radio and the weather has led to the discovery that the lowest layers of the atmosphere may sometimes bend radio wave tracks with a curvature exceeding that of the earth. Such abnormal refraction is associated with temperature inversions and marked water-vapour lapse-rates.

The use of radio-wave exploration for investigating the electrical state of the upper atmosphere has been the subject of continuous experiment in Britain since 1925. It has been found that the ionosphere is subject to a marked solar control, there being a general waxing and waning of the ionization densities in sympathy with the trend of the sunspot cycle. Transient radio echoes have also been noted from the levels of the lower ionosphere, and these have been traced to reflexions from meteor trails.

Finally, the use of sensitive short-wave receivers has disclosed the terrestrial reception of radio noise from both the sun and the stars. Sunspots are found to be powerful emitters of 5-metre waves, the emission being specially enhanced at times of visual solar flares. A continuous radio noise has also been identified as originating in the Milky Way. It is not yet known whether such galactic radio noise originates in interstellar space or in sunspot regions on the stars themselves.

SCIENCE IN THE COLONIES

AFTER reviewing some of the historical examples of the application of research to Colonial problems, Dr. J. L. Simonsen, president of Section B (Chemistry), emphasizes that only with the help of men of science could many of these be solved. While agriculture must continue to be a main industry of the Colonies, its maximum development will require research of a high order. The Colonies can, however, no longer be regarded solely as prime producers, and the introduction of other industries deriving their raw materials from agriculture will be essential. In 1942 the Colonial Products Research Council was formed to review the field of Colonial raw materials, and by research methods ascertain how fuller use could be made of them.

Large-scale industry based on plant products must look to the most abundant of these, namely, the carbohydrates, starch and sugar, as its raw materials. Starch already finds an extended application in industry, and the methods devised at Birmingham for the separation of its two constituents, amylose and amylopectin, have now rendered these products readily accessible. A detailed survey of the little-known starches of tropical Colonial countries is urgently needed. Although sucrose is the organic chemical produced on the largest scale, it has been little used as an industrial raw material apart from fermentation processes. The sucrose molecule is complex, and rapid progress of research into the production of substances of increased industrial value which is now being carried out in Great Britain and the United States cannot be expected, although some of these have been shown to have useful antifreeze, plastic and chemotherapeutic properties.

Recognition of the importance of microbiology has resulted in the decision of the Colonial Products Research Council to open a Microbiological Research Institute in Trinidad. Among the problems it is hoped to attack are those associated with soil fertility and the control of the Panama disease of bananas.

Synthetic organic chemistry has replaced many drugs previously obtained from plants; but this does not, however, diminish the need for a study by modern technique of the constituents of plants with which medicinal properties have been associated. Furthermore, it has been shown that the botanist can no longer disregard the nature of the chemical constituents in his classification of plants.

The value of improved methods of agriculture and the control of soil erosion will be neutralized if steps are not taken to prevent the large losses of the world's food supply incurred through pest infestation. If the new synthetic insecticides, D.D.T. and 'Gammexane', can be shown to be used with safety on foodstuffs, a weapon will be available which should largely eliminate this destruction by insect attack.

Of even greater importance is the control of two of the foremost insect enemies of man and animals, the mosquito and the tsetse fly. Experience with the new insecticide sprays against the mosquito indicates that the problem is not insoluble, and if by a co-ordinated attack on malaria in conjunction with the use of prophylactics, such as paludrine, meets with success, science will have made an outstanding contribution to Colonial prosperity. The control of tsetse, the transmitter of trypanosomiasis, presents a problem of far greater difficulty. The fly can be killed if brought into contact with insecticides, but it is not yet known how best this can be done. Possibly the use of smoke or smoke bombs from aircraft may be a solution; but the problem must be vigorously attacked on a scale commensurate with its magnitude.

GEOLOGY IN THE DEVELOPMENT OF THE COALFIELDS

IN conformity with the general theme of 'swords into ploughshares', the presidential address to Section C (Geology) by Dr. Murray Macgregor deals with the place of geology in the development of the coalfields. The transference of the coal mines of Britain from private to public ownership has created an entirely new set of conditions, bringing with them their own complexities and hazards and demanding vigilant and unsparing service from all concerned. The unified industry will certainly require the best scientific and technical assistance that the country can give. Scientific research applied to the numerous problems that arise in connexion with the exploitation and utilization of the coal resources of Great Britain must be more directive and more closely integrated than in the past. There are the problems connected with occurrence, distribution, structure and correlation; with vertical and lateral variations in the number and thickness of seams, in the lithology, and in the fossil content; with the size and direction of faults, the amplitude and pitch of folds, the occurrence of suites of contemporaneous igneous rocks and of intrusions, etc. There are the chemical and physico-chemical problems connected with the composition and classification of the coals, and the problems related to their preparation for the market and their economic use.

The fact that the geologist is the first link in this chain of concerted effort is too often overlooked or forgotten, and it must be emphasized that all development schemes, short-term and long-term alike, depend upon a proper and thorough knowledge and

appreciation of the relevant geological conditions. In the new era opening out, the unified coal industry, with all its potentialities and its capacity to quicken or retard the *tempo* of our whole national life, must receive all the assistance that geology can provide in planning ahead, in suggestions for economic working, in interpreting structures, in reading doubtful sequences, etc.

The task of the geologist in the coalfields is to correlate and assess all the information already available, to advise as to future developments, and to follow these up much more closely than it has been possible to do in the past. This cannot be achieved by periodic efforts or by a discontinuous service. Research in the coalfields is not a series of separate *ad hoc* pieces of investigation but a continuous service which requires a full-time staff. It is only in this way that geology can be enabled to take its proper place in the economic life of the country. It is only in this way, too, that the gaps in our knowledge of many aspects of Carboniferous geology can be filled, and a more and more broadly based synthesis built up. The coal-mining industry has now become a national trust, and it is as such that it must be regarded by all; the issues are clear-cut and indeed vital, and it is for geologists to see that geology plays its part in the difficult times ahead.

ZOOLOGISTS IN WAR AND PEACE

DR. EDWARD HINDLE, in the opening remarks of his presidential address to Section D (Zoology), mentioned that in view of the exceptional conditions under which they met, he proposed to devote his address to an account of some of the work in which zoologists had been engaged during the past few years. He first referred to war-time activities and gave a brief account of the application of the principles of animal coloration, known as camouflage, and also of some work on anti-fouling. Special attention was devoted to the contributions of zoologists to the maintenance of our food supplies, without which it is very doubtful whether the country could have been adequately fed. An important section of this work was the protection of our food stocks against animal pests, and mention was made of the work of the Bureau of Animal Population at Oxford on rodent control and the development of the Infestation Division of the Ministry of Food. The activities of the latter were dealt with at some length, since it developed as a direct result of war conditions and was staffed mainly by graduates in zoology.

Various attempts were made during the War to increase food supplies. These included extending the use of unmarketable fish which, in the English Channel alone, resulted in the production of about 1½ tons a week of excellent fish-paste from fish that was formerly wasted. The experiments at Loch Sween (Argyll) on the possibility of raising the fertility of a given area of the sea by the addition of nitrates and phosphates were also considered.

Zoologists took a prominent part in some branches of operational research. In particular, they were closely involved in the practical development of radar in connexion with gun-laying devices for anti-aircraft guns, and the development of 'H_2S', an apparatus used for the localization of targets. Eventually this was fitted in various aircraft, and its use resulted in enemy submarines being brought under control during the first half of 1943. Moreover, they did not become a serious menace again until the invention of the 'Schnorkel' in 1945.

Zoologists were found to be particularly well-fitted to cope with the early difficulties of radar, since by their training they become accustomed to handling large numbers of uncontrollable variables.

Some of the peace-time activities of zoologists were then referred to, with special emphasis on the work of entomologists in checking the serious losses in our agricultural products, stored products, and in the prevention of disease. To take only one item, the loss of grain in India, due to rodents, insects and moulds, has been estimated to amount to 12–15 per cent, and a saving of 10 per cent would be sufficient to prevent a famine. In Africa the Colonial Development Scheme, involving the expenditure of some £24,000,000 in the production of ground-nuts, would mean the use of mechanized agriculture on an unprecedented scale in that continent, and would create conditions favourable to the spread of animal pests and disease. Dr. Hindle expressed the hope that the number of professional biologists employed in this project would be commensurate with this expenditure.

The subject of taxonomy was then discussed, and the increasing difficulty of getting accurate identifications of species. An Empire Biological Service, somewhat analogous to the Fish and Wild Life Service in the United States, was suggested, as this might offer the possibility of establishing a pool of taxonomic specialists who could be attached not only to national and provincial museums in Britain, but also to corresponding institutions in the British Empire. Ultimately, this might be extended on an international basis. Finally, Dr. Hindle stressed the educational value of an academic training in zoology, which was out of all proportion to its economic possibilities; and appealed for a return to a less mechanistic training of the younger generation.

GEOGRAPHY IN WAR AND PEACE

IN her presidential address to Section E (Geography), Prof. E. G. R. Taylor points out that, while everyone admits that 'circumstances of place', that is, geography, are relevant to human history and human affairs, it remains true that geographical circumstances are normally regarded as 'accidents'; and as being, moreover, of so obvious a character that it needs no trained geographer to point them out, much less being such as to deserve analysis in detail. This over-simplified idea of geography, which can be exemplified in the writings of historians, economists, military commentators and others, is responsible for the fact that the subject receives no mention in the schemes for revised university curricula aimed at the provision of a more balanced general education embracing both science and the humanities. Nor is it included in plans for the advancement and endowment of the social sciences. The pure scientist, too, rejects geography since (except in certain limited aspects) it is not susceptible of study by the method of controlled experiment. Yet departments of geography are over-full, and chairs in geography multiply faster than they can be effectively filled. Ordinary people are recognizing that the regional differentiation of the world's surface (although they would not thus define it) lies behind some of our most crucial problems, and is at the root