measure of State organisation for redepositing and cleaning the shell-fish. Dr. Johnstone considered briefly some of the administrative problems involved.

Dr. A. T. Masterman stated that in running sterile water mussels will, in three hours, cleanse themselves of sewage organisms which have been introduced into their mantle cavity and alimentary canal with food. Mussels may be relied upon to feed at night and at a suitably low temperature. It was found that chlorine in any form was not available as a direct sterilising agent, for its presence in the water in any appreciable quantity (0·5 per million) interfered with the normal functions of the mussel, and retarded the self-cleansing processes. Efficient sterilisation of sea-water can, however, be produced by the use of chlorine, and the following process of mussel purification has been devised at Conway by the Board of Agriculture and Fisheries. Into an upper tank river-water (80,000 gallons) is pumped and allowed to settle, and the clean water is run into a lower tank, together with sufficient hypochlorite solution to produce an initial strength of three parts per million. Sterilisation of the water is effected overnight. In other still lower, shallow tanks mussels, which have been thoroughly washed, scoured, and picked over, are placed two deep on grids. The sterile water is then passed into the mussel tanks, its surplus of hypochlorite being removed during its passage by addition of sodium thiosulphate. The mussels remain in the sterile water for at least one night, and are then washed and hosed. They are left in sterile water for another night, and are then ready for packing.

Dr. E. J. Allen referred to the account given by Prof. Herdman of the establishment of a fishery for sprats on the Lancashire coast, and expressed the hope that attempts would be made to establish in this country an industry for preserving these fish in oil, as had been done on a large scale in Norway. He thought that a great deal more might be done in the way of preserving fish if the matter were properly organised. There were often gluts, when large quantities of fish were wasted which might well be saved and made available as food.

In his account of the scales of fishes and their value as an aid to investigation Prof. Meek pointed out that it had been established by a wealth of observations that the physiological processes in fishes suffer a relapse in winter, and that the seasonal diminution in the rate of growth is recorded on the scales, as in other skeletal structures. This discovery has enabled investigators to state the rate of growth, the age-composition of samples, and other important correlated facts. The method was illustrated by photographs of the scales of the herring, bass, and several Gadoids and Pleuronectids.

Dr. Masterman stated that although the great majority of scales in a Gadoid fish, *e.g.* the haddock, show the same number of annual rings, it was possible to find a certain percentage with a smaller or greater number. In large samples of haddock from the Dogger Bank and other parts of the North Sea the scales showed evidence of active growth for two separate periods of the year, the explanation of which is obscure. In the salmon the determination of age is complicated by cessation of growth at certain periods, and also by destruction of the edge of the scale at spawning. As a general rule, the zones on the scales of fishes are an expression of variations in growth dependent upon seasonal changes, but the interpretation of individual cases is full of pitfalls.

Dr. E. C. Jee reviewed the fluctuations of the herring, mackerel, and pilchard fisheries off the south-west coasts in the light of seasonal variations of hydrographical factors. The landings of herring, mainly at Plymouth in December, appear to be heavier in those years in which the sea-temperature is below the normal, but are also dependent in some way upon the preceding summer maximum. During the years 1904–11 (inclusive) the landings of mackerel, which are caught chiefly in May, seem to be correlated with the sea-temperature of that month. For the years 1905–10 (inclusive) the yields of the pilchard fishery fluctuated in the same manner as the magnitude of the seasonal salinity ranges. These are probable measures of the strength of the Atlantic current, which was therefore stronger in those seasons which were followed by a more successful pilchard fishery.

J. H. A.

BITTER PIT.[1]

THE disease of apples (and pears) known as bitter pit manifests itself externally by depressions of the surface of the fruit and internally by patches of discoloured and dead tissue. It is a disease which may make its appearance whilst the fruit still hangs on the tree, or it may declare itself in the fruit-room and even in cold storage.

This disease has been, and still is, the cause of great loss to growers. Thus it has happened not infrequently that whole consignments of apples shipped from Australia to England have developed the disease so severely as to have become unsaleable. Hence it is not surprising that so progressive a community as the Commonwealth of Australia should have instituted, with the co-operation of the State Governments, a special research into the nature of the disease, its remedy and prevention. This research, endowed for a period of four years, was entrusted to Prof. D. McAlpine, and the fourth and final report now issued testifies to the assiduity and thoroughness with which both Prof. McAlpine and his colleagues have prosecuted their inquiries. As is pointed out in the introduction to the report, when the investigations which it summarises were begun bitter pit was regarded as a mysterious disease. It is associated with the presence of no parasite, nor is it a consequence of puncture by insects of the skin of the fruit. Ewert had, it is true, advanced evidence in support of the view that bitter pit is a result of the local toxic action of copper-containing spray fluids. That hypothesis has not, however, met with general acceptance.

Our knowledge of the ætiology of this disease being so vague, we turn with interest and curiosity to learn the results of Prof. McAlpine's inquiries; but it must be confessed that although we discover much valuable and interesting information in this large and admirably illustrated volume, we fail to find the revelation of the mystery. The symptoms of the disease are described in detail; evidence is brought forward that severely pruned trees yield more pitted fruit than is produced by lightly pruned trees; that nitrogenous manures appear, albeit often to no considerable degree, to increase the pitting of fruit; that certain varieties are more resistant and certain others more susceptible to the disease—in fine, we learn much that is useful and suggestive, but of the cause or causes of bitter pit we are no wiser after than before the perusal of this monograph. We insist on this point with some emphasis because we think that it should have been made clear at the outset of the report, instead of which we find it there claimed that the research has been brought to a successful issue.

[1] "Bitter Pit Investigation. The Experimental Results in Relation to Bitter Pit, and a General Summary of the Investigation." By D. McAlpine, issued by the Commonwealth and State Governments of Australia. Fourth Report, 1914–15. Pp. 178+70 figures and coloured frontispiece. (Melbourne: The Government Printer.)

That Prof. McAlpine has made a definite and valuable contribution to our knowledge of this pathological problem will appear presently, but this is only an added reason why he would have done well to make it perfectly clear that the main problem still remains to be resolved. To conclude that the "immediate cause" of the disease is "the concentration of the cell sap" (p. 75) is not to discover a cause, but to use words the meaning of which is at least as obscure as the nature of bitter pit. Moreover, if quick-acting nitrogenous manures, which lead to sappy growth, encourage bitter pit, how may that disease be attributed to concentration of sap?

Perhaps the most valuable part of Prof. McAlpine's studies is that which demonstrates the possibility of preventing the outbreak of bitter pit in cold-stored apples. As the result of experiment, he shows that if apples be stored at a temperature of about 30° or 32° F., and if fluctuations beyond these limits be prevented, no bitter pit manifests itself during a period sufficiently prolonged to transport the fruit from Australia to Europe. This is a great gain, and the practical results accruing from it should not only pay for the cost of this elaborate investigation, but encourage the Commonwealth to promote further investigations into the origin of the disease.

A point of some interest on the scientific side of the problem is the fact that starch persists in the broken-down tissue of the pitted region of the apple pulp, whence it is concluded that the incipient but invisible stage of the disease occurs in the pre-ripening phase, or at all events during the phase in which starch gives place to sugar. This is plausible, but the opposite view is not precluded that the starch of the bitter pit arises as a result of a reconversion of sugar. In favour, however, of the view that bitter pit develops, although it is not apparent, at an early stage is the evidence obtained by subjecting suspected apples to X-rays, as a result of which it is claimed, and the claim is supported by photographs, that prospective pit areas appear on the radiographs.

Prof. McAlpine is hopeful that the loss due to bitter pit may be ultimately prevented by breeding pit-resistant varieties. It is a work worth undertaking, but nevertheless is not to be undertaken lightly, for it may prove a long business.

F. K.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE president, Prof. W. S. Boulton, delivered his address on Wednesday, September 6, to a good audience, and was followed by Prof. G. A. Lebour who described the general geology of the rocks round Newcastle.

The Permian formation, which forms such a large part of the surface geology in the neighbourhood, received special treatment at the hands of Dr. D. Woolacott, who has made it a detailed study, and brought order out of the complicated bedding He shows that the Middle Permian Beds consist of a fossiliferous, unbedded reef formation, which ran parallel to the coast of the Permian sea, and on each side of which are well-stratified, unfossiliferous limestones, which were formed in waters permeated with calcium sulphate, which afterwards formed gypsum beds. The concretionary formations found in the various beds were lucidly dealt with.

During the meeting Dr. Woolacott took the geologists to see several typical sections of the Permian beds, and exhibited interesting evidence in proof of his contentions.

The important questions of the underground mapping of prominent coal seams were dealt with by Mr. Wickham King in his plexographic model of the South Staffordshire thick seam, by Dr. G. Hickling in diagrams of the Black Mine coal of Lancashire, and by Prof. W. G. Fearnsides in maps of the Barnsley Bed.

In the afternoon a special joint meeting with Section K was held to receive the report of the Research Committee appointed to investigate the Old Red Sandstone of Rhynie, Aberdeenshire, and to hear a paper by Dr. R. Kidston and Prof. W. H. Lang describing the very interesting fossil remains found in that deposit. The present paper dealt only with one of these, *Rhynia gwynne-vaughani*, which is the oldest known peat. The plants, which were rootless and leafless, and grew crowded together, consisted entirely of a system of cylindrical stems, attaining a height of 8 in. or more, and ranging in diameter from 1 to 6 mm. The stems bore small hemispherical projections, from some of which lateral branches were developed. The aerial stems had a thick-walled epidermis with stomata, a cortex, and a simple central cylinder. Large cylindrical sporangia, containing numerous spores, were found in the peat. They were evidently borne terminally on some of the leafless aerial stems.

On Thursday there was an important joint discussion with the members of Section B, which dealt with the investigation of the constitution and classification of coal. A combined geological and chemical study was recognised by all speakers as an essential to success. There was also general agreement as to the need for more systematic and careful selection of samples, for the separate investigation of the various constituent elements of seams, and for the microscopic examination of the specimens analysed. The great national importance of the work was also emphasised. The discussion was opened by Prof. G. A. Lebour, followed by Prof. W. A. Bone, Prof. P. F. Kendall, Prof. P. P. Bedson, Dr. J. T. Dunn, Mr. D. Trevor Jones, Dr. Marie C. Stopes, Dr. G. Hickling, Prof. W. G. Fearnsides, and Prof. W. Boyd Dawkins.

At the close of the discussion Dr. J. W. Evans gave a suggestive description of a method of representing geological formations and structures in black and white on maps. Mr. Leonard Hawkes described the Tertiary acid volcanic rocks of Iceland. In places this acid series is at least 2000 ft. in thickness, and consists of tuffs, sphæro-like liparites, and obsidians, The eruptions were similar to those of post-Glacial times. The uneroded character of the liparite lavas shows how rapidly the successive basalts which submerged them were poured out. Since the close of the Tertiary volcanic period enormous denudation has obtained, and the varying resistance offered to erosive agents by acid and basic rocks has produced remarkable topographical effects.

Dr. Alexander Scott gave the results of an extensive examination of the Arran pitchstones, describing four groups varying from non-porphyritic glasses with abundant microlites of hornblende, to a more basic type with scarce phenocrysts, but with abundance of pyroxene microlites. An attempt had been made to determine the cooling histories from an examination of the field relations and the microscopic structures of the various types, and also to indicate the conditions which were responsible for such a large development of glassy intrusive rocks.

On Friday a joint meeting was held with Section E, to hear a paper by Dr. Albert Wilmore on the Northern Pennines. The structure of the range and its gaps with the intervening rock-blocks were described. The effects of the fault and fold systems on the scenery were dealt with, and many interesting problems which still leave scope for careful investigation were pointed out.