annual Reports of Proceedings under the Diseases of Animals Acts, published by the Ministry of Agriculture and Fisheries, frequent references are made to the possibility that certain outbreaks of disease were due to the presence in the infected area of unusually large numbers of such birds as rooks, gulls, or starlings. The first serious attempt to correlate the movements of birds with the spread of the disease appears to have been that of Stockman and Garnett[1], but their work was strongly criticized, mainly from an ornithological aspect, by Thomson[2]. They did, however, make the valuable suggestion that the only obvious way in which the disease can be transmitted over large distances, often apparently in a very short time, is through the agency of birds, and their ideas have formed a basis for a new survey of the problem now in press in the *Proceedings of the Royal Society*[3]. This survey has been made possible by a study[4] of the breeding behaviour of the British and Continental races of the starling, *Sturnus vulgaris* L., and it consists of a correlation of this new knowledge with an analysis covering nearly forty years of the records of foot-and-mouth disease in the British Isles and on the Continent.

The migrations and movements of all the species of birds studied by Stockman and Garnett have not been considered again in the present survey. Attention has been focused on the starling alone, as this species is extremely numerous, normally frequents and feeds on pasture land, and is closely associated with farms and with cattle. The birds, keeping together in large companies, excavate their food from the ground, and for reasons not yet explained, they prefer to feed in the immediate vicinity of the noses and feet of grazing animals and often perch on their backs. If the normal food source fails due to frost or snow, starlings commonly flock into the cattle sheds and feed in hundreds from the feeding troughs. Although there are other species of birds with similar habits to these, there is no other present in such enormous numbers and which moves about Great Britain in such large flocks.

The first problem to be considered is that of the introduction of foot-and-mouth disease into Great Britain. Unless a natural reservoir of disease exists in some wild species within the British Isles, it appears that such introduction must take place, because each epidemic is so vigorously suppressed, and it is possible that the virus may be imported by Continental starlings on migration in autumn. In this connexion it is important to note that the native British starling is almost entirely sedentary, and therefore cannot be concerned at this stage. Hundreds of Continental starlings have been ringed on the Continent in summer and recovered in the British Isles in winter, or marked here in winter and recovered in their native countries in the breeding season. Analysis shows that of ten birds natives of Norway, seven were reported in Scotland and only one in Northern Ireland and two in England, whereas of 563 birds coming from or going to Continental countries other than Norway, 559 were reported in England, Wales and Ireland and only four in Scotland. The numbers of marked birds moving between Norway and Scotland are unfortunately only small, but nevertheless it appears that the migrating Norwegian starlings tend to winter in Scotland while the other Continental starlings come to England, Wales, and Ireland. Probably two separate migration routes are used, the birds from the countries bordering the Baltic being prevented from entering Norway, and so crossing to Scotland, by the mountain chain which marks the western boundary of Sweden. This conclusion is significant because foot-and-mouth disease is rare in both Norway and Scotland, whereas it is common in England, Wales and Ireland and in such countries as Sweden, Denmark, Germany and Holland, whence come most of the starlings which arrive each autumn on the east coast of England. It is interesting to note that when an unusually large epidemic starts on the Continent it appears to spread to England at the autumn migration time. This was true in 1925 and 1926, and again in the autumn months of 1930 and 1932.

The spread of foot-and-mouth disease inside the British Isles may also be due to birds, and here again the starling has a striking habit, namely its tendency to roost communally in enormous numbers in a plantation or reed-bed. All the birds within about twenty-five miles of such a place fly there each night to sleep. Opportunities for the spread of a virus inside a roost are great as the birds pack closely together shoulder to shoulder, and next morning it is possible that the disease may be taken for many miles in some new direction. The strength of the urge for communal roosting varies with the seasons. British starlings indulge most strongly in the habit from June to December, in which month a close attachment to the nesting places begins. Immigrant Continental starlings roost communally from September to March, which is the entire period spent in the British Isles. The numbers of birds present in the roosts in each month of the year give an indication of the numbers travelling daily across the country, and therefore they may also give an indication of the probability that a disease will be spread. Counts were made each month of the numbers of starlings frequenting two roosts in the neighbourhood of Leeds, and the results were checked by observations on seven other roosts.

TABLE 1. APPROXIMATE AVERAGE NUMBERS (IN THOUSANDS) OF STARLINGS OCCUPYING COMMUNAL ROOSTS IN THE NEIGHBOURHOOD OF LEEDS.

1939									1940		
Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
10	1	4	25	35	15	25	50	65	70	35	30

These figures are compared in Graphs 1 and 2 with the monthly numbers (Table 2) of unexplained outbreaks of foot-and-mouth disease, and it is seen how close is the correspondence.

TABLE 2. NUMBERS OF UNEXPLAINED OUTBREAKS OF FOOT-AND-MOUTH DISEASE IN THE BRITISH ISLES BETWEEN 1900 AND 1937.

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
42	30	19	16	8	12	22	15	31	54	53	47

Both graphs rise and remain high in the autumn when millions of starlings arrive from the Continent to reinforce the local population. Extremely large numbers of birds are then moving backwards and forwards across the country each day. The fall in both graphs from December to February may be correlated with the fact that at this time most adult

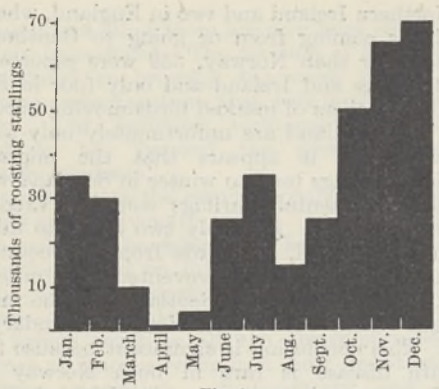

Fig. 1.
AVERAGE NUMBER OF STARLINGS OCCUPYING COMMUNAL ROOSTS IN WHARFEDALE IN 1939 AND 1940.

British starlings remain to roost in their nesting holes, so that the daily movements of birds are considerably reduced. In March the Continental birds leave for their breeding places, and the roosts, then mainly occupied by first-year and non-breeding males, reach a minimum size. In June the parents and newly fledged young return to sleep communally and both graphs rise steeply as big daily starling movements are resumed. A peak is reached in July to be followed by a fall which, at least in the case of Graph 1, appears to be connected with the serious weakening of the power of flight during the August moult of the flight feathers. An exceptional case was discovered of a bird which was hardly able to fly at all[5]. In September the new flight feathers are fully formed, the British birds again make long daily flights, and the first Continental birds arrive.

It was considered possible that if foot-and-mouth disease is brought into Great Britain from the Continent in autumn due to starling migrations, and if the birds (from countries other than Norway) arrive first on the east coast and only later spread right across England and Wales, the peak of the monthly incidence of disease might be earlier in the eastern counties than in the west. England was therefore divided into roughly equal eastern and western parts, Wales being included in the western part, and it was discovered that, in fact, the greatest monthly number of outbreaks occurred in the eastern area in October whereas the peak for the western area was not reached until November. Further, whereas in the western area the minimum incidence of disease was in April, in the eastern counties there was a small peak in that month possibly connected with the return journey across this area made late in March by birds from the western area.

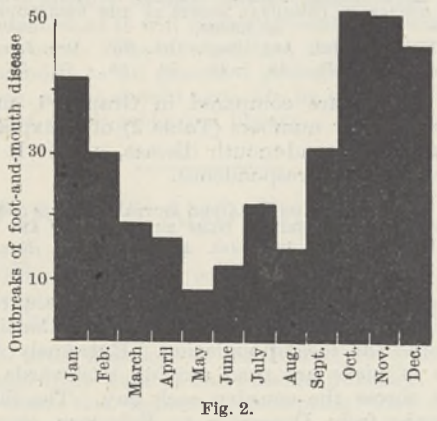

Fig. 2.
NUMBER OF UNEXPLAINED OUTBREAKS OF FOOT-AND-MOUTH DISEASE IN THE BRITISH ISLES BETWEEN 1900 AND 1937.

It has been shown that foot-and-mouth disease is most prevalent in the British Isles in autumn and winter when the starling population is at a maximum, and in order to test this correlation it was decided to study the monthly incidence of the disease in some northern country where the starling population is reduced or even absent in autumn and winter. Sweden was chosen as most suitable, and the numbers of outbreaks of disease from 1900 until 1937 were obtained through the generosity of Prof. H. Magnusson. Unfortunately, in the records no distinction was made between the primary unexplained outbreaks and the secondary outbreaks due to known causes. The figures in Table 3, therefore, refer to the total number of outbreaks, and only broad conclusions may be drawn from them.

TABLE 3. TOTAL NUMBER OF OUTBREAKS OF FOOT-AND-MOUTH DISEASE IN SWEDEN BETWEEN 1900 AND 1937.

Jan.	Feb.	Mar.	Apl.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
489	975	1396	1855	1810	1203	823	696	609	464	426	427

These figures are expressed in Graph 3, and it is

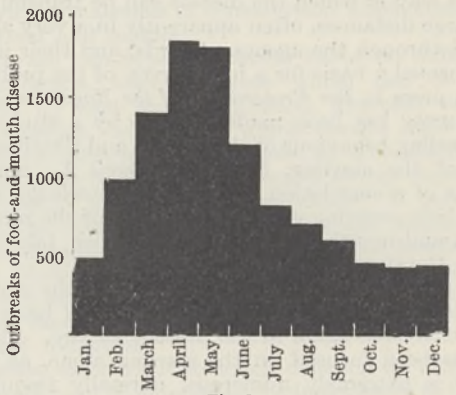

Fig. 3.
TOTAL NUMBER OF OUTBREAKS OF FOOT-AND-MOUTH DISEASE IN SWEDEN BETWEEN 1900 AND 1937.

immediately clear that this is a direct opposite to Graph 2 for the British Isles. There is a sharp rise in the incidence of foot-and-mouth disease in late winter, a maximum being reached in April when all the birds have returned from the south. Again, instead of a rise in autumn, the graph falls to a minimum in November and December.

One further line of evidence remains to be considered, namely, the geographical distribution of the starling and of foot-and-mouth disease in the British Isles. In 1932 and 1933, Marples[6] made a survey of the roosting places of the starling in Great Britain, and found that they are not usually located above an altitude of 600 ft. Of 285 roosts recorded only five were above that level. Marples considered that this is probably due to the fact that above 600 ft. there are, on the average, only rough hill pastures or heather moors, both of which habitats the starling tends to avoid. The positions of the primary unexplained outbreaks of foot-and-mouth disease were plotted to discover whether these also tended to occur below 600 ft., and it was found that of 270 outbreaks occurring between 1922 and 1937 only two were above that level. The value of this last correlation is not certain because, of course, most cattle are also found on lower land, and many of the sheep and deer which frequent the higher ground

come down from the hills in the winter. Therefore, before the true significance of this correlation could be assessed it would be necessary to find the proportions of sheep and cattle above and below the 600-ft. level at all times of the year.

These various analyses provide striking, if only circumstantial, evidence of a connexion between the movements and distribution of British and Continental starlings and the incidence of foot-and-mouth disease; but there are certain facts contrary to this general conclusion which must be mentioned. In the first place, experiments with captive starlings have indicated the great difficulty of inducing birds to transmit the virus of foot-and-mouth disease, and it may be that some special condition, such as illness, is required before the bird can act as a carrier. In this connexion it will be noticed that although many millions of starlings must have entered and moved about the British Isles between 1900 and 1937, only 349 unexplained outbreaks of foot-and-mouth disease occurred in the whole period. A second point of difficulty is presented by the great epidemic of foot-and-mouth disease which appeared in Europe immediately after the period surveyed in Tables 2 and 3, and the numbers of these outbreaks, if included, would considerably alter the shape of Graph 3. In the autumn and winter months of 1938–39 there were almost as many outbreaks of foot-and-mouth disease in Sweden as in the whole of the previous thirty-eight years, and similar conditions prevailed all over the Continent. However, an epidemic of this magnitude would be expected to present abnormal features, and it seems that the spread of the disease northwards across Europe may have been due to unusual factors.

It is difficult to see how proof or disproof of a thesis that the starling is an important carrier of foot-and-mouth disease can be obtained, and certainly many factors other than the starling must be involved in greater or lesser degree. Latitude, weather, and several species of birds may exert an effect, and possibly also there exists in some species of wild mammal a natural reservoir of disease[7] although, if this last contention is correct, it is difficult to understand why many more outbreaks do not occur. At the present moment it does not seem possible to do more than put forward the suggestive but inconclusive evidence.

[1] Stockman, S., and Garnett, M., *J. Min. Agric.*, **30**, 681 (1923).
[2] Thomson, A. L., NATURE, **113**, 52 (1924).
[3] Bullough, W. S., *Proc. Roy. Soc. Lond.* (in the press).
[4] Bullough, W. S., *Phil. Trans. Roy. Soc. Lond.* (in the press).
[5] Bullough, W. S., *Ibis*, **6**, 225 (1942).
[6] Marples, B. J., *J. Anim. Ecol.*, **3**, 187 (1934).
[7] Elton, C., Progress Report of the Foot-and-Mouth Disease Research Committee, **5**, 379 (1937).

CANTEEN FEEDING

By F. LE GROS CLARK and DR. N. W. PIRIE

MUCH has been written, in NATURE and elsewhere, on the relative merits of research that has absolutely no practically useful end in view and of research that it is hoped will lead to improvements in practice. The latest meeting organized by the Nutrition Society was held on May 30 to consider "Problems of Collective Feeding in War Time", and it gave invaluable evidence on the ease with which nutritional and biochemical research could produce immediately useful results without coercion of the research worker or any sacrifice of interest in the more fundamental aspects of science. Few research workers can have attended the meeting without being impressed by the extent to which pure scientific research was needed as a preliminary to the solving of the very practical problems of food distribution and cooking. If more meetings can be held at which men of science have the opportunity of learning about the problems that arise in practice, it is very probable that much of the necessary practical research will in fact get done with no greater interference with the freedom of choice of the individual research worker than we had in the last years of peace. It is greatly to be hoped therefore that the Nutrition Society will organize other conferences along the lines of the one that has just been held.

Squadron-Leader J. Salmon described the standard conditions in the Royal Air Force. An aircraftman's mess can serve a thousand meals at a time; it is often necessary to have two sittings for meals because of the unanticipated growth of a station. The mess is under the control of a catering officer, if there are more than six hundred men on the station, and a mess committee; close attention is paid to the general wishes of the eaters, for no choice of food is available. The amounts of rationed food drawn by the catering officer are rigidly controlled, and he is encouraged to draw his full rations so that an average of 3,500 calories a day for each man and 2,800 for each woman can be maintained.

Experience has shown that, to avoid waste, it is best to serve moderate helpings and allow those who wish more to get further helpings. In the discussion there was agreement that catering in the R.A.F. is better than in the other Services, but that there is still room for improvement. The old adage "God sends the food but the Devil sends the cooks" seemed to sum up the view of several critics, and the sensible suggestion was made that cooks should be paid extra if only for the reason that they could then lose pay if they cooked badly. Other speakers mentioned the difficulty found in getting women with cooking experience in civil life to take up cooking in the W.A.A.F.s. in spite of the extra pay that is in fact given.

Works canteens and British Restaurants are presented with a somewhat different problem, for they do not have a guaranteed clientele but have to attract diners by the quality of the meals served. How successful they are at doing this is shown by Lord Woolton's opening statement that 94,000,000 meals a week are now served "off the ration", and by the great extension of the works canteen system. Miss I. M. Clift said that there are now 7,500 industrial canteens—five times as many as in 1940—and she described vividly the methods used in her canteen to popularize the eating of foods to which the workers were unaccustomed. The mass-psychological aspect of these canteens was also referred to by Miss M. C. Broatch in her paper on school canteens. The first principle is that a novel food should appear as an extra rather than as an alternative and that at the beginning it should be in short supply; furthermore a choice of meats and vegetables on each day and a different choice on each day of the week is an advantage. It is interesting to learn that 40 per cent of the workers in one factory choose wheatmeal bread rather than white when a choice was offered, for before the introduction of the 85 per cent extraction loaf it was often stated that the British public insisted on white bread.

Miss M. Abrahams described measurements made on the meals served in forty-one British Restaurants. The calorie value ranged from 494 to 1,797 per meal; only six gave more than 1,000 calories. The prices ranged from 8*d.* to 1*s.*, and the calories per penny from 41 to 163, with only seven Restaurants giving more than 100. Part of this variation is deliberate, for Dr. M. Pyke had already said that the Ministry of Food tried to get bigger meals served in those Restaurants that tended to cater for heavy workers, but it was suggested that much of the variation was unintentional and to be deplored. The Londoners Meals Service makes every effort to serve children with a uniform balanced meal of an agreed protein, fat and carbohydrate content, and this organization is now supplying London school-children with fifty thousand meals a day. These meals contain as much meat as the meal that works canteens serve to heavy workers; there has been some opposition to this practical appreciation of the fact that a growing child needs more protein than a normal adult, but headway is being made in most areas.

In considering the nutritive value of the food served in these various canteens most of the speakers concentrated on ascorbic acid. This preoccupation with only one out of some hundred known essential metabolites was deplored by several speakers, notably Squadron-Leader T. F. Macrae and Mr. A. L. Bacharach, but it is presumably inevitable on account of the greater difficulty with which the other minor dietary constituents can be estimated.

It was clear in the discussion of most of the papers that the academic research workers tended to turn automatically to calories, protein and ascorbic acid as the criteria of a good meal. This suggests that work should be undertaken to see whether an ordinary British meal that is adequate in these three respects is likely to be adequate in other respects also, for, if this were true, it would greatly facilitate the problem of inspection.

The various factors that lead to unevenness or inadequacy in the consumption of ascorbic acid were considered in some detail. In the first place a better selection of vegetables could be planted and more care could be taken to ensure that green-stuff is available all the year round. Prof. J. R. Marrack pointed out that, in the bulletin issued by the Ministry of Agriculture, kale is scarcely mentioned whereas considerable attention is paid to parsnips. The former is a valuable source of ascorbic acid in the spring whereas the latter is almost valueless from this point of view. With green vegetables speed is essential in distribution; a cabbage that has taken 3–7 days in getting from the field to the kitchen will have lost half its ascorbic acid in the process. The potato is more stable, but there is loss during the correspondingly longer period for which it is generally stored.

Many speakers referred to the eating of vegetables raw as a means of avoiding the losses that are often entailed in cooking. The consensus of opinion seemed to be that this would not altogether solve the problem and that it might lull the caterer, who does not consider closely what weight of material is actually being eaten, into a state of false confidence. Raw vegetables are bulky and, if served up as a salad with whole leaves, very little is actually eaten. If, on the other hand, the bulk is reduced by grating, ascorbic oxidase is liberated from the damaged leaf cells and causes serious destruction of the ascorbic acid. This destruction can be greatly minimized by shredding or slicing instead of grating, for in these circumstances the proportion of damaged cells is smaller. Even if the vegetable gets into the diner's mouth with its ascorbic acid undiminished all is not necessarily well; for Dr. M. Pyke quoted an experiment in which 19 per cent of the ascorbic acid in a sample of sliced raw cabbage was destroyed in thirty seconds' chewing and 29 per cent in sixty seconds. In the subsequent discussion it was pointed out that further destruction probably took place in the alimentary canal before absorption had taken place and that, although it is likely that the destruction is due to enzyme action, this should have been confirmed by a similar experiment with cabbage in which the enzyme had been destroyed by boiling under proper conditions.

When green vegetables are being cooked what is to be aimed at is the most rapid possible destruction of ascorbic oxidase and the smallest possible loss of minerals and ascorbic acid in the water used for boiling. Many suggestions for achieving these two desiderata were made. Macrae said that the gradual addition of quartered cabbages to the boiling cauldron of water, at such a rate that the temperature never fell below 85° C., led to the preservation of most of the ascorbic acid; whereas 80 per cent was destroyed if all the cabbage was added at once so that the whole mixture fell to 60° or 70°. Dr. R. G. Booth described the successful avoidance of this loss in some British Restaurants by using a large number of small pots that can be heated rapidly. Dr. L. W. Mapson said that a smaller volume of water could be used for cooking if the vegetables were shredded first and suggested that the outside leaves of cabbage might be boiled in the water first and then removed before adding the shredded cabbage. By this means the cooking would be done in dilute ascorbic solution. The value of this suggestion depends on a number of quantitative factors that cannot be assessed on the spur of the moment in a meeting and there was no further discussion of the point. Several speakers pointed out that the extraction of ascorbic acid and minerals was only objectionable if the water were then thrown away but that it did not matter if the same water was used over and over again for boiling vegetables or if it was afterwards used for making soup or gravy; both procedures are in fact followed in many establishments.

If the problem of cooking large amounts of vegetables without serious loss of ascorbic acid has been surmounted, there is still an opportunity for loss if the food is kept hot for long before it is consumed. Mr. F. Le Gros Clark described the Russian pioneer experience in this field. In 1925 central kitchens sent out cooked food, in insulated containers, to factories, but this system was given up progressively from 1931 and thereafter they sent out food prepared and ready for cooking. This change is in accordance with British experience during the last few years and several speakers condemned the insulated container. Dr. Pyke found that after 2½ hours about half the ascorbic acid present in cooked greens or potatoes had been lost, but he pointed out that the final product might well be better than badly cooked vegetables prepared on the spot. It is clearly impossible to do all the cooking in a large canteen or mess immediately before the meal is served; and the cooks and catering officers should therefore be advised which foodstuffs are but little damaged by being kept hot until the rest of the meal is ready and which are seriously damaged. Several speakers mentioned the readiness with which scientific advice on these matters was accepted by cooks and catering officers.

The proceedings of this most successful conference fell into three parts: first, the organization and method of control of canteen feeding; secondly, the stability of ascorbic acid under the conditions of large-scale cookery; and thirdly, a buffet lunch in the production of which at least some of the principles on which there had been substantial agreement seemed to have been borne in mind.

DEGENERATION AND RELICT ADAPTATION

By PROF. JULIAN HUXLEY, F.R.S.
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RECENT advances in biology have shed considerable light on the evolutionary fate of originally adaptive structures which have since become functionless. It is a commonplace that in the great majority of animals such organs degenerate and either disappear entirely or become vestigial, while often showing excessive variability. This tendency to degeneration (and excess variation) of functionless organs appears to be automatic in sexually reproducing organisms with any considerable degree of outbreeding, like the great majority of higher animals. In such cases, as Muller[1] has pointed out, mutation-pressure alone will tend to cause useless organs to degenerate. Sewall Wright[2], while agreeing with this view, believes that a more important factor operating in the same direction is the prevalence of multiple-factor (polygene) systems of genes with multiple (pleiotropic) effects, in the genetic make-up of organisms. Wherever this is so, "the evolutionary changes in a system of genes, some bringing increased development and others reduced development in those parts of the organism which are under direct selection, should have a net effect on *indifferent* parts in the direction of reduced development". Further, when linked polygenic systems exist (that is, polygene systems consisting of one or more sets of genes which show genetic linkage with each other) and two such systems are lodged in the same chromosome or chromosomes, then anything which promotes change in the one will, by virtue of the resultant general recombination, promote change in the other. Thus, if selection is acting to alter the main character controlled by one such system, while the character controlled by the second is selectively neutral or useless, the resultant recombination will 'break up' the useless character, and in virtue of the obvious tendency of change to be towards decreased efficiency unless kept up to the mark by selection, this will promote degeneration of the useless feature. Degeneration of useless organs is thus genetically inevitable, partly as the direct effect of mutation pressure, partly indirectly as a by-product of selection acting on polygene systems with multiple effects.

None of this reasoning, however, should apply in the case of organisms which do not practice outcrossing, that is, species (mostly plants) with complete obligatory self-fertilization, parthenogenesis or apomixis, or exclusively vegetative reproduction. For one thing, in them the recombination of 'loss' mutations is no longer possible, and in its absence degeneration should only be able to proceed with extreme slowness. Furthermore, since many loss mutations are deleterious to general viability, it seems probable that they need buffering to survive, and for this again recombination is necessary, so that where recombination is impossible, mutant characters of this type will be automatically eliminated.

The result should be the opposite of that found in most higher animals, namely, the complete or almost complete persistence of originally adaptive structures in spite of their having become wholly functionless—'relict adaptations', one might call them.

The most natural place in which to look for such organs would be among the floral mechanisms of such higher plant species as have abandoned outcrossing for compulsory self-fertilization or apomixis. At first sight there would appear to be numerous examples of this. For example, in various genera of Compositæ such as the dandelions (Taraxacum) and the hawkweeds (Hieracium), there exist a number of forms which appear to produce all their seed by obligatory apomixis. Yet in spite of this they continue to produce an abundance of showy flower-heads, obviously adapted to attract insects.

It might, however, be objected that the persistence of these erstwhile adaptations was due to the short time which had elapsed since the type had changed over from normal sexual reproduction to apomixis. We know of such instances in animals. For example, in the spruce sawfly Gilpinia (Diprion), there are two extremely close 'biological races' or species of which one shows obligatory parthenogenesis, while in the other parthenogenesis alternates with sexual reproduction (Balch, Reeks and Smith[3]). There can be no doubt that here obligatory parthenogenesis is a very recent acquisition, so that we should not be surprised at the persistence of organs subserving sexual reproduction, such as the spermatheca in the females, or the testes in the occasional but functionless males produced. However, in Taraxacum, Dr. W. B. Turrill informs me that apomixis may well date back at least ten thousand years, to the period when the ice was retreating.

On the other hand, there is a more serious objection to considering flower-heads such as those of dandelions as relict adaptations, namely, the presence of numerous 'correlated characters' which might still be regarded as having functional significance even after the main (entomophilous) function of the capitulum had been lost. Various parts of the mechanism must be useful in providing the developmental scaffolding for the production of the pappus, which is, of course, highly adaptive in regard to the dispersal of the (apomictic) seeds, and the long ray florets still play a part in protecting the central parts of the head during its closure at night, though this protection itself may perhaps be a relict adaptation, as it probably concerns the pollen. However, such considerations do not seem to apply in some of the obligate apomicts in grasses, where the floral mechanism was adapted to anemophilous cross-pollination, and yet survives its loss of function.

Still another complication exists, in the shape of the segregation which we now know to occur in various apomicts (Crane and Thomas[4]). This is due to crossing-over, the apomictic embryo presumably arising after the first meiotic division. This asexual segregation may well have been responsible for some of the swarms of forms found in apomictic groups. It will also give a certain amount of recombination, which in its turn will facilitate a certain amount of degeneration.

Another apparently good case, unless the change of reproductive method is very recent, is provided by the coral-root *Dentaria bulbifera*, which reproduces

entirely by bulbils, but continues to make the unnecessary gesture of producing obviously entomophilous flowers, which further do not seem to have any subsidiary non-sexual function as in Taraxacum.

The complexity of the phenomena is well illustrated by the lesser celandine, *Ranunculus Ficaria*. Here, as Marsden-Jones[5] has shown, two varieties co-exist in Britain, one reproducing sexually, mainly by cross-pollination, the other (var. *bulbifera*, a tetraploid form) mainly vegetatively, by means of bulbils. However, in this latter form a small percentage of viable seed may be produced, apparently by cross-pollination. Furthermore, the mean width and number of its petals and the mean number of its stamens are slightly reduced. If this should not be a consequence of tetraploidy, it is evidence of incipient degeneration of these relatively useless organs—a degeneration made possible by their small residual function. Dr. W. B. Turrill tells me that similar floral degenerations are associated with apomixis in Alchemilla, indicating that here too some degree of recombination is still possible.

Obligatory self-pollination would bring about the same genetic result as obligatory apomixis. Here, however, the difficulty is to find satisfactory examples, since in the great majority of cases self-pollination is not completely obligatory and a certain fraction of seeds result from outcrossing. Thus the orchis *Epipactis leptochila* is normally self-pollinating, but cross-pollination appears to be possible for a brief period (Godfery[6]). The closely related *E. latifolia* is exclusively cross-pollinated. However, Dr. Mather informs me that the common tomato (*Solanum lycopersicum*), which has been investigated for many years at the John Innes Horticultural Institution, shows no cross-pollination at all in Great Britain (save in one anomalous structural variety). Yet the obviously entomophilous flowers persist in spite of this, and in spite of never being visited by insects.

In some strains of cereals, the frequency of cross-pollination is only 2 per cent, and it would seem that a rate as low as this should enormously reduce the speed at which degeneration might occur; but in other strains the cross-pollination rate may be considerably higher. The fact that forms like certain species of Taraxacum have abandoned incomplete self-pollination for obligate apomixis would indicate that the amount of cross-pollination previously possible was interfering with the immediate advantages obtainable by reduced outbreeding.

A prima facie case thus seems to be made out for the failure of degeneration to occur, with the consequent persistence of 'relict adaptations', whenever cross-breeding is absent and perhaps when it is markedly reduced. However, the phenomena are often exceedingly complex, and the interpretations of floral mechanisms by earlier writers have often been coloured by a somewhat uncritical armchair Darwinism. Thus, a good deal more investigation is required before this interesting theoretical deduction can be regarded as confirmed.

In conclusion, I would like to thank Prof. E. J. Salisbury, Dr. W. B. Turrill, Mr. John Gilmour, Dr. C. D. Darlington, Mr. E. B. Ford, and especially Dr. K. Mather, for their help and advice.

[1] Muller, H. J., *Biol. Rev.*, **14**, 261 (1939).
[2] Wright, Sewall, *Amer. Nat.*, **63**, 274 (1929).
[3] Balch, R. E., Reeks, W. A., and Smith, S. G., *Canad. Ent.*, **73**, 198 (1941).
[4] Crane, M. B., and Thomas, P. T., NATURE, **143**, 684 (1939).
[5] Marsden-Jones, E. M., *J. Linn. Soc. Lond.*, (Bot.), **50**, 39 (1935).
[6] Godfery, M. J., "Monograph and Iconograph of British Orchidaceæ" (Cambridge, 1933).

MODERN SCIENCE AND THOMAS HOBBES

By A. E. BELL
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THREE hundred years ago appeared the first of Hobbes's chief philosophical works, his "De Cive". The "Leviathan" followed in 1645, the "De Corpore" in 1655 and the "De Homine" three years later. Few scientific men would claim to read these works to-day, and in the history of science Hobbes is usually given little notice. 1642 is famous rather as the date of Galileo's death and Newton's birth. The scientific movement was at this time gaining momentum; scientific societies were springing up in Florence, London and Paris and gaining the support of men of wide interests as well as the 'mathematical heads'. Evelyn and Pepys, Chapelain and Perrault illustrate the general appeal which science then made. "This is the age," wrote Power, "wherein methinks, philosophy comes in with a spring tide."

This natural philosophy was not regarded as threatening existing ideas; poets and divines were among those who hailed the discoveries of science as opening out new vistas to the human spirit. Bacon's new world indeed seemed to be in sight. "It is the great prerogative of Mankind above other creatures," wrote Hooke in 1665, "that we are not only able to behold the works of Nature, or barely to sustein our lives by them, but we have also the power of *considering*, *comparing*, *altering*, *assisting* and *improving* them to various uses." Science was regarded as a study of phenomena which could yield a measure of control over man's environment. Even in the seventeenth century, however, it was becoming clear to men like Huygens, Newton and Boyle that practical control was to be looked for rather as the inevitable by-product of the amassed theoretical knowledge—the 'intellectual control'—than as the immediate aim of research.

From all this inquiring and empirical spirit of the seventeenth century Hobbes came to be alienated by an unfortunate though perhaps inevitable combination of character and circumstance. For years he was on close terms with Mersenne and some of the greatest natural philosophers of the Continent; he was a friend of Bacon and he met Galileo. But Hobbes's acquaintance with the men of science came rather late and his studies never adequately prepared him for active work, especially in mathematics. Yet, like his contemporary Descartes, he felt a desire to generalize the conclusions of science where possible and to demonstrate its relation to other fields of knowledge. Descartes had the merit of stimulating research and of being a mathematical genius. Hobbes had far less equipment and committed inexcusable blunders in his attempted innovations in science and mathematics. Nevertheless we have in his best work, as Prof. Burtt has remarked, "the first important attempt to apply the new assumptions and method of Galileo universally". Unfortunately, Hobbes's errors were relentlessly exposed by Wallis, a great mathematician and a formidable opponent. The feud which developed lasted to the end of Hobbes's long life and effectively alienated him from the English men of science. The members of the Royal Society, he suspected, were banded together against him, and in time, polemic and ridicule and the resort on both sides to political accusations made this almost the case.

The result was to draw from Hobbes some radical criticism of the fundamental ideas employed in scientific writing. Hobbes carried to its logical conclusion the criticism of secondary qualities begun by Galileo. Denying the real existence of all secondary qualities such as colour, sound and odour as Galileo had done, he went on to assert that space and time themselves were mere 'phantasms'. He made a distinction between space and geometrical extension, the latter only, in his view, being an essential characteristic of a body. Time for Hobbes was "the phantasm of before and after in motion": "The present only has a being in Nature; things past have a being in the memory only; but things to come have no being at all . . ."

The men of science were critical of *a priori* speculations but Hobbes's attacks enforced the use of words in a narrow scientific sense, a change for which Hobbes will always be held as partly responsible. His own style was whetted and sharpened on the grindstone of scientific and logical polemic. The mathematical concept of featureless time and the scientific notion of cause were among the ideas which became more explicit. Over the definition of cause Hobbes may be held to have forestalled Hume, for he swept aside all notion of a final cause and equated cause with the sum of the antecedent conditions.

Hobbes's determination to be clear-headed made him a convinced nominalist. Particular objects only had a real existence, and words corresponded to mental images of things. Reasoning, he supposed, was explicable as a succession of images the order of which resulted from the operation of forces of the same nature as those operating in the world of corporeal things. Carried to an extreme, it could be held that true propositions about the world might be evolved out of the proper use of a symbolic language. Such a language was sought by Bishop Wilkins, but many were sceptical about Hobbes's materialistic explanation of the mind and limited mechanical causation to the physical world. For Hobbes the whole of Nature was a closed system in which the changes of configuration were completely determined by the laws of impact of the ultimate particles of which everything was composed. In the eighteenth century Condillac continued Hobbes's materialism. Science, in his view also, was only "une language bien faite". It is worth remembering that Diderot was one of Condillac's most celebrated pupils.

At this point it should be stated that the seventeenth century men of science were more influenced by Gassendi than by Hobbes. Earlier than the English philosopher, he put forward a materialistic atomism of a sufficiently crude nature. Through Huygens and Boyle, however, his ideas were spread and became especially important in chemistry. The great developments in chemistry came in the second half of the eighteenth century, and this, under the leadership of Diderot and the Encyclopædists and of Voltaire, was a materialistic era. Hobbes, though his position was fundamentally similar to that of Gassendi, had little influence over contemporary men of science. He professed great contempt for their ideas and even attacked their empiricism: "Experience concludeth nothing universally". It may be remarked that Galileo was not primarily an experimentalist and that the attitude to experiment had undergone some change with the growth of the scientific societies. Nothing illustrates Hobbes's dictum better than the contents of his "Dialogus Physicus sive de Natura Aeris" (1661) written in criticism of Boyle's work "New Experiments Touching the Spring of the Air" (1660). Hobbes there claimed that he had years before derived all Boyle's conclusions by reasoning from first principles. The weakness of such a position was not apparent to him; he did not see the force of the Royal Society's motto *Nullius in Verba* adopted a few years later. Because of this lack of comprehension and the obstinacy with which he defended his attitude, Hobbes, even in his advancing years, was an object of ridicule to Hooke and others. According to Hooke, writing of an encounter with Hobbes at a telescope-maker's, the philosopher was found "to lard and seal every asservation with a round oath . . . to have a high conceit of his own abilities and performances, though never so absurd and pitiful, etc." Hobbes, he said, asserted "that a common spectacle glass was as good an eye-glass for a thirty-six foot glass objective as the best in the world, and pretended to see better than all the rest, by holding his spectacle in his hand, which shook as fast one way as his head did the other, which I confess made me bite my tongue"[1].

Hobbes's contribution to scientific thought, however, has been important in spite of his professed indifference to scientific studies and his personal hostility to the English men of science. By trying to reduce all phenomena to the one cause of material impact between ultimate particles, he carried to an extreme a 'legitimate' materialism employed by the scientific men themselves. The need of other causal mechanisms, notably wave theories of sound and light, at first weakened the claims of such a view. It became clear that the scientific mode of *cause* is *force* and of this there appeared to be many kinds. It was only with the development of the concept of energy and work done that a return to a unified scheme appeared possible.

Huygens in 1693 gave the first clear statement of the principle of conservation of energy in mechanical systems[2], and the idea was developed by Daniell Bernoulli and Thomas Young. Rumford, Gay-Lussac, Sadi Carnot and Julius Mayer then paved the way for Joule's establishment of the general law of conservation of energy. The publications of Kelvin and Helmholtz popularized the concept of energy while Coriolis and Poncelet completed the system of physics required in engineering by introducing the term *work*. By the end of the nineteenth century it seemed as if the cycles of matter and energy were closed; the outlook of Hobbes had returned. So long ago as 1780 Lavoisier and Laplace had shown the equality of the heat generated by oxidation of carbon inside and outside the animal body. With the successful extension of physical and chemical principles to biology in the nineteenth century, it began to look as if the closed cycles existed indifferently in the organic and inorganic worlds.

Insufficient attention seems to have been given to the intellectual influence of chemistry in the nineteenth century. This was in fact the dominant science in industry after about 1860, and it was difficult to resist the suggestion that it was the science which could throw most light on the ultimate nature of matter. The stereo-chemical theory built up Pasteur, van't Hoff, Kekulé and others, for example, encouraged a visual imagery which all subsequent research proved to be correct in essentials. There seemed to be little doubt about the material nature of molecules; such work as that of Perrin disposed of that. Indeed the whole tradition of chemistry is materialistic, and experiments such as those on the artificial

transmutation of elements are most commonly treated from this point of view. The problem of steric hindrance is perhaps the best example of the old outlook coming into contact with the new.

It is well known that chemists tend to adopt materialistic forms of physical entities ("when chemists talk about electrons they use a different language from physicists"); and if this is true to-day, it was so much the more difficult to escape from materialism in the nineteenth century. "For no man can live in the external truth among acids and salts", wrote Stevenson, "but in the warm phantasmagoric chamber of the brain with the painted windows and the storied wall". Stevenson could not have anticipated the phenomenalism of Mach and Karl Pearson which averted this antithesis. This was the view that the doctrine of determinist mechanism only applies to the abstract entities provided by logical analysis. Phenomenalism has never been adopted universally by scientific men, and in the nineteenth century the rift between science and philosophy encouraged the retention of a naïve realism.

Now that men of science show a renewed interest in certain philosophical problems, new opportunities have arisen for investigating the consequences of adopting the phenomenalist or realist position. The limitations of a method of abstraction would appear to incline one to phenomenalism. The only point on which one finds substantial agreement among scientific writers is that science can give us only a network of relations, and the search for the ultimate nature of substance is likely always to be fruitless. We discover relations, but the *relata* are defined by the relations and nothing else. In spite of this, arguments are adduced by some writers to support a scientific form of Berkeleyan idealism. The cycles of determinism which chain the mind are then broken by invoking a form of Heisenberg's uncertainty principle which has not yet gained universal approval. Human aim and value appear to be permitted simply because, as J. W. N. Sullivan explained, the cycles of determinism at present exist only in what is called 'field' physics. In the remainder of phenomena one supposes the quantum jumps are indeterminate in the sense that they cannot be fully predicted. As is well known, this is not to say they are outside any causal nexus, for we know the set limits of the effects.

The result is bleak and cheerless enough as the basis of a 'humanistic' outlook. Ethical and æsthetical considerations may still be valid, but they seem to be left over with a rather apologetic air. The whole position is Hobbesian: science, instead of being an instrument for reducing our apprehension of the world to forms providing increased control, is regarded as disclosing the nature of an objective and pre-existent reality "in its linkage to consciousness". Because there are difficulties in the old 'spectator' theory of observation, the mind is enmeshed in the determinist (or indeterminist ?) scheme. If one favours ultimate determinism it is easy for the ordinary man to relapse into pure Hobbesian materialism; if one seriously tries to adopt some kind of objectivized chance, the character of Nature appears lunatic and its 'order' is only another of those illusory ideas which need exposing. On either basis it is difficult to see how science can intellectually be other than an obstacle to its own application to ethical ends. Both in education and in adult thought this is surely the greatest problem of modern times.

[1] "Œuvres Complètes de Christian Huygens", 4, 381.
[2] *ibid.* 18, 554

GEOPHYSICAL METHODS IN GEOLOGY

A JOINT meeting of the London and Home Counties Branch of the Institute of Physics and the Geological Society of London, held on April 22, provided a useful review of the principal geophysical means now available to supplement the routine methods of geological survey. Prof. O. T. Jones opened the meeting with a brief account of the four main types of geophysical survey, which measure respectively the ground resistivity, the rate of transmission of an artificial seismic vibration and the gravitational and magnetic fields at the surface. He stressed the importance of close co-ordination between the two sides of the subject: geology might indicate the probable materials and structures, but confirmation of their actual existence and a closer estimate of their position could in many cases be best obtained by geophysical means.

It was clear that no general preference can be given to any one method. Each has its own range of suitability and its limitations, some of which were outlined in Dr. J. M. Bruckshaw's contribution. His warnings might perhaps be specially recommended to the notice of non-physicists, for complaints as to the 'failure' of geophysics have not uncommonly arisen from the quite impossible expectations put forward by uninformed critics. There are at least as many inaccessible problems in geophysics as in geological surveying; fortunately, they are not the same problems in each case.

The principal limitations arise from the necessity for adequate physical differences between the rock masses, and from instrumental difficulties. Dr. Bruckshaw pointed out that gravitational and magnetic surveys are largely differential, depending upon local irregularities in the field, produced by discontinuities in the geological structure. Thus they are particularly adapted for detecting faults, boundaries, etc., while the presence of a uniform flat-lying bed would only produce zero (or constant) anomaly. But in practice some of the other methods have been used differentially to locate discontinuities even if the exact interpretation of the records is obscure. Another, and very interesting, point was the contrast between the Eötvös torsion balance and the gravimeter: for the former the values observed depend upon the inverse cube of the depth; for the latter, upon the inverse square. If the size of the structure increases proportionately with the depth, the effect to be observed with the torsion balance remains the same whatever the depth, while with the gravimeter the effect increases with the dimensions. Thus the torsion balance is in this respect better suited for shallow structures.

First-hand accounts of geophysical work in the field were given by Dr. D. T. Germain-Jones, who dealt with seismic exploration in Iran, and Dr. A. F. Hallimond, who described the magnetic work of the Geological Survey of Great Britain.

In using the seismic refraction method in Iran, the recording instruments were placed along an arc at about ten miles from the explosion point. The object of the survey was to locate an anticline believed on geological grounds to exist in the oil-bearing Asmari Limestone, which is concealed beneath the Lower Fars Series. This first conclusion was not confirmed, but further seismic observations to the south-west led to the discovery of an anticline in the limestone, concealed beneath a syncline in the surface rocks.

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This was confirmed by drilling, at a depth in agreement with the geophysical estimate, but only half that expected from neighbouring geological data. The peculiar structure is believed to be due to plastic deformation of the Lower Fars beds, which have been squeezed out above the Asmari anticline and thickened on either side.

The Geological Survey of Great Britain has employed magnetic methods at intervals since 1928. The range is restricted by the non-magnetic nature of most sedimentary rocks, but on the other hand the same fact allows a particularly satisfactory investigation of any underlying magnetic formations. A striking example of this was provided by the Survey mapping of the Melton Mowbray magnetic anomaly. The resulting contoured vertical force map bore practically no relation to the surface geology (Lias and Trias) but showed a remarkable magnetic 'high' area, with subsidiary ridges, such as might be due to igneous masses in the floor of older rocks. As a well-known French writer has observed: "la géophysique voit flou"; from east to west the outlines in the magnetic map become sharper until a system of ridges with east-north-east trend links up with the anomaly due to the exposed intrusive igneous mass at Mount Sorrel. The estimated depth of the floor is from 1,500 ft. to 500 ft. across the Melton anomaly.

Oil geology has afforded perhaps the most spectacular examples of success in geophysical exploration. Indeed, the value of the new oilfields discovered has tended to obscure the large number of explorations carried out on equally adequate grounds but which happened to yield negative results. They are sometimes described as failures, but they are in reality an essential part of the research. Obviously, researches cannot be limited entirely to 'successful' results, yet in the larger commercial departments programmes are designed in the expectation of only a few per cent of even moderately 'successful' results.

A clear account of some of the outstanding geophysical achievements in oil geology was contributed by Prof. V. C. Illing. Here the geological structures are chiefly anticlines or domes, and the principal methods employed are (1) seismic reflexion, for gently sloping structures, (2) torsion balance and seismic refraction, for steeper-sided salt-dome structutes, (3) gravity, refraction and reflexion in faulted and folded areas. Prof. Illing again stressed the need for co-operation in work which has for its ultimate object the presentation of a picture that is geological rather than physical. In conclusion, he described the successful employment of the Schlumberger method for correlating strata in boreholes. Electrodes are lowered down the boreholes and the resistivity of the adjacent rock is determined at intervals and plotted as a profile characteristic of the strata passed through. Very striking sets of profiles from groups of boreholes were shown, but caution was indicated since the results are affected by the methods of boring used, especially the nature of the mud; and the resistance of the rock itself may have widely differing values according to the presence of interstitial oil or saline waters.

To sum up: the meeting once again indicated the wide use now made of geophysical methods, and their acceptance in fact as one of the most important tools of geological research. The restrictions in their use are at present largely due to their relative novelty and rather high cost, which in Great Britain has tended to restrict their employment to commercial enterprise.

OBITUARIES

Captain John D. S. Pendlebury

CLASSICAL and prehistoric archæology suffer a severe loss in the death, during the invasion of Crete, of Captain John D. S. Pendlebury. He was the son of Herbert S. Pendlebury, a well-known London surgeon, and was educated at Winchester College and Pembroke College, Cambridge, where he held an exhibition and represented the University, and also England, in the high jump in 1926–27. As an undergraduate he showed already the high promise in classical scholarship and in archæology which he fulfilled in later years, and, on graduating in the first class of the Classical Tripos, he was awarded the School Studentship in the British School of Archæology at Athens (1927–28) followed by the Macmillan Studentship in 1928–29. He took part in excavations on prehistoric sites in Macedonia, and at Armant and Tell-el-Amarna in 1928 and 1929. This combination of Ægean and Oriental interests enabled him to put together in *Ægyptiaca* (1930) a 'corpus' of scarabs and other objects of Egyptian workmanship found on prehistoric sites in Greek lands, and he projected, with his scholarly and accomplished wife, a similar record of Ægean objects found in Egypt.

In 1930, Pendlebury was appointed curator of Knossos, in succession to Duncan Mackenzie, who had for many years been the principal assistant of Sir Arthur Evans. Here was a post which gave full scope to his abilities, for he was a persistent traveller and field-observer, and had the genial temperament which endeared him to all classes of Cretans. At Knossos itself there was still much to be done: supplementary excavation to clear up obscurities, reinforcement of repairs and precautions against weather damage to the 'Palace'; the preparation of a much-needed "Handbook to the Palace of Minos" (1933); and the classification, storage and calendaring of a very large accumulation of potsherds and other objects not needed by the Candia Museum, and indeed indispensable for minute study of the ruins. His intimate knowledge of the whole island found record in a larger handbook of the "Archæology of Crete" (1939).

It was part of the original arrangement that Pendlebury should continue during the winter months his direction of the Egypt Exploration Society's work at Tell-el-Amarna, but by 1934 the Egyptian and the Cretan duties had begun to conflict, and to the general regret Pendlebury resigned the curatorship of Knossos. For unforeseen reasons, however, the Egyptian work came to an end, and he found it possible to devote himself in his private capacity wholly to Cretan archæology. His memoir "City of Akhenaten II", published in 1933, gives a full account of his work in Egypt.

Thenceforward, with his wife, and a succession of younger students of the British School of Archæology, Pendlebury carried on minute and intensive exploration in the Lasithi highland, below the Dictæan Cave at Psychro, already excavated by the School; and the results of this have now appeared in a separate volume of the School's *Annual* (38, 1937–38) as well as current reports in earlier volumes; a remarkable record of the human occupation of this secluded region from the early Bronze Age until it became a refuge and last fortress of the Minoan people after the Iron Age invaders had conquered the lowlands of Crete.

When the War came, Pendlebury received a commission in a cavalry regiment but remained in Crete as British Vice-Consul and was able to render very valuable services through his intimate acquaintance with the country and the people. Rumours of his death during the German invasion remained long unconfirmed, but his death has now been presumed. He will be remembered as a man of varied ability, strong character and personal charm, and it is to be hoped that he may have left further memorial of his devoted study of Cretan antiquity.

JOHN L. MYRES.

WE regret to announce the following deaths :

Prof. A. C. Davis, jun., head of the Department of Experimental Engineering at Sibley College, Cornell University, on March 17, aged fifty-two.

Prof. W. E. Davis, professor of plant physiology at the Kansas State College of Agriculture and Applied Science, on January 17, aged seventy-five.

Prof. R. W. Hegner, professor of protozoology in Johns Hopkins University, on March 11, aged sixty-two.

NEWS and VIEWS

King's Birthday Honours List

THE following names of scientific men and others associated with scientific work appear in the King's Birthday Honours list :

O.M. : Prof. E. D. Adrian, professor of physiology in the University of Cambridge.

Baron : Mr. J. M. Keynes, the distinguished economist.

K.C.M.G. : Sir Guy Marshall, director of the Imperial Institute of Entomology.

K.B.E. : Dr. C. G. Darwin, director of the National Physical Laboratory.

Knights : Prof. R. H. Fowler, Plummer professor of mathematical physics in the University of Cambridge, lately liaison officer in North America ; Dr. W. H. Fyfe, principal and vice-chancellor of the University of Aberdeen ; Mr. H. Gaskell, a director of Imperial Chemical Industries, Ltd. ; Mr. W. Gavin, chief agricultural adviser, Ministry of Agriculture ; Mr. L. Mason, deputy director-general of supply, India, and lately inspector-general of forests ; Prof. W. F. Shaw, president of the Royal College of Obstetricians and Gynæcologists ; Major-General J. Taylor, I.M.S., director of the Central Research Institute, Kasauli ; Mr. R. A. Watson Watt, scientific adviser on telecommunications, Ministry of Aircraft Production.

C.B. : Dr. H. J. Gough, deputy controller-general of research and development, Ministry of Supply.

C.M.G. : Prof. D. B. Blacklock, professor of tropical hygiene, University of Liverpool ; Mr. G. F. Clay, director of agriculture, Uganda ; Dr. A. F. Mahaffy, director of the Yellow Fever Research Institute, Uganda.

C.I.E. : Mr. W. T. Hall, chief conservator of forests, United Provinces ; Mr. C. M. Harlow, chief conservator of forests, Central Provinces and Berar ; Colonel E. A. Glennie, director of the Survey of India ; Lieut.-Colonel G. R. McRobert, professor of medicine, Medical College, Madras ; Dr. L. E. Napier, director of the School of Tropical Medicine, Calcutta ; Lieut.-Colonel E. McK. Taylor, director of the Irrigation Research Institute, Punjab.

C.B.E. : Mr. G. E. Bodkin, director of agriculture and principal of the College of Agriculture, Mauritius ; Dr. E. A. Carmichael, director of the Neurological Research Unit of the Medical Research Council, National Hospital for Nervous Diseases ; Prof. T. J. Mackie, professor of bacteriology, University of Edinburgh ; Mr. F. J. Mortimer, lately president of the Royal Photographic Society ; Prof. A. C. Norman, director of the X-Ray Institute in Iraq and professor of radiology in the Royal College of Medicine, Baghdad ; Dr. Z. F. Willis, general secretary of the Y.M.C.A.

O.B.E. : Mr. V. A. Beckley, senior agricultural chemist, Kenya ; Mr. E. G. Bowen, senior scientific officer, Ministry of Aircraft Production ; Dr. H. J. O'D. Burk-Gaffney, senior pathologist, Tanganyika ; Mr. S. Butterworth, principal scientific officer, Admiralty ; Mr. T. G. Henderson, principal veterinary officer, Basutoland ; Mr. G. D. A. Macdougall, chief assistant, Statistical Branch, Prime Minister's Office ; Mr. A. Monro, chief veterinary officer, Ministry of Agriculture ; Dr. B. Prasad, director of the Zoological Survey of India ; Mr. A. H. Stein, divisional forest officer, Hoshangabad, India ; Mr. C. B. Symes, medical entomologist, Kenya ; Mr. A. F. Thelwell, secretary of the Jamaica Agricultural Society ; Mr. A. F. Wilkins, principal scientific officer, Ministry of Aircraft Production ; Mr. H. Wooldridge, senior scientific officer, Department of Scientific and Industrial Research.

M.B.E. : Canon L. A. Lennon, for services to education and agriculture, in Nigeria ; Mr. G. W. Lines, agricultural officer, Nigeria ; Mr. R. E. Mills, technical assistant, Ministry of Aircraft Production ; Mr. H. C. Mundell, agricultural and livestock officer, Basutoland ; Miss K. M. Shaw, personal assistant to the Dean, London School of Hygiene and Tropical Medicine ; Mr. L. B. Turner, deputy assistant director, Explosives Department, Ministry of Supply ; Mr. J. J. Unwin, scientific officer, Ministry of Aircraft Production.

I.S.O. : Mr. G. D. Goode, chief clerk, Department of Science and Agriculture, and personal secretary to the Director of Agriculture, Jamaica.

Prof. E. D. Adrian, O.M., F.R.S.

THE recognition of the value of the work of Prof. E. D. Adrian to science by the award of the Order of Merit will be a source of great pleasure to his colleagues and students throughout the world. The advance in our knowledge of the working of the nervous system that has taken place in the last twenty years owes much to his long series of researches into the nature of the fundamental processes in nerve cells. As research in clinical neurology is able to make full use of this knowledge, further advances may also spring from his work, but this application must, of necessity, take a long time to reach fruition. Prof. Adrian's work on nerve and muscle, in association with Keith Lucas, started before the War of 1914–18 ; during that War he worked in clinical neurology, which gave him a wide experience and

interest in neurology as well as electrophysiology. During the War of 1914–18 Keith Lucas and Adrian had discussed the new possibilities opened up by the thermionic valve, of investigating the electrical activity of the nervous system in detail. After Lucas's death, Adrian succeeded in realizing these possibilities, and in 1924 started the series of researches on the activity of single nerve fibres which in the next ten years were to yield such a rich harvest of new knowledge of the action of the sense organs and of reflex activity. As technical advances became possible these were adopted to refine the method, and his laboratory became the centre of research in electrophysiology to which research workers went from all over the world to learn these methods. The focus of work gradually moved from the investigation of the electrical activity of peripheral nerve fibres to that of nerve cells and synaptic regions of the central nervous system.

The spread of interest in brain potentials in man is largely due to Adrian's work in this field; the implications of the discoveries in this field by Hans Berger were not generally realized and the discoveries lay dormant for ten years until Adrian reinvestigated them, confirmed and extended Berger's work, and linked up his findings with general knowledge of the nervous system by animal experiments. Adrian's main interest has always been to discover the principles underlying all nervous structures as these apply throughout the animal kingdom, and the application of these to the nervous system of man. Thus his work on the electrical activity of the nerve ganglion of the water beetle assisted him in interpreting brain potentials in man; again, experiments on single motor nerve fibres in cats led to the investigation of voluntary control of human muscles in intact man by needle electrodes, and this method has become a valuable tool to the neurologist in investigating the nature of nervous diseases. Adrian's work owes much to his manual dexterity; he carries out all details of experiments himself and constructs much of his own apparatus. He encourages his students to work in the same way to the surprise of some visitors who expect to find a large staff of technical assistants. The success of this policy of close contact with experimental material is attested by the large volume of research carried out by students in his laboratory, and by schools founded abroad by physiologists trained in electrophysiological research in Cambridge. Since Prof. Adrian's work on individual nerve cells has been complementary to the researches of the Sherrington School on reflex action and the behaviour of large numbers of neurones, it is fitting that he should join Sir Charles Sherrington in the select company of those who have received the Order of Merit.

Science and Engineering in China

In a review of developments in China under the republican regime entitled "China To-day: The Thirtieth Anniversary of the Chinese Republic, 1911–1941" (Central Union of Chinese Students in Great Britain and Northern Ireland, Sidney Sussex College, Cambridge. Pp. 55. 1*s*.) there are three articles of special interest to scientific workers. The first of these, by P. M. Yap, describes the utilization of science in China, where science and statecraft are already closely linked. In peace-time, the National Economic Council is responsible for economic planning, the execution of its plans resting with the Ministries of Economic Affairs, Agriculture and Forestry, and Communications. The former maintains three research institutes for hydraulic engineering, for mining and metallurgy, and for industrial technology. Under the Ministry of Agriculture there is the National Agricultural Research Institute, and various research bureaux are attached to the Ministry of Communications, and also directly to the National Economic Council. The National Health Administration has steadily established a series of public health stations and clinics all over the country and has contributed much to the expansion and improvement of the Army Medical Service. Most of its research and development work is carried out in the National Institute of Health. Apart from the universities and private research foundations, scientific research of the long-range type is carried out by the Academia Sinica and the National Academy at Peiping, the former of which, through the National Research Council, is responsible for directing and co-ordinating scientific activities in China.

The difficulties which face the development of the medical profession in China are outlined in an article "Unburied Ghosts", which indicates that traditional knowledge and forms of medical practice are likely to be detrimental to the progress of medical science, particularly in view of the low proportion of medical students with a scientific outlook. A brighter picture is given by T. C. Chan in his article "Review of Chinese Engineering". Despite the persistent opposition of Japan, particularly her destruction of Chinese engineering institutes by air attack, a vigorous engineering policy has been executed. During the second stage of the War, 386 factories were transplanted into the interior, while a further 1,378 factories have been recently established in eleven industrial centres all over free China, to increase production for military and non-military needs. At the end of 1940, the number of higher educational institutions, including universities and technical colleges, was 113, as against 108 before the War. Engineering works for communication and transport have been in full swing since 1937, and once peace is restored Mr. Chan considers that the effective development of Chinese industries will open up a new era for the engineering world.

The Royal Institution

The managers of the Royal Institution have made special arrangements for carrying on the work of the Institution under the present conditions. Activities are necessarily somewhat limited by war circumstances, and many members of the staff of the Institution itself and of the Davy Faraday Research Laboratory are absent on war service. The laboratories and workshops are, however, fully employed, and a programme of lectures has been successfully carried out during the 1941–42 season. The Institution has also, with the managers' permission, been the centre for various scientific meetings and conferences in connexion with war purposes; among them, a course of special lectures, in November and December 1939, to meet the needs of students wishing to qualify for radio branches of the Defence Forces; a series of lectures on "The Nation's Larder", in April and May 1940, arranged with the approval and support of the Ministry of Food; and in September 1941, the Conference on Science and World Order, held by the Division for the Social and International Relations of Science of the British Association. It

is hoped to maintain and perhaps extend the activities.

As a temporary measure, pending the appointment of a successor to Sir William Bragg, the managers have made the following appointments: The general secretary, Mr. Thomas Martin, on leave of absence with the Ministry of Supply, to be 'resident' in charge of the house; Mr. R. Cory, librarian, to be deputy general secretary; Dr. A. Muller, assistant director of the Davy Faraday Research Laboratory, to be acting director.

American Philosophical Society Research Grants

THE Yearbook of the American Philosophical Society, 1940, covers the year January 1–December 31, 1940, and in addition to the minutes of the executive sessions includes the reports of standing committees as well as of the Special Committee on Education and Participation in Science, the purposes of which are to conduct a survey of amateur science in the Philadelphia area and to stimulate participation of laymen in scientific research. Almost half the volume is occupied by the report of the Standing Committee on Research, which includes reports from recipients of grants from the Penrose Fund, from which 107 grants, totalling some 360,750 dollars, were awarded during the year. Of these, two were in mathematics, five in astronomy and astrophysics, seven in physics and eleven in chemistry and geochemistry. Eight grants were made in zoology, four in genetics and cytology, nine in botany, eight in physiology, one in biochemistry, four in pathology and medicine, ten in American and modern history, one in political science, four in archæology, and four in ethnology. The distribution is roughly proportional to the number of applications from the different classes, and the Committee on Research has always attempted to make the grants to the most worthy applicants without reference to the subjects represented. Further, since the funds at the disposal of the Committee are insufficient to make long-continuing grants, the policy has been to help start or finish worthy projects rather than to furnish continuing support, nor have grants been made to pay in whole or part the salaries of members of the staff of any institution, nor in general to pay living expenses of applicants.

New Exchange-Area Cable

AN article by N. V. Firth (*Bell Lab. Rec.*, 20, No. 8; April, 1942) describes an investigation carried out to determine whether the most economical series of new telephone cables would result from reductions in the diameters of cables having 24- and 26-gauge conductors, together with the addition of a cable with conductors of a smaller size such as 28-gauge, or whether the 24- and 26-gauge should be superseded by 25- and 27-gauge. Experimental lengths of cable were manufactured with conductors of each of these sizes, all with reduced amounts of pulp insulation. Studies of dielectric strength were made on each type. Thickness of pulp insulations used for full-sized cables containing 1,515 pairs of 24-gauge, 1,818 pairs of 25-gauge, 2,121 pairs of 26-gauge, 2,424 pairs of 27-gauge, or 3,030 pairs of 28-gauge provide satisfactory dielectric strength. No major alterations in the cable manufacturing equipment would be required for the introduction of any of these new types. A study of overall savings indicated that the greatest advantage would result by retaining the four existing standard gauge sizes and increasing the maximum number of pairs in 24-gauge and 26-gauge cables to 1,515 and 2,121 pairs respectively. Thinner insulations of the new cables have somewhat lower dielectric strengths than those of the previously standard 24- and 26-gauge pulp-insulated cables. Tests indicate, however, that they are at least as good as the corresponding strip-insulated 24- and 26-gauge cables which form a large part of the existing plant.

For assembling the required number of 24- or 26-gauge pairs into cables the method is the same as that for the previously standard 24- or 26-gauge designs. Cables ranging in sizes from 11 pairs to 101 pairs are stranded as a single unit. Those larger than 101 pairs and up to 303 pairs are first built up in small units of 50 or 51 pairs which are then assembled in long spirals to form the completed cable. All sizes larger than 303 pairs are formed similarly from units of 101 pairs each. The colour code for the groupings of pairs remains the same in the new designs as in other unit type cable in recent years. The larger number of pairs obtainable in the full sizes of these new designs will in some instances prove economical in plant rearrangements incident to central-office cutovers and should be advantageous in making additions to plant where there is underground conduit congestion. The major savings, however, are expected from the reductions in sheath diameters for cables of the same numbers of pairs as formerly.

Earthquake Recorded at Kew

THE strong earthquake of May 14 in Ecuador (NATURE, May 23, p. 578, and May 30, p. 607) was recorded at Kew Observatory, *iP* appearing on all components of the seismograph at 02h. 25m. 51s. U.T. This was compressional. A full suite of pulses followed and the shock finished recording at about 07h. 45m. U.T. The estimated epicentral distance was 9,520 km. All interpretations are tentative.

Announcements

MR. WILLIAM MORRISH SELVEY is to continue for another year as president of the Institute of Fuel. Mr. Selvey, who has been connected with the Institute since its inception, and has for several years been chairman of the Council, took office as president in October 1941.

THE following appointments and promotions in the Colonial Service have recently been made: H. D. Jordan, agricultural officer, Sierra Leone; A. G. Beattie (assistant director of agriculture), deputy director of agriculture, Nigeria; L. D. Cleare (entomologist), deputy director of agriculture, British Guiana; R. M. Davies (senior agricultural officer, Tanganyika Territory), senior agricultural officer, Zanzibar; I. E. James (principal agricultural officer), assistant director of agriculture, Nigeria; D. H. Urquhart (senior agricultural officer), principal agricultural officer, Nigeria.

MR. T. SHEPPARD has produced an important catalogue of the Bronze Age implements in the Mortimer Museum, Hull (*Hull Museum Pub.*, No. 213). There are a number of illustrations. Hull has been fortunate in the past in the matter of acquisitions and its Bronze Age collections are important. Prehistorians, therefore, will be grateful for this new catalogue.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Origin of the Solar System

THE tidal theory of the origin of the solar system which I proposed in 1916 supposed that when the planets were born, the sun was comparable in size with the present planetary orbits. Recent workers at the subject have, however, supposed that the sun was of about its present size.

Yet on any reasonable view of stellar evolution, there must have been a time in the past when the sun, then rapidly contracting, extended to thousands of times its present radius. If, for simplicity, we imagine an epoch in which sun and stars all had precisely n times their present radii, the chance (per unit time) of planets being generated by a tidal encounter of the type contemplated by my theory would be n^2 times as great as now. For example, when the sun extended as a semi-nebulous mass to the orbit of Uranus, the chances would be 17,000,000 times as great as now: more planetary systems would be born in 120 years then than in 2,000 million years of present conditions.

Let A denote the chance (per unit time) of planets being born out of our sun under present conditions, this being of the order of $(5 \times 10^{18}$ years$)^{-1}$. Then the total chance of planets having been born in the whole period since the sun was of N times its present radius is

$$A \int n^2\,dt = -A \int_1^N \frac{n^2\,dn}{dn/dt}.$$

In its earliest stages, in which n was large, the sun was probably engaged in a rapid Helmholtz contraction, having no sources of energy beyond its own gravitation. Assuming Lane's law to hold, the rate of solar radiation would be C/n^2, where C is the present rate, and the exhaustion of the sun's energy would be G/n, where G is the present exhaustion. Equating C/n^2 to the rate of increase of G/n, we find that $-dn/dt$ has the constant value C/G. This is about $(2 \times 10^7$ years$)^{-1}$, since G/C is the time through which the sun could have radiated at its present rate on the Helmholtz theory of gravitational contraction, that is, Kelvin's estimate of the maximum age of the earth.

If we replace $-dn/dt$ by C/G, the above integral assumes the value $\frac{AG}{3C} N^3$, or about $10^{-12}N^3$. The true value must be greater than this, since every additional source of energy retards contraction, and so decreases the value of $-dn/dt$. But it will not be much greater, since nearly all the value of the integral comes from large values of n, for which our approximation is good; the contribution from values of n near to unity, where our approximation fails through other sources of energy being operative, is quite insignificant.

If we take N equal to 5,000, we start from a sun which is big enough to include the orbit of Uranus, and yet is not too diffuse to hang together dynamically, and find that the planets are most likely to have been formed before n fell much below 4,000. With such values for n, we escape the very serious dynamical difficulties which result from supposing that the sun was of its present size when the planets were born. Moreover, the integral gives the total chance of planets being born as 1 in 6, whereas the chance of a sun of the present size producing planets in 2,000 million years is only about 1 in 2,500,000,000. Thus there is no longer any need to strain the probabilities to account for the existence of the planets.

The average mass of planets born by gravitational instability out of a gaseous filament varies as $T^{\frac{3}{2}}\rho^{-\frac{1}{2}}$ and if we again assume Lane's law this remains constant through the contraction. The minimum mass which can hold together gravitationally, without scattering into space, also varies as $T^{\frac{3}{2}}\rho^{-\frac{1}{2}}$, so that this again remains constant. Thus the values of these two quantities will not be affected by an increase in the value of n.

The foregoing rough calculations obviously call for many adjustments: for example, Lane's law cannot be expected to give accurate results for a star of 5,000 times the diameter of the sun. But most of the adjustments will, I think, be found to strengthen, rather than weaken, the case I have been putting and, even if some do not, there is an ample margin to spare. Thus I suggest, although very tentatively, that:

(1) Of the various planetary systems in the sky, the vast majority were formed while their suns were still in a semi-nebulous state.

(2) The supposition that our own system was formed while the sun was still a semi-nebulous mass, of hundreds or perhaps thousands of times its present diameter, avoids most—perhaps all—of the dynamical objections which have recently been urged against the tidal theory.

(3) A far larger proportion of the stars than we have hitherto imagined must be accompanied by planets; life may be incomparably more abundant in the universe than we have thought.

J. H. JEANS.

Park House,
Wanstrow,
Somerset.
May 30.

[1] *Mem. Roy. Ast. Soc.* (1916).

The Amphibian Pituitary

IN a recent paper[1] Atwell reports an examination of the pituitary complex of *Xenopus lævis*, and concludes the discussion with the assertion that this species "does not afford unique morphological opportunities for determining the function of the *pars tuberalis*". So stated, this controverts earlier views expressed by Hogben and Slome[2,3]; but a lengthy addendum printed after it shows that Atwell's findings are not necessarily in opposition to views expressed by workers in my laboratory. What difference of opinion exists seems to be a semantic rather than a factual issue. There is no disagreement concerning the following facts:

(*a*) The anterior lobe of Xenopus has a prominent median 'anterior process' made up of basophil cells.

(*b*) The pituitary of Rana has no such process; but a corresponding vestigial structure may be present in toads (Arcifera).

(*c*) The pars tuberalis of Bufo is represented by a pair of glandular discs lying on the infundibulum, detached in the process of development from the two extremities of a bifid outgrowth in much the same position as the anterior process of Xenopus.

Atwell now contributes the additional information that there are comparable discs on the infundibulum of Xenopus but concedes: (*a*) they are "composed of small cells which give slight indication of glandular

capacities"; (*b*) "it is not surprising that (*they*) have been overlooked by other observers". It is not clear what the epithet "slight" signifies in this context. From my own experience at the time when I first examined the pituitary of Xenopus I can confirm the existence of these discs; and am not disposed to dispute their *structural* homology with the paired glandular lobes of Firmisternia. I rejected, and still reject, the propriety of regarding them as *functionally* equivalent to the latter because indications of their glandular activity are at most as slight as stated above.

If they are not functionally active, the validity of the view under discussion turns on whether the anterior process of Xenopus corresponds to the base of the embryonic tuberalis of other Anura at the time of metamorphosis. In the text which precedes the postscript mentioned, Atwell casts doubt on this. He states: "whether the anterior process represents the region of earlier attachment of the pars tuberalis, and whether it is histologically related to the pars tuberalis are unknown". The addendum which follows the discussion deals with the development of the pituitary complex of *Bufo boreas boreas*, a species with a detached anterior process of variable size. Atwell there describes its origin as follows: "The lateral lobes which are destined to form the pars tuberalis are still attached to the anterior lobe by a single median stalk . . . there is a constriction between the anterior lobe and the single stem of the Y. . . . If this constricting process should continue to the point of complete separation and the lateral lobes should become detached (as apparently they always do) to form the two plates of the pars tuberalis, then this central mass of cells would be left isolated on the surface of the median eminence. . . . It seems justifiable to conclude that the anterior process of the hypophysis of *B. boreas boreas* is a rudimentary structure probably derived from the median stalk which served to attach the embryonic pars tuberalis to the anterior lobe."

My original reason (see ref. 3, p. 168) for regarding the anterior process of Xenopus as the functional equivalent of the paired pars tuberalis of other Anura was based on Atwell's earlier description of the development of *Bufo americana*[4]. This species also has a *Y*-shaped extension at the time of metamorphosis. Atwell now appears to agree: (*a*) that the anterior process of Xenopus is equivalent to the anterior process of *B. boreas boreas*; (*b*) that the anterior process of the latter is the persistent median portion of the *Y*-shaped extension of the embryonic pars anterior. Thus the only matter about which there is difference of opinion is whether we are entitled to apply the term pars tuberalis: (*a*) to derivatives of the *whole* embryonic structure including the persistent median portion which apparently persists as a prominent glandular lobe in Xenopus and disappears in Rana; (*b*) *only* to the remains of the lateral limbs which persist in all Anura but merely as vestigial organs in Xenopus. I am still inclined to regard the former as more reasonable. Either way, the pituitary of Xenopus offers unique opportunities for studying the physiological properties of histologically differentiated components of the pituitary complex.

LANCELOT HOGBEN.

Department of Zoology,
University of Birmingham.
May 21.

[1] Atwell, *Amer. J. Anat.*, **68**, 191 (1941).
[2] Hogben and Slome, *Proc. Roy. Soc.*, B, **103**, 10 (1931).
[3] Hogben and Slome, *Proc. Roy. Soc.*, B, **120**, 158 (1936).
[4] Atwell, *Anat. Rec.*, **15**, 73 (1918).

Microbiological Assay of Riboflavin in Cereals

THE assay of riboflavin in cereals by fluorometric methods[1,2] is difficult and the results are of doubtful reliability. One difficulty is the low riboflavin content of cereals. There is also the possibility of the presence of interfering substances in cereal extracts. On the other hand, the microbiological method of Snell and Strong[3], using *Lactobacillus helveticus*, with certain modifications, has proved to be satisfactory and expeditious.

The work described below will be published later in detail, but the chief modifications that have been introduced are the addition of xylose, asparagine, nicotinic and pantothenic acids to Snell and Strong's original medium, and the method of preparing the extract. The actual estimation was carried out by measuring the turbidity of the solutions nephelometrically or by titrating the amount of lactic acid formed by the bacteria with 0·1 *N* NaOH. The results from either of these methods of estimation are in good agreement.

It has been shown[4] that starch has a marked effect in stimulating the growth of *L. helveticus*, and as cereals contain a large amount of starch, this must be destroyed in the extract before the estimation is carried out. Scott *et al.* recommend taka-diastase for this purpose. In the present investigation it was found, however, that taka-diastase was unsatisfactory. The various samples of the enzyme used showed a marked stimulating activity over other hydrolysing agents, such as ptyalin, sulphuric and hydrochloric acid. The method of extraction that was eventually adopted was to hydrolyse suitable weighed samples of material with 0·25*N* HCl for 15 minutes at 15 lb. pressure in an autoclave. Nevertheless, hydrolysis with ptyalin in place of taka-diastase[4] or refluxing for one hour with 0·25*N* sulphuric acid[1] or 0·25*N* hydrochloric acid were all found to give the same results as autoclaving for 15 minutes. Autoclaving of the material was adopted simply because it was found to be more convenient.

Results from the different methods of extraction are given below:

Sample	Riboflavin content γ/gm.
National straight run flour (75 per cent extraction)	
1. Hydrolysed with ptyalin	0·75
2. Refluxed with 0·25*N* H_2SO_4 for 1 hour	0·75
3. " " " HCl " " "	0·8
4. Autoclaved at 15 lb. pressure for 15 min. with 0·25*N* HCl	0·8
5. Hydrolysed with taka-diastase	1·15

The results of a number of determinations on different varieties of wheat, various fractions of the wheat grain, wheaten flours, as well as other cereals are given in the accompanying table: figures are

Sample	Riboflavin content γ/gm.
1. Wheat, English	2·65
2. " Manitoba	2·9
3. " Australian	2·65
4. " Russian	3·7
5. " Testa	5·8
6. " Aleurone layer	6·3
7. " Germ, commercial sample (1)	11·35
8. " " " " (2)	12·85
9. " " " " (3)	9·7
10. Flour A roll	0·4–0·5
11. " C "	0·5–0·6
12. " National straight run (75 per cent extraction)	0·75–1·25
13. " National wheatmeal (85 per cent extraction)	2·0–2·1
14. Barley	2·3
15. Rye	2·65

based on the normal water contents of the products.

Since this work was completed, Andrews, Boyd and Terry[5] have published results for the riboflavin content of different cereals, using apparently the original Snell and Strong procedure, but no details of the medium are given. With the exception of patent flour, their results are all much lower than those now reported. One explanation for these low figures is that their extracts were too concentrated (5–10 gm. made up to 100 ml.). In my experience there is always a falling off in estimated riboflavin content if the extract is too concentrated. The extracts used in the present investigation were always made up to 500 ml., and in some cases, for example, germ, to 1,000 ml.

It is of interest to note that Miss Copping[6] (see also in this connexion Bacharach[7]), using a biological method, obtained values of the order of 2–3 γ per gram for a National wheatmeal, or of the same order as those reported here. A further proof that the microbiological method is specific is shown by the fact that for milk the values obtained by me (1·4–1·5 γ/ml.) are practically identical with those obtained by the fluorometric method[7].

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May 29.

[1] Hodson, A. Z., and Norris, L. C., *J. Biol. Chem.*, **131**, 621 (1939).
[2] Najjar, V. A., *J. Biol. Chem.*, **141**, 355 (1941).
[3] Snell, E. E., and Strong, F. M., *Ind. Eng. Chem.* (Analytical Edit.), **11**, 346 (1941).
[4] Scott, M. L., Randall, F. E., and Hessel, F. H., *J. Biol. Chem.*, **141**, 325 (1941).
[5] Andrews, J. S., Boyd, H. M., and Terry, D. E., *Cereal Chem.*, **19**, 55 (1942).
[6] Copping, A. M., *Chemistry and Industry*, **60**, 723 (1941).
[7] Bacharach, A. L., *Chemistry and Industry*, **60**, 791 (1941).
[8] Kon, S. K., NATURE, **148**, 607 (1941).

Disappearance of the Ascorbic Acid in Raw Cabbage after Mincing or Chopping

PYKE[1] has lately stated that when raw savoy cabbage was shredded by means of household shredders part of the ascorbic acid disappeared during the ensuing 5–10 minutes and thereafter no further loss occurred during three hours standing; the extent of the initial loss of ascorbic acid varied with the type of shredder used. His explanation is that the initial loss of ascorbic acid is essentially due to the mechanical rupture of the cells, and will therefore vary with differing types of shredder or grinder.

As mentioned previously[2], we have been working on similar lines and have sought to find a correlation between mechanical breakage of cells and loss of ascorbic acid. It would appear that the amount of liquid which can be squeezed from shredded cabbage would be indicative of the breakdown of cell tissue, and we have proceeded on this line of attack. *Inter alia* we have confirmed Pyke's results.

In Fig. 1 the concentration of ascorbic acid in minced cabbage, expressed as a percentage of that originally present, is plotted against the time of standing after mincing. The curves show that the concentration of ascorbic acid falls rapidly during the first 10–15 minutes. The steady value reached remains constant for periods up to thirty hours (provided that the cabbage be kept cool, at, say, 15° C.). The extent of the initial loss of ascorbic acid varies with the type of mincer used.

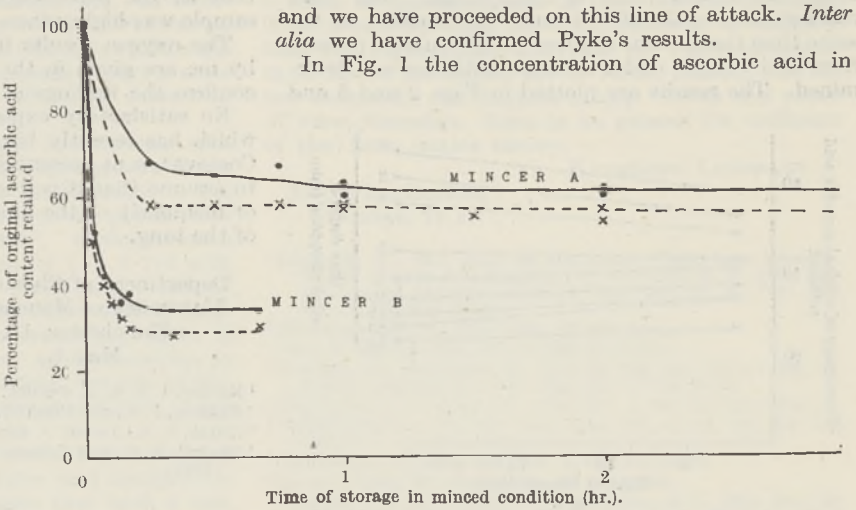

Fig. 1.

●——● total ascorbic acid; x - - - - - x, reduced ascorbic acid.

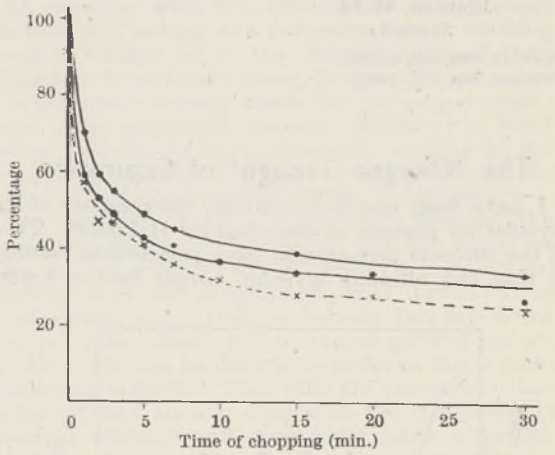

Fig. 2.

●——●, total ascorbic acid. x - - - - x, reduced ascorbic acid.

Uppermost curve, percentage of residue from pressing; other two curves, percentage of original ascorbic acid retained.

All samples allowed to stand for 2 hr. after chopping.

Some confirmation of the theory that the extent of initial loss varies with the extent of rupture of cells has been obtained by chopping cabbage in a machine primarily used for chopping sausage mixes. The material to be chopped is placed in a bowl which revolves beneath a set of rotating knives; for short

periods of chopping the degree of comminution obtained is considered to be roughly proportional to the time of chopping. Samples were withdrawn at intervals and allowed to stand. The concentration of ascorbic acid was determined in these samples after two hours, when a steady state had been reached, and again after twenty-two hours. At the same time the amount of juice which could be pressed from each sample under certain conditions was determined. The results are plotted in Figs. 2 and 3 and

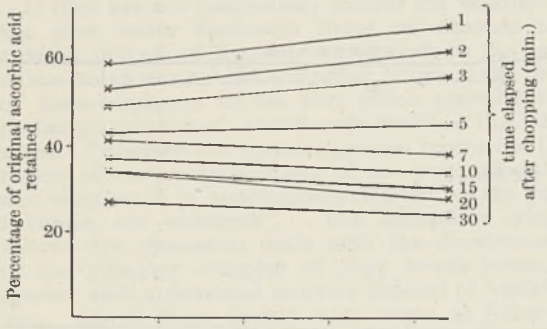

Fig. 3.

indicate that the longer the time of chopping the greater the percentage of ascorbic acid lost and the greater the amount of juice which may be obtained by pressing. In Fig. 2 the correspondence between the curves for the percentage of ascorbic acid lost and the percentage of residual material after pressing may be fortuitous.

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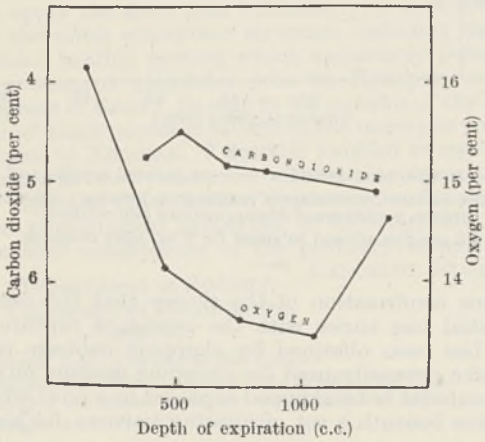
[1] NATURE, 149, 499 (1942).
[2] NATURE, 149, 271 (1942).

The 'Oxygen Trough' of Expiration

I have been unable to confirm[1] the presence of an alveolar air plateau as described by Haldane[2]. Two of the subjects investigated gave paradoxical results in that the ultimate alveolar sample had a lower carbon dioxide tension than the penultimate. In a paper presented at the same time, Cotton[3] examined the oxygen percentages, and demonstrated what he later described as the "oxygen trough of expiration". His oxygen figures were in harmony with my results; that is, the percentage of oxygen of the ultimate sample was higher than that of the penultimate.



The oxygen results from one of the subjects used by me are given in the accompanying graph. They confirm the findings of Cotton.

No satisfactory explanation of this phenomenon, which has recently been confirmed by Marenzi and Costoya[4], is at present available. It seems reasonable to assume that it is due to inequality of ventilation, or inequality of the blood-flow to the different parts of the lung.

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[1] Mackay, I. F. S., *J. Physiol.*, **98**, 73 (1940).
[2] Haldane, J. S., and Priestley, J. G., "Respiration", 20 (1935).
[3] Cotton, F. S., *Austral. J. Exp. Biol.*, **17**, 433 (1939).
[4] Marenzi, A. D., and Costoya, M. A., *Rev. Soc. Argent. Biol.*, **17**, 190 (1941).

Crystal Dynamics of Rocksalt

THE early X-ray experiments of James, Firth and Waller[1] on the modification of the diffracting power of crystals of sodium chloride due to thermal vibrations of the atoms dealt only with the reduction in intensity of the Bragg reflexions at different temperatures, and could therefore only give average root mean square amplitudes, but the more recent diffuse spot methods promise to give information concerning the whole frequency spectrum. By observation of the position, shape and intensity of the diffuse spots when the crystal is turned into a succession of reflecting positions, the effect of vibrations travelling in different directions, polarized in definite ways and with frequencies within known limits, can be traced[2,3,4].

The above interpretation of the diffuse spot photographs has, however, been challenged by Sir C. V. Raman[5], and one of his colleagues, Dr. C. S. Venkateswaran[6], has published experimental results for sodium chloride crystals which are claimed to be inconsistent with the thermal (Faxén-Waller) theory. Since the challenge includes a denial of the validity of the Born theory of lattice dynamics, it is important that the experimental evidence should be carefully examined.

Venkateswaran's observations are as follows: (1) variation of diffuse spot intensity with temperature (one crystal setting, three temperatures); (2) comparison of diffuse spot and Laue spot intensities for three different irradiated volumes of crystal, using a slightly divergent beam; (3) measurements of relative sharpness; and (4) intensity, of 200, 400, 600 reflexions (molybdenum unfiltered radiation, one crystal setting); (5) comparison of 111, 222 reflexions; (6) measurement of the 'drift' of the diffuse maxima towards the Laue spots as the crystal rotates.

Every one of these experimental observations is either inaccurately performed or wrongly interpreted. The main criticisms are as follows:

(1) Venkateswaran has neglected the falling off of

atomic scattering power with temperature, an important effect which would reduce his deduced 'X-ray active' frequency from 160 cm.$^{-1}$ (his figure) to 100 cm.$^{-1}$. The latter does not correspond to a Raman frequency, and is in fact altogether below the range of optical frequencies for NaCl. It corresponds to an angular frequency $1 \cdot 89 \times 10^{13}$, but no reliance can be placed even upon this figure (although it would agree well with the thermal theory), since the intensity measurements are obviously extremely rough and limited in extent.

(2) He assumes that Laue spot and thermal spot intensities should vary differently with crystal volume. This is not the case; both are proportional to the crystal volume, proper experimental precautions being taken and corrections made[7]. Venkateswaran has compared diffuse spots given by $\lambda = 0 \cdot 710$ with Laue spots due to $\lambda = 0 \cdot 417$, $0 \cdot 592$ and $0 \cdot 401$ A., using a thick crystal for which no differential absorption corrections are made. He states that there is no variation of the Laue/diffuse spot intensities, as indeed the thermal theory predicts, but his photographs cannot be accepted as serious evidence either way.

(3) He assumes that the velocities of elastic vibrations are identical in all directions and irrespective of polarization (Raman also states that such a simplified treatment "should be a fair approximation to the truth"; *ibid.*, p. 344). A recognition that this is far from being true is vital to a proper comparison of theory and experiment. Venkateswaran's measurements of sharpness, etc., are in reasonable agreement with the correct version of the thermal theory, though not with the approximate theory that he assumes.

(4) His assumption that the thermal theory predicts the same law of intensity decay with angle of diffraction for diffuse as for Bragg reflexions is incorrect. Temporary displacements of atoms naturally affect the small-spacing and high-order reflexions much more than those of large spacing or low order. This was well confirmed by Laval's careful observations[8]. He found for potassium chloride at 290° C., using molybdenum $K\alpha$ monochromatized radiation and measuring the diffuse spot intensities (by the ionization spectrometer) at a constant angular displacement from the Bragg reflecting positions:

	002	004	006	008	0010
Bragg intensity	100	20	7	3	1
Diffuse intensity	100	50	33	21	12

For planes of similar structure factor but different force constants the diffuse spot intensities may bear little relationship to the Bragg intensities. This was also confirmed by Laval.

(5) It follows from (4) that Venkateswaran was wrong in expecting that, according to the thermal theory, the 111 : 222 diffuse spot intensity ratio would be equal to that of the Bragg spots. Moreover, the method he used of obtaining the diffuse reflexions by transmission through a thick crystal of an "effective X-ray wave-length maximum" of 0·46 A. was quite unsuitable for comparison of intensities. In fact, Fig. 3 (plate 29) of his paper shows that some molybdenum characteristic radiation was also being transmitted, and this would certainly invalidate his measurements. Accurate intensity comparisons are only possible using monochromatic radiation, proper allowance being made for 'unwanted' components.

(6) In order to explain the drift of the diffuse maxima towards the Laue spots, Venkateswaran postulates 'phase-waves' parallel to certain of the {311} planes. This drift is a natural consequence of the thermal theory, which predicts its magnitude and direction correctly[9] and without any extraneous assumptions.

I do not suggest that the thermal theory has reached a state of perfection and is now beyond criticism. That is not the case. It may, however, be claimed that the experiments described by Venkateswaran, in so far as the results are of value, confirm and do not contradict the thermal theory. From this point of view, therefore, there is no ground for criticism of the Born lattice theory.

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[1] James R. W., *Phil. Mag.*, **49**, 585 (1925); *Manchester Memoirs*, **71**, No. 2 (1926–27); James, R. W., and Firth, E. M., *Proc. Roy. Soc.*, A, **117**, 64 (1928); Waller, I., and James, R. W., *Proc. Roy. Soc.*, A, **117**, 214 (1928).
[2] Zachariasen, W. H., *Phys. Rev.*, **59**, 860 (1941).
[3] Jahn, H. A., *Proc. Roy. Soc.*, A, **179**, 320 (1942).
[4] Lonsdale, K., and Smith, H., NATURE, **148**, 628 (1941): **149**, 21 (1942). Lonsdale, K., *Proc. Phys. Soc.* (in the press).
[5] Raman, Sir C. V., *Proc. Ind. Acad. Sci.*, A, **14**, 317, 332 (1941).
[6] Venkateswaran, C. S., *Proc. Ind. Acad. Sci.*, A, **14**, 387, 395, 426 (1941).
[7] Robinson, B. W., *Proc. Roy. Soc.*, A, **142**, 431 (1933).
[8] Laval, J., *Bull. Soc. Franç. Min.*, **62**, 137 (1939).
[9] Jauncey, G. E. M., Baltzer, O. J., and Miller, D. C., *Phys. Rev.*, **59**, 908 (1941). Zachariasen, W. H., *Phys. Rev.*, **59**, 909 (1941). Baltzer, O. J., *Phys. Rev.*, **60**, 460 (1941).

Regulation of Experiments on Living Animals

AT the end of June a somewhat rare event will take place. The Home Office will make an appointment under the Cruelty to Animals Act, 1876, which regulates the practice of experiments on living animals.

An inspector under the Act exercises an important function, not, indeed, as a policeman, but in advising research workers as to the interpretation of their obligations in particular cases. In view of the number of experiments licensed under the Act, direct supervision is not practicable on any material scale, but I assume that the majority of research workers do not desire to contravene the regulations, and that the inspector's guidance will in general be effective.

The Act lays down a compromise between the claims of science, on one hand, and the rights of animals, on the other; the line drawn in the practical application of the compromise must inevitably be an arbitrary one. Until somebody can lay down clear-cut rules which will command general assent, the best that can be done is to make as fair a compromise as possible. This calls for exceptional impartiality, and since a man with the indispensable scientific training will necessarily have a predisposition in favour of science, it is important that he shall also have an offsetting predisposition in favour of the other party in the compromise. This could be ensured by requiring candidates for the post to prove that they have in the past been effectively associated with some effort to better man's treatment of animals, wild or domestic. Preferably they should also have veterinary knowledge.

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(President).

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RESEARCH ITEMS

Fishes from the Philippines

Bulletin, 13, 100, of the United States National Museum (1941), is the sixth volume of Henry W. Fowler's studies of the fishes collected by the United States Bureau of Fisheries steamer *Albatross* in the Philippines. This is mainly on the primitive fishes, following through the various groups of living forms to the more generalized bony types. The greater part deals with the sharks, rays and chimæras, but among the bony fishes clupeoids, catfishes and carp are included. It is a handsome volume of nearly nine hundred pages and will be of much use to systematists not only for the description of species but also for the analyses given of sub-classes, orders, families and genera which include general definitions. The type of each genus is noted but the species dealt with are only those occurring in the area studied. Most of the localities recorded relate to the Philippines, but other regions where the *Albatross* cruised, as the Netherland Indies, China, Formosa and parts of Oceania, are also listed. General and very brief notes on breeding and food in the various families are occasionally given. More of this would be welcome. The statement on p. 24 that all the Scyliorhinidæ, so far as is known, appear to be viviparous, is obviously a slip, as the egg cases and attachments to weeds and rocks are described.

Study of a Deepwater Fish

WILBERT MCLEOD CHAPMAN ("The Osteology and Relationships of the Bathypelagic Fish *Macropinna microstoma* with notes on its Visceral Anatomy", *Ann. and Mag. Nat. Hist.*, Eleventh Series, 9, No. 52 ; 1942) has described previously the external anatomy of this fish (1939) and indicated its relationships with Opisthoproctus. He found, however, that there were sufficient differences from the latter to warrant the formation of a new family. A further specimen being available for anatomical study the skeleton was worked out in detail, also the gross visceral anatomy, and, to some extent, the musculature. Of particular interest are the great changes in the head region occasioned by the enormous dorsally directed eyes, the peculiarities of the oral regions, and the absence of an air bladder. The new family Macropinnidæ is proposed to include the genus Macropinna, while in the family Opisthoproctidæ the new genus Grimaldia is proposed for *Opisthoproctus grimaldi* Zugmayer. The relationships of other little-known genera are also discussed.

Accuracy of a Few Observations in a Large Population

W. L. STEVENS (*J. Genetics*, 43, 301 ; 1942) points out that the customary attachment of an estimated standard error to indicate the limits of accuracy of a mean value may lead to misinterpretation in those cases where the distribution is not normal and the value is based on small numbers. Such a case is the estimate of a mutation-rate in a population N where the ratio n/N (n being the number of observed mutations) is very small. For example, the occurrence of three mutations in 1431 cultures gave a mutation rate of 0·21 per cent $\pm$0·12 ; thus a negative mutation rate would be perfectly reasonable with such a method of estimating the limits of accuracy. To overcome these difficulties, the author provides a useful table whereby the limits of accuracy of values based on less than fifteen individuals may be rapidly estimated. For genetical work and possibly in other directions this table will be of great service.

Cell Division in Small and Large Cells

E. W. SINNOTT (*Proc. Nat. Acad. Sci.*, 28, 36 ; 1942) has shown that large and small cells divide and multiply at the same rate in the fruits of several cucurbits where cell division is in progress. Therefore he concludes that cell division is controlled by some factor, independent of cell size, throughout the different tissues of an organ.

Carbonization

EXPERIMENTS on the gaseous products of carbonization by heating of cellulose, glycine, petroleum coke, bakelite, anthracite and bituminous coal (K. Bolton, J. E. Cullingworth, B. P. Ghosh and J. W. Cobb, *J. Chem. Soc.*, 252 ; 1942) throw some interesting light on the mechanism of the process. Substances forming a solid residue form a repatterning of carbon atoms in a hexagonal network which resists any disintegrating tendency of further temperature rise and forms graphitic crystallites. It is established at 400°–500° and its progress is accompanied by a rise in density, rapid up to 800° (in coal, etc., such material is initially present). The other molecular groups form no part of this pattern or are easily detached from it, and are volatilized and expelled with rise of temperature. Some gaseous products (carbon dioxide and some carbon monoxide) appear early ; the chief gaseous products (methane, hydrogen and carbon monoxide) come later and are regarded as formed from the more firmly attached CH_3, H and OH radicals by molecular condensations of the type : $R_1H + CH_3R_2 = R_1R_2 + CH_4$. The maximum emission of methane is at 500°–600°, the maximum hydrogen and carbon monoxide at 700°–800°. The latter is supposed to be formed from steam by a water gas reaction. The amounts of higher paraffins and unsaturated hydrocarbons are small with the substances tested.

Separation of Isotopes

THE separation of isotopes of oxygen and nitrogen by means of fractionating columns working with water and ammonia solutions has proved very successful. Some of these columns are very tall (60 ft. or more) and the question of packing becomes important, among other ways in that of expense. H. G. Thode and F. O. Walkling (*Can. J. Res.*, 20, 61 ; 1942) have used a packing which is inert, cheap and easily wetted, which has given results and is suggested for use in industrial separation of isotopes. This was a shale which had been passed through a furnace at a temperature well above the melting point, the clinkers being crushed, cleaned and graded according to particle size. The fractionating column was tested with water and ammonia solution. In the second case a 60 per cent solution of ammonium nitrate is pumped to the top of a fractionating column at a constant rate, drains to the foot of the column where it reacts with alkali to liberate ammonia, which is stripped and returns to the column where it flows to the top against the current solution. Since ^{15}N is favoured in the liquid phase, there is a net transport of it towards the foot of the column, where it concentrates. The apparatus is worked at room temperature and 10 cm. pressure. Some figures for different types of packing are given.

Faxén-Waller Theory of Diffuse X-Ray Scattering

An elementary derivation of the Faxén-Waller formula for the diffuse scattering of X-rays by thermally excited lattice vibrations and the shapes of the surfaces of isodiffusion in reciprocal space for some cubic crystals has recently been given by H. A. Jahn (*Proc. Roy. Soc.*, A, 179, 320; 1942). It is shown that for substances with high elastic anisotropy large deviations from spherical character are to be expected for the surfaces of isodiffusion belonging to each of the individual lattice planes and, moreover, marked differences in shape between surfaces belonging to different lattice planes. The theory is illustrated by calculations made for a single crystal of sodium.

Magnetostriction

F. Brailsford and R. G. Martindale describe the results of an investigation into the magnetostriction of five grades of iron and silicon-iron electrical sheets, including a cold-rolled silicon steel and a high silicon steel (*J. Inst. Elec. Eng.*, 89, Pt. 1, No. 17, May, 1942). The silicon content varied from 0·14 per cent to 6·26 per cent. Measurements were made on strip specimens 24 in. long by 2 in. wide by 0·014–0·016 in. thick. A solenoid 20 in. long and 3 in. inside diameter was used to magnetize the strip, the magnetic circuit being completed by a massive laminated yoke. Measurements of magnetostriction were confined to a length of 5 in. at the centre of the specimen, and the variation of flux density over this length was less than 5 per cent. Changes in length were measured by a small extensometer specially developed for the purpose. Readings were made by a telescope and cross-wires on an illuminated scale, the magnification being rather more than 100,000. As the scale could be read to 0·01 in., a change in length of 10^{-7} in. could be detected. A typical maximum magnetostrictive strain of 4×10^{-6} could, therefore, be read to about $\frac{1}{2}$ of 1 per cent. Magnetostriction in the sheet materials was found to vary considerably, depending upon the direction in the sheet relative to the rolling direction. The general form and direction of traversal of the hysteresis loops formed by plotting magnetostriction against flux density can also vary, depending upon the material and other factors. The theoretical analysis, while very approximate in its application to polycrystalline material, nevertheless gives some evidence for the view that, on account of the method of demagnetization or the presence of directional residual strains, the initial distribution of domains in the material in the demagnetized condition is not purely a random one. This in turn might be an important contributory factor to the magnetic anisotropy observed to occur at flux densities below the 'knee' of the magnetization curve. A number of graphs is given showing the variations of magnetostriction with changes of values of the different variables affecting the phenomenon.

Impulse Voltage Measurements

In a paper read before the Institution of Electrical Engineers recently on measurements on impulse voltages with a ballistic galvanometer, G. W. Bowdler describes two simple circuits for measuring the crest value and duration of transient impulse-testing voltages. In the measurement of crest voltage, the impulse is applied to a resistor-divider, the voltage across a part of which is applied through a thermionic rectifier to a capacitor which is connected to the galvanometer through a series resistance. A bias battery suppresses any steady thermionic current tending to flow through the valve and galvanometer. For measuring time-lag, a fraction of the impulse voltage is applied to the grid of a triode from a resistor-divider. The galvanometer and anode battery are shunted by capacitors which have impedances negligible compared with that of the series resistance in the anode circuit. A series resistance in the galvanometer circuit isolates the galvanometer from the applied impulse voltage when measurements are being made on negative impulses. Both methods of measurement are compared with the results obtained simultaneously by a high-speed cathode ray oscillograph. The agreement in crest voltage was within 2 per cent even with voltages of the order of 10^{-7} sec. duration, and in time-lag the agreement was within 0·2 microsec. when the grid bias of the valve was suitably adjusted. The measurements are not critically dependent on the characteristics of the thermionic valves used in the circuit, and the range of voltages which may be measured can easily be extended by the use of suitable high-voltage resistors. The two circuits described have been assembled conveniently into a general impulse-measuring equipment with mains-operated supplies for the valves. As an example of its use, the time-lag curve of a 10-in. rod gap, obtained in a small fraction of the time necessary to do so by oscillographic methods, is reproduced. The paper concludes with a record of a few measurements made with this apparatus of the lengths of the front and tail of an impulse wave.

Ionospheric Measurements during Total Solar Eclipse

A. J. Higgs has published a paper on ionospheric measurements made during the total solar eclipse of October 1, 1940 (*Mon. Not. Roy. Astro. Soc.*, 102, 1) which describes very fully the ionospheric results obtained during the eclipse, with equipment operated at Victoria West, South Africa. The conditions were particularly favourable for settling the question regarding a definite ultra-violet effect and/or corpuscular effect within the F_2 region, because the corpuscular or particle eclipse for particles travelling with the expected velocity of 1,600 km./sec. was due to take place about noon. The F_2 gradient is then generally near its maximum and the diurnal curve flat, so that any corpuscular effect should be more easily detected. In this region it was found that there was no marked corpuscular effect, but that there was an ultra-violet effect. A decrease in maximum ionization density of about 25 per cent was observed, the minimum being reached at approximately 30 minutes after totality, and these results were confirmed by Dr. J. A. Pierce of the Harvard University expedition at Queenstown. The F_1 region was well defined throughout the eclipse, and on the whole it showed the expected results, but the region is more complex than is generally supposed. A subsequent paper will provide detailed examination of the connexion between E region density and size and intensity of bright hydrogen areas. For the present, it can be accepted that the major portion of the ionization responsible for the production of region E was coming, not uniformly from the sun's disk, but from regions near observed clouds of bright hydrogen or calcium. In corroboration of this it may be noticed that observations made by the Carnegie Institution of Washington at the partial eclipse of the sun on April 7, 1940, indicated "that the Sun is not giving out the ultra-violet radiation uniformly from all parts of its surface".

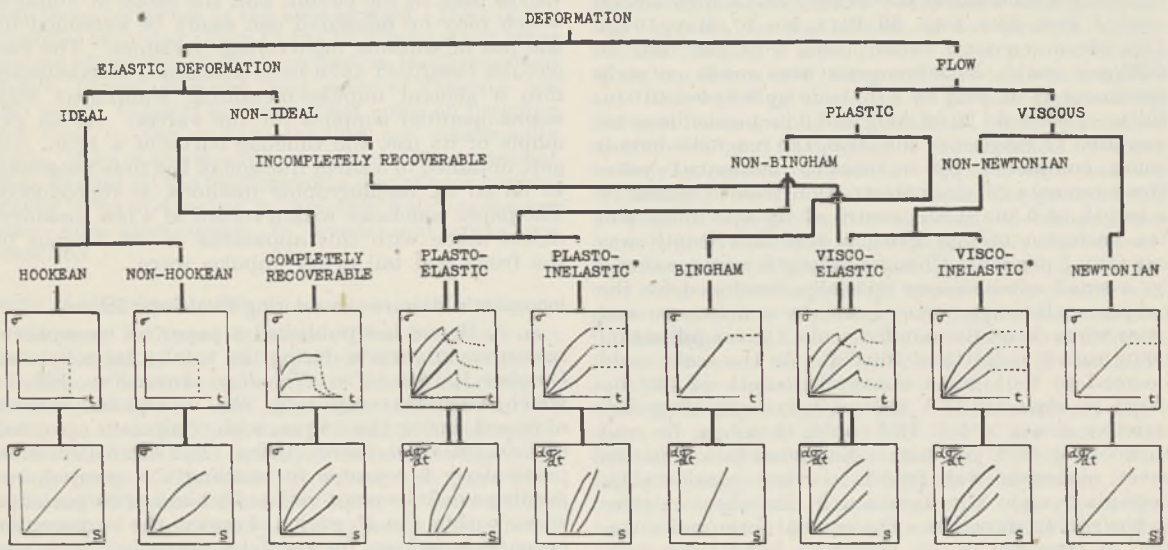
CLASSIFICATION OF RHEOLOGICAL PROPERTIES

AT a meeting of the British Rheologists' Club held at the Imperial College of Science, London, on May 16, the accompanying chart was presented for discussion by the Committee. The discussion was introduced by Dr. V. G. W. Harrison (hon. treasurer).

It is believed that this classification marks a considerable advance on the earlier draft discussed at Birmingham, which was reproduced in NATURE of Feb. 14, p. 197. It incorporates many of the suggestions made by members at that meeting, and also the hatched 'frame' enclosing those categories for which the rate of deformation is liable to increase or decrease with time for constant stress is eliminated. The Committee realized that the use of this frame as possible, examples of materials showing each type of deformation should be quoted. Mr. J. C. Gage doubted whether the insertion of the graphs had adequately replaced the 'frame' of the earlier table.

Dr. J. Needham asked whether the complex rheological properties described by him in a paper read earlier in the day could be fitted into the table, and Mr. L. Bilmes submitted a circular form of the table, which the Committee will consider in the near future.

Replying on behalf of the Committee, Dr. G. W. Scott Blair (hon. secretary) said that he did not think that it would be possible to explain all kinds of complex rheological behaviour in terms of the present table. The Committee has taken as its first task the formulating of a table of types of deformation. It is hoped that with the help of members and



(1) σ represents shear strain.
S ,, ,, stress.
t ,, time.

(2) Continuous curves represent deformation under stress.

(3) Dotted curves represent behaviour after removal of stress.

(4) Where two or more curves appear in a diagram, these indicate alternative types of behaviour.

(5) In cases marked * either the σ/t curve or the $\frac{d\sigma}{dt}/S$ curve may be a straight line, but not both, since in this case the systems would be Bingham or Newtonian, which are given separate categories.

(6) The upper series of diagrams in which shear strain is plotted against time represents deformations under constant stress. The lower series, in which $d\sigma/dt$ is plotted against stress, is for an arbitrary time.

added considerably to the complexity of the table and that, even with it, the picture was incomplete, since another 'frame' would be required to allow for changes in the strain (σ) — time (t) relation with changes in stress (S).

In order to simplify the table, Mr. D. C. Broome had been asked to draw graphs relating σ/t, σ/S and $(d\sigma/dt)/S$ for each category showing, where necessary, the possible types of curvature which may occur in each category. These graphs, after slight revision by the Committee, have been included in the revised table. The table has also been re-arranged so that elastic deformations remain on the left-hand side throughout, the viscous and plastic deformations being on the right.

In the discussion which followed, Dr. C. A. Maunder Foster suggested that the Committee might proceed to consider the more detailed drawing of recovery curves and Mr. J. Pryce-Jones proposed that, as soon of colleagues in the (American) Society of Rheology, the scope of classification of properties may be extended, but for the present the effective range of activity is limited. It is realized that the categories in the table cannot be regarded as hard-and-fast limits of behaviour, but rather as convenient landmarks, analogous in many ways to the psychologist's classifications of character and personality types. It would be rash to regard intermediate systems as, of necessity, mechanical mixtures of the simple types between which they lie. As soon as the categories are found to be acceptable, the Committee will consider the possibility of designating each type by means of a letter or number.

Any one who may wish to make criticisms or suggestions with regard to the above table is invited to communicate with the honorary secretary of the British Rheologists' Club, c/o Institute of Physics, University of Reading.

INSULATING OILS

IN a symposium on insulating oils, five important papers were presented before the Institution of Electrical Engineers in London on May 13 by various authors. In the first one, on "Manufacture and Testing of Oils and Oil-Rosin Saturants for use in Electrical Equipment", A. W. Thompson and J. C. Wood-Mallock described briefly the selection of oil crudes, and the choice of refinery methods best suited for the manufacture of transformer and switch oils, and condenser and cable saturants. Methods of test are discussed and consideration is given to the changes undergone by these liquid dielectrics under high electrical stresses.

Highly paraffinic oils are undesirable in transformers, cables and condensers, and therefore solvent processes are, in general, unsuited to the production of such oils. Rosin is a desirable constituent of cable saturants. It is concluded that in respect of transformer oils, revision of British Standard 148, particularly of the oxidation test, is overdue. Any proposed oxidation test should take account of acidity development as well as sludge, and should be carried out at a lower temperature. Solvent treatments lend themselves to production of transformer oils having the desired characteristics, but the distillate must be chosen for the purpose. For switch oils, further work is required on carbon production during arcing and its relation to refining.

For condenser saturants transformer oil is not ideal. They should be judged on the basis of dielectric loss and stability to ionic bombardment.

Sulphuric acid treatment of a naphthenic distillate, which may have a reasonably high viscosity, is the best method of production. In cable saturants for solid-type cables the oil component should be assessed on power loss, particularly at high temperatures, and freedom from gas formation under electrical stress. A suitable oil is prepared from a viscous vacuum distillate from a naphthenic or intermediate crude, by sulphuric acid refining. Solvent processes are unsuitable. Rosin is a desirable constituent because of its effect on gas formation and cable stability, and should be chosen with regard to its effect on dielectric loss.

The second paper, "Insulating Oils for Cables", by S. Beckinsale, indicated the present position in Great Britain of the insulating oils and compounds available for cables, and described their behaviour in impregnating plants. The oils in question are of the paraffinic and naphthenic types, and either class may be used in oil-rosin compounds. Naphthenic oils are the better solvents for rosin and for the oxidized bodies produced from rosins, and their use is increasing rapidly. All the oils and compounds can be prepared with excellent electrical properties, but as some of their constituents are very subject to chemical change in the presence of air, the cable-making plant and processes must be types which reduce this interaction to a minimum. For voltages up to and including 66 kv. the various oil-and-rosin compounds are employed, but for higher voltages either a thin naphthenic oil is used for the oil-filled cables, or a viscous naphthenic oil, sometimes containing a viscous hydrocarbon polymer, is the saturant for the pressure-type cables.

Cable oils should be resistant to gassing, and both British and American oil refiners leave in certain aromatic constituents which absorb any gas that may be generated under electrical stress from the more saturated compounds in the oil. Solvent-refined naphthenic fractions have been found suitable for cables, but the solvent-refined paraffinic fractions have proved unsuitable owing to their failure to absorb gas and to the physical instability of their rosin compounds. The use in Great Britain of oil-rosin compounds for the impregnation of cables for voltages up to 66 kv. is based on their increased viscosity combined with the excellent impregnation and good adhesion between compound and paper fibre. In the early 1920's, papers made from cellulose from the conifers were developed, for it was considered that as resinous substances had been present in the cells in the tree, such cellulose with its characteristic cellular structure would have a greater affinity for rosin than the cellulose produced from such fibres as manila and cotton. The use of this wood pulp has now become almost universal for power cables.

The further improvement of oils and rosins for cables is largely a problem for chemists and physicists, with electrical engineers in the background testing the results obtained from new processes and, where necessary, working out new methods of test as the dielectric losses are reduced.

The third paper of the series, by W. Fordham Cooper, on "Insulating Oil in Relation to Circuit-Breaker Failures", is based upon the author's investigations in the course of the last ten years of a considerable number of accidents and dangerous occurrences due to the explosive failure of oil circuit-breakers and oil-immersed control gear, in the course of which it has become apparent that not all were due to inadequate rupturing capacity or defective insulation. This has been true particularly of a number of failures in recent years of the control gear for arc furnaces. The paper assesses what part deterioration of the switch oil may play, and the importance of the problem may be judged from the fact that oil in such switches is now frequently changed every two or four weeks, and, at some works, once a week.

Many engineers responsible for the maintenance of switchgear have felt that while the tests laid down in British Standard specifications may eliminate many new oils which are definitely unsuitable, they provide no certain guide to the rejection of used oil after a period of service. The author therefore includes a section suggesting the initial tests which might be taken in the search for a more suitable basis. Explosions occur occasionally without previous insulation breakdown or severe arcing, and it is necessary to correlate their occurrences with some definable condition of the oil or the switch.

The study is divided into two parts: (i) surface contamination and the associated presence of suspended matter in the oil; and (ii) general chemical deterioration of the oil. There are then four aspects of each of these, namely, reproduction under controlled conditions of the phenomena observed in the field; laboratory examination of new and used oil, and correlation of the result with experience of breakdown; development of comparatively simple tests for the rejection of seriously defective oil; the determination of whether repeatedly 'cleaning' oil by conventional methods renders it safe for re-use, or whether cumulative effects of chemical change may, after a time, lead to danger. In the initial stages the second and third aspects mentioned above must progress together so that, if possible, a corre-

lation is established between simple tests and those requiring the services of a skilled chemist.

The next contribution is on "Mineral Oil for Transformers and Switchgear", by A. A. Pollitt, in which the author sets out to familiarize the electrical engineer with the nature and characteristics of mineral oils. In spite of the advent of non-inflammable, liquid-chlorinated hydrocarbons, mineral oil still remains the chief dielectric used in liquid-filled transformers and switches. Mineral oil has been chosen because of its high electric strength compared with that of air and because, where necessary, it can function as a cooling medium and so maintain the operating temperature of the equipment at a safe value. The outstanding characteristic of mineral insulating oils is their stability in service. Efficient operation of mineral-oil-filled electrical equipment is dependent, therefore, to a large extent upon the ability of the oil to retain substantially unimpaired, in the presence of deteriorating influences, its initially good electrical properties, its inertness towards the solid insulating materials that are also present in most electrical equipment in which oil is used, and its ability to effect efficient cooling.

The author deals with the constitution of mineral insulating oils, refining, causes of deterioration, oxidation products and their influence, the evaluation of insulating oils, and oils in service.

The last paper, on the "Maintenance of Insulating Oils in the Field", by L. H. Welch, reminds one that insulating oil deteriorates in use and the maintenance engineer must see that the working conditions are such as to minimize this. The oil must be reconditioned when the necessity is revealed by regular observations on its condition. Reference is made to points which should be watched in the design and installation of plant and it is suggested that, of the oils specified in British Standard 148–1933, only grade *B*.30 should be retained. The revised specification should include high-viscosity oils which are frequently used in electrical apparatus. Routine tests for sludge and moisture contamination are universal, but determination of acid value may be important and the flash-point has to be determined occasionally. Suggestions are made as to what values of these should be permitted before purification is considered necessary. The type of contamination likely to be present and the apparatus available for its treatment and various methods of using it are discussed. A table showing suitable maintenance periods is given, and it is pointed out that as it is difficult to handle oil and to work on oil-immersed gear without causing deterioration, these periods depend more on the immersed apparatus requiring attention than on the oil.

Oil maintenance can be kept to a minimum by giving attention to the following points: minimum operating temperature of transformers and kindred apparatus to be ensured by adequate ventilation for indoor equipment and correct adjustments of controls on forced cooling systems; adequacy of breathers, and their maintenance; careful selection of mechanical and electrical design of apparatus, particularly in relation to tap-changing gear; use of grade *B* oils—grade *A* oils have proved liable to develop excessive acidity and sludging in service whereas grade *B* oils have developed less total acidity and less total sludging and should, therefore, be used wherever oil of this viscosity is required; such oils can be expected to prove a reasonable cure for acidity and sludging, which have occurred where grade *A* oils have previously been used; cold purification is much to be preferred and a filter is generally more useful and easier to operate than a centrifuge.

Finally, it is considered that the present British Standard 148 requires revision. It covers six oils of the same viscosity and these could all be replaced by *B*.30 oil. There is need to include other oils, however, particularly a more viscous oil for switchgear.

INSTITUTION OF ELECTRICAL ENGINEERS

THE report of the Council for the year 1941–42 of the Institution of Electrical Engineers discloses that 1,650 new members were elected during the year and that there are now 10,483 corporate members on the register. An Installations Section was inaugurated during the year with an initial membership of 1,127. There are now nine students' sections aggregating a membership of 4,483, which includes 1,944 graduates.

Post-war planning continues to receive attention and a joint committee has been set up consisting of two representatives of each of the three engineering institutions, while contact has also been made by the planning committee with a number of other organizations which are discussing planning problems. Co-operation with the Ministry of Labour and National Service in the working of the Electrical Engineering Section of the Central Register continues and 1,121 members have been placed on work of national importance. Reference is made to the Institution's part in the intensive training courses in engineering, which are designed to carry men from the Ordinary National Certificate to the Higher National Certificate standard in six months. Co-operation with the Institution of Mechanical Engineers has been promoted in this connexion.

More than two thousand members of all classes are on active service with the Forces, and arrangements have been made for ensuring that those liable for military service are posted to appropriate technical branches of the Forces. More than three hundred applicants for technical commissions in the Forces have been dealt with; two hundred cases were presented to the Beveridge Committee with the view of up-grading or transfer to duties in the Services more appropriate to the member's qualifications. More than 4,500 enrolments have been accepted by the War Office from men in the Army and the R.A.F. for tuition in various engineering courses under the scheme set up by the three engineering institutions, the Board of Education and the Service Departments.

Other activities upon which the Institution has been engaged are the preparation of codes of practice, war emergency standards, A.R.P. in the engineering industry, the statistical control of materials and manufactures, and fuel efficiency and economy. On the educational side, in collaboration with the Institutions of Civil and Mechanical Engineers, a joint panel of senior engineers has been formed for the purpose of delivering lectures to university engineering societies, in order to bring students into touch with actual practice. A centre of the Polish Society of Electrical Engineers, with headquarters in London, has been formed and the Institution's premises have been placed at its disposal for meetings, etc.

Associate membership examinations were held for 538 candidates and, in English only, for 193 holders of National Certificates in electrical engineering. Arrangements have been made with the British Red Cross Society for prisoners of war in Germany to sit for the associate membership examination in prison camps. 1,065 national certificates and diplomas in electrical engineering were awarded during the year.

297 books and pamphlets have been added to the Institution's reference library and 58 new volumes to the lending library. Subdivision of the *Journal* came into effect in January 1941, Part I being distributed free to members; more than 6,000 members subscribed for Part II and some 4,000 for Part III. *Science Abstracts* continue to be published monthly in two sections, Section 'A', dealing with physics, and Section 'B', with electrical engineering. The universal decimal classification has now been adopted in both sections, as from January 1942. 1,045 copies are issued each month to members and 6,720 copies per month to others.

FOLK-LORE OF VENEREAL DISEASE

IN a recent article (*Brit. J. Ven. Dis.*, 18, 1; 1942) Dr. J. D. Rolleston attributes the scarcity of the folk-lore literature on venereal disease partly to the fact that most medical practitioners know little and care less about folk-lore, and partly to the fact that folk-lorists are rarely medical practitioners and shrink from dealing with what they regard as an unsavoury and repulsive subject. No mention of venereal disease, for example, is to be found in W. G. Black's "Folk-Medicine" (1883) or Sir James Frazer's "Golden Bough" (3rd ed., 1927–36), the two principal works by lay writers, in which much valuable medical folk-lore is to be found, while of the two chief works in Great Britain by medical authors, namely, Pettigrew's "Superstitions Connected with the History and Practice of Medicine and Surgery", published in 1844 or two years before the term 'folk-lore' was invented by William John Thoms, does not mention venereal disease at all, and the comparatively recent work by Dan McKenzie on "The Infancy of Medicine" (1927) has only two brief references to the subject.

The only important treatise on medical folk-lore in which the subject of venereal disease is adequately discussed appears to be that of O. V. Hovorka and A. Kronfeld (1908–9) entitled "Vergleichende Volksmedicin". Owing to the comparatively recent establishment of their autonomy, there does not seem to be any folk-lore connected with chancroid or the fourth, fifth and sixth venereal diseases, so that Dr. Rolleston's paper deals only with syphilis and gonorrhœa.

As regards nomenclature, the term 'syphilis', which was introduced by Fracastoro in 1521, did not at first receive general recognition and during the whole of the seventeenth and eighteenth centuries only about half a dozen writers employed it. Although, however, no scientific term was given to the disease, on its first appearance in Europe a host of new names was introduced by the laity, the commonest being those indicating that the malady had originated in France. Popular theories as to its origin included the views that the disease had a divine source, being a punishment for unchastity, that it was due to intercourse between a man and an animal or that it was caused by intercourse with a woman who was menstruating or had a vaginal discharge of any kind.

Belief in a cure of a disease by transfer of it to another person or animal is a well-recognized tenet of medical folk-lore, but whereas in the case of other complaints such as epilepsy, whooping cough, warts, boils, pulmonary tuberculosis and the acute exanthemata, the transfer is purely imaginary, in venereal disease, especially gonorrhœa, it only too frequently actually takes place without, of course, having any curative effect. The person to whom the disease is transferred is preferably a young virgin of either sex, much less frequently an adult. This superstition, which dates back for several centuries, is world-wide. Other folk-lore methods of treatment for venereal disease include animal and plant remedies and miscellaneous cures which in the case of syphilis include sweating and fumigation, and local application of drugs or other substances. In the case of syphilis but not of gonorrhœa, several patron saints may be invoked, while in gonorrhœa but not in syphilis coprotherapy is sometimes employed.

COLLECTIVE FARMING IN RUSSIA AND THE UKRAINE

SIR JOHN RUSSELL has made a study of Russian agriculture, and, through his visits to that country from time to time, has been able to observe trends in agricultural policy, and the results of the State and of collective farms. He discussed his observations in a lecture recently delivered at the Royal Institution.

It was impossible to arrive at once at the most desirable system of land utilization, this being influenced by progress in farming methods, particularly as regards mechanization, and the effect of this on the growth of the workers' interest in the State or collective unit, as opposed to his own personal stake in the land. The application of modern machinery to tillage, and of methods of livestock improvement and disease control to herds and flocks are more suited to large than to small units, and it is probable that success in these directions influenced the workers' views as to the extent to which they were prepared to identify their own interests with that of the large unit in which they are employed.

After the Revolution, State farms were developed, but the peasants, who expected nothing less than individual ownership of the land that they tilled, were not then sufficiently mature, either politically or technically, to make a success of this form of organization. Instead of the State farm, the collective farm figured more and more prominently in the development of Soviet land policy. Thus, by 1939, the area occupied by collective farms was more than eleven times that of State farms.

Collectivization is based on the principle that an entire village, with its land, is run by the inhabitants as one farm, boundaries being obliterated, and the whole area divided into a few fields, the number depending on the rotation. All possessions are pooled, and the workers share the produce remaining after paying out the Government share, and meeting other obligations. Collectivization at first met with great opposition, particularly owing to the compulsory pooling of all livestock; peasants who, by years of hard work and economy, had got together a cow and a few pigs, found it difficult to have to restart from the same level as those who had never made any sacrifice to provide their families with

livestock necessary to maintain them in milk, butter, and other produce. For this reason, collectivization at first resulted in a heavy decrease in the numbers of livestock. The opposition to collectivization decreased when the benefits of the tractor in large-scale farming were realized, and, later, by the action of the State in securing the land to the collective farm for ever, and in giving to each householder a small plot of land, a cow, one or two pigs and poultry. The peasant of the collective farm is allowed to sell the produce of his plot and of his stock. A worker's time is shared between the collective farm and his own plot, and, in the same way, his income is derived from those two sources.

Sir John gave some data showing the proportion of workers' time spent on the collective farms, the proportion of his total income derived from that source, and the influence of efficiency in the management of the collective on the proportion of his total earnings derived from it. It has become necessary, in some instances, to enforce a minimum of two hundred working days per annum on the collective farm, in order to prevent the peasant from devoting too much of his time to his own plot and stock.

The most important feature of the new system, however, is that production is planned, each farm being told what, and how much, to grow for a period of five years. Requirements are allocated to the different districts, and each farm in the district is allotted its area for the various crops, and told what quantities of animal products are expected of it.

Great efforts are made to utilize science. Thus, extensive soil surveys are carried out, and made use of in developing rotations; one important result of this is a reduction in the area of fallow from 35 per cent under the old three-course system to 20–25 per cent now that rotations are practised. Science also plays a part in the struggle against drought; the importance of this can be understood when it is realized that in large areas in the south the average annual rainfall is not more than 12 inches.

The standard of comfort and of living of the Russian farm workers has not reached that of the British land worker. Houses are smaller, and are not so well furnished. The diet is simple, and would be considered monotonous by many standards. Great strides have been made in education, and by 1939 the ladder was complete, every child having an opportunity of university education.

The author has succeeded in presenting the reader with a brief but clear picture of the lines along which Russian policy is developing. The results of collective farming are discussed, and there is an interesting account of life in a Russian village, or collective farming.

E. J. ROBERTS.

APPOINTMENTS VACANT

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

PATHOLOGIST AND DIRECTOR OF THE CLINICAL RESEARCH LABORATORY—The Secretary and Treasurer, Victoria Infirmary of Glasgow, 40 St. Vincent Place, Glasgow, C.1 (June 27).

MASTER (OR MISTRESS) TO TEACH MATHEMATICS, MECHANICS, SOME SCIENCE, AND ENGLISH at the Junior Technical School of the Wellingborough Technical Institute—The Secretary for Education, County Education Offices, Northampton (June 27).

ASSISTANT SCIENCE MASTER, GRADUATE, TO TEACH PHYSICS PRINCIPALLY, at the Junior Technical School for Boys—The Director of Education, Education Office, Leopold Street, Sheffield 1 (June 27).

TEACHER OF BUILDING CONSTRUCTION, SCIENCE AND MATHEMATICS, at the Oxford Schools of Technology, Art and Commerce, Building Trades and Junior Day Departments—The Chief Education Officer, City Education Offices, 77 George Street, Oxford (June 29).

HONOURS GRADUATE IN ENGINEERING at the Quakers' Yard Technical School—The Director of Education, Education Department, Town Hall, Merthyr Tydfil (June 30).

LECTURER IN CIVIL AND MECHANICAL ENGINEERING—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1 (June 30).

MISTRESS TO TEACH PHYSICS AND CHEMISTRY at the Wellingborough High School—The Secretary for Education, County Education Offices, Northampton.

ASSISTANT FOR MATHEMATICS, and an ASSISTANT FOR SCIENCE WITH ELECTRICAL ENGINEERING, if possible—The Principal, Technical Institute, Longport Street, Canterbury.

FORTHCOMING EVENTS

Saturday, June 20

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES BRANCH) (at the South-West Essex Technical College, Forest Road, Walthamstow, London, E.17), at 2.30 p.m.—Conference on "The Eye in Industry".

Monday, June 22

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Annual General Meeting.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Empire Cotton Growing Corporation. Annual Report for the Season 1940–1941. Pp. ii+18. (London: Empire Cotton Growing Corporation.) [56

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1942. Pp. 29. (Edinburgh: Zoological Society of Scotland.) [86

Other Countries

Ministério de Trabalho, Indústria e Comércio: Instituto Nacional de Tecnologia. Publicação 70: As argilas descorantes e sua ativação tecnologia, análises e aplicações. Pela Yvonne E. Stourdzé. Pp. 103. Publicação 71: Sobre uma substância graxa do litoral do Piauí. Pela Camilla Rolin. Pp. 16. Publicação 72: Desenvolvimento da técnica para a determinação do volfrâmio em seus minérais. Pela Antonietta de Larmo Cantição. Pp. 13. Publicação 73: Dosagem do fósforo pelo método de N. v. Lorenz (Com a dosagem volumétrica segundo F. Scheffer). Pela Yvonne E. Stourdzé. Pp. 40. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [26

Sudan Government: Wellcome Chemical Laboratories, Sudan Medical Service, Khartoum. Report of the Government Analyst for the Year 1940. Pp. 22. (Khartoum: Wellcome Chemical Laboratories.) [36

U.S. Office of Education: Federal Security Agency. Bulletin 1940, No. 6 (Monograph No. 8): Supervision of Elementary Education as a Function of State Departments of Education. By Helen K. Mackintosh. (Studies of State Departments of Education.) Pp. vi+86. 15 cents. Occupational Information and Guidance Service, Leaflet No. 6: Medicine. By Walter J. Greenleaf. Pp. 24. 10 cents. Vocational Division Bulletin No. 215 (Occupational Information and Guidance Series No. 7): The Individual Inventory in Guidance Programs in Secondary Schools; a Study of Present Practices in Selected Schools. By Eugenie A. Leonard and Anthony C. Tucker. Pp. v+60. 15 cents. (Washington, D.C.: Government Printing Office.) [86

Proceedings of the United States National Museum. Vol. 92, No. 3137: Descriptions of Five New Species of Chalcidoidea, with Notes on a Few Described Species (Hymenoptera). By A. B. Gahan. Pp. 41–51. (Washington, D.C.: Government Printing Office.) [86

Cornell University: Agricultural Experiment Station. Bulletin 763: Soils in relation to Fruit-Growing in New York, Part 15: Seasonal and Soil Influences on Oxygen and Carbon-Dioxide Levels of New York Orchard Soils. By Damon Boynton. Pp. 43. Bulletin 764: Consumer Buying of Potatoes and Store Offerings. By Alida S. Hotchkiss. Pp. 34. Bulletin 765: The Demand for Milk and Cream as revealed by Consumer Purchases at Retail Food Stores in New York City. By Charles J. Blanford. Pp. 47. Bulletin 767: A Study of Dairy-Farm Management in Onondaga County, 1938 and 1939. By R. W. Hoecker. Pp. 21. Bulletin 768: The Transmission of Farming as an Occupation. By W. A. Anderson. Pp. 29. Bulletin 769: Agricultural Production in New York, 1866 to 1940. By T. E. LaMont. Pp. 36. Bulletin 770: Control of White Grubs in Strawberries. By Theodore W. Kerr, Jr. Pp. 40. Bulletin 771: Measurements and Weights of One Hundred Cows in the Cornell Dairy Herd. By E. G. Misner. Pp. 21. Bulletin 772: The Winter Hardiness of some Ornamental Woody Plants in New York State. By John F. Cornman. Pp. 32. Bulletin 773: Changes in the Prices of Apples and other Fruits. By M. D. Woodin. Pp. 25. Bulletin 774: Relative Economy of Nutrients in Servings of some Commonly Used Foods. By Barnara Barber Kennedy. Pp. 18. Memoir 240: Studies on the Biology of Four Common Carpet Beetles. Part 1: The Black Carpet Beetle (*Attagenus piceus* Oliv.), the Varied Carpet Beetle (*Anthrenus verbasci* L.), and the Furniture Carpet Beetle (*Anthrenus vorax* Waterh.), by Grace H. Griswold; Part 2: The Old-fashioned Carpet Beetle (*Anthrenus scrophulariæ* L.), by Margaret Greenwald. Pp. 75. (Ithaca, N.Y.: Cornell University.) [116