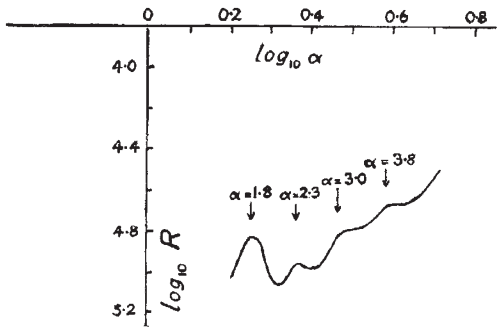

Fig. 2. Experimental scattering curve for rocksalt

$\alpha = 3{\cdot}8$, and also two more turning points in between at $\alpha = 2{\cdot}3$ and $\alpha = 3{\cdot}0$. These turning points appear at the same values of α in all our experiments, and they are therefore most likely to be due to the higher modes of vibration of the crystal scatterers.

In a cubic crystal the 'blocks' are probably also cubic in shape. The normal modes of vibration of a cube are easily calculated, as the wave numbers are proportional to the distances of the points of a cubic lattice from one of the lattice points. Accordingly, the ratios of the wave numbers are: 1, $\sqrt{2}$, $\sqrt{3}$, 2 . . ., and we should expect the values of α for the turning points of the scattering curve to have the same ratios. Starting from $\alpha = 1{\cdot}8$ for the fundamental vibration, one obtains the sequence $\alpha = 1{\cdot}8$, $2{\cdot}5$, $3{\cdot}1$, $3{\cdot}6$ . . ., which is indeed close to the observed sequence.

The preliminary results of our investigation thus show that data from the coherent scattering of visible and ultra-violet light provide quantitative information on the sub-microscopic, as distinct from the molecular, structure of real crystals. Our work is continuing with other crystals, a greater range of wave-lengths, and for different temperatures.

We have to thank the Council of the Royal Society for a government grant for the optical equipment, and the Department of Scientific and Industrial Research for a special research grant. [Dec. 2.

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BIRDS AND RODENTS IN RELATION TO AGRICULTURE

A MEETING of the Association of Applied Biologists, held on March 16 at the Imperial College of Science and Technology, London, took the form of a discussion on the relation of birds and rodents to agriculture in Great Britain. Four papers and two films were presented, and provoked considerable discussion.

A. Roebuck, of the National Agricultural Advisory Service, summarized the work of his department on the wood mouse (*Apodemus sylvaticus*), most of which was done on farms in the east Midlands; the mice were not amenable to artificial conditions, and laboratory and small-plot experiments proved difficult. The wood mouse, which does not hibernate, is generally regarded as the most abundant mammal in Britain. Under natural conditions it breeds when five months old and lives for about eighteen months; breeding continues throughout most of the year, litters following each other at intervals of rather less than four weeks. The nests are about three feet underground, with three entrances; the burrows of other rodents and moles are sometimes shared.

The wood mouse has a very varied diet; grain and legume seeds, young shoots, young flower buds, crocus corms and tree bark are eaten. Animal food also seems necessary, and in captivity it is often a cannibal. It sometimes makes extensive stores of food, especially of field beans carried to old rabbit burrows, but often does not use them. Cereal crops, especially wheat, are sometimes badly damaged during the winter. Three types of damage have been recognized: nibbling off the young shoots as they appear above ground; uprooting the young plants and eating some of the seeds and tops, and scattering the rest; and eating out the hearts of young plants. In mature crops of wheat and linseed the mice sometimes climb the stems, and at times fell them, to obtain the seeds. Many of the feeding habits were observed in the laboratory.

The mice can readily be trapped alive, and marked individuals were recaught up to two hundred yards from the point of release. They have been trapped in abundance on the 'feeding front'—a straight line across the field—in wheat crops adjacent to woods. The maximum rate of advance of this 'feeding front' was found to be five yards a night. Attacks were stopped by prebaiting and poisoning on trays protected from other mammals and birds. Rabbits graze in the same manner, so that only trapping and field observations can determine which pest is responsible. Reviewing observations during 1934–51, Mr. Roebuck stated that large fluctuations in numbers occurred; grazing of winter cereals was noticeable only in periods of abundance. Other speakers stated that wood mouse damage has been confirmed in the north and south-west of England, and in north Wales. Oats are sometimes grazed, the hearts of cauliflowers eaten, and anemone beds attacked.

A film about farm rats was followed by a paper on rats and mice by Dr. D. Chitty, of the Bureau of Animal Population, Oxford. Most of the recent work on the biology and control of the brown rat and house mouse is still unpublished, and Dr. Chitty, in addition to his own observations, used information obtained by C. S. Elton, C. S. Middleton, H. N. Southern, Miss E. M. O. Laurie and other colleagues at Oxford. Damage by rats in fields is usually small, although greenstuff is probably a necessary part of their diet; fields are important reservoirs from which farm buildings and ricks are invaded in autumn. Damage to sacked goods is obvious and often spectacular; but losses from bins and troughs may not be fully appreciated. On one farm where hens had a continual supply of dry mash, rats were found to be eating more than the hens. Rats start entering ricks soon after harvest, and some ricks may have maximal infestations of about a hundred and fifty rats in January; considering all ricks, however, the average density of rats increases throughout the first three months of the year. Breeding is continuous, and it may be that the surplus of young accounts for the belief that rats leave the ricks in spring, for many remain, however late the threshing. In the Oxford district only six per cent of ricks had no house mice in them by April; almost half had fifty or more at that time. It is estimated that about fourteen hundred tons of wheat was eaten by rats and mice in the first three months of the year, for every hundred

thousand ricks standing on January 1; this does not allow for the grain spoiled but not eaten.

Dr. Chitty described in detail a technique of rat control by prebaiting and poisoning, which was developed after the behaviour of the rat had been studied, and which proved efficacious in nearly all environments. 25,000 acres could be almost cleared of rats by one man working full time at an annual cost of 2–3*d*. per acre (1946). Maintenance of a cleared area is tedious, however, and costly in comparison with the numbers of rats killed. Cats have proved admirable in preventing serious re-infestation, though unable to deal with well-established infestations. In the discussion that followed Dr. Chitty's paper, it was stated that the risk to other domestic animals of rat poison is small if the poison is handled intelligently. There is danger if poisoned corpses are left about to be eaten by dogs and cats. New poisons, less toxic to other animals, are being investigated, particularly in the United States. Rats can wander up to five hundred yards each night, although they sometimes remain within a range of a few yards. Dr. H. C. Gough reported rat damage to growing corn; channels are made along the drills and the seeds removed.

After a film about rabbits as farm pests, Harry V. Thompson, of the Ministry of Agriculture Infestation Control Division, read a paper on rabbits and referred briefly to the other rodents of the countryside. Damage to pasture is less obvious than that to arable crops; but recent studies by Miss W. M. Phillips in Cardiganshire, on the effects of rabbits on reseeded pastures and their value as lamb grazings, have shown that grazing by rabbits caused a marked reduction in the yield of total herbage, while there was an increase in the yield of weeds. The rate of growth of the herbage and the feeding value of the pasture in terms of lamb live-weight increment were also adversely affected. Rye grasses were eaten by rabbits in preference to clover and rape. A similar experiment is being carried out at Wye College, with the emphasis on the number of sheep displaced by a population of rabbits, rather than on herbage analysis. During the first seven months of the experiment (May–November 1950), the sheep live-weight increase on the rabbit-free plots was 800 lb., compared with 650 lb. on the rabbit-grazed plots.

Mr. Thompson said that damage to market garden and arable crops is well known. Entire fields of winter wheat or oats may be grazed down to the ground in a few days or weeks, and resowing is often necessary. Damage to spring cereals is more localized, but nevertheless may seriously reduce the crop. Members of the National Agricultural Advisory Service are aware of the importance of this damage[1]; further studies are being made in a number of provinces, and demonstrations of the damage for the benefit of farmers are being arranged. Rabbits prevent the natural regeneration of forests by eating seedlings, distort the growth of trees by damaging leading shoots, and kill trees by ring-barking. Orchards are particularly vulnerable, especially when pasture is scarce, and work on rabbit-repellent substances is at present in hand in Kent.

The use of poison baits is illegal, continued Mr. Thompson, and the killing of rabbits by viruses is not considered advisable in Great Britain. The established techniques of trapping, ferreting, gassing and snaring, with the use of dog and gun, and the long net, should all be employed, according to the terrain. Research is being done on the comparative efficiency of these methods of control in different environments. Long-term observations on the place of natural predators as a factor in rabbit control are necessary. The cost of rabbit clearance is higher in areas of abundant cover, long-standing infestation and entrenched trapping industry. In such areas mutual aid and constant vigilance on the part of owners and occupiers of the land, with resort to compulsory powers under the 1947 Agricultural Act when necessary, offer the only hope of control.

In the discussion that followed Mr. Thompson's paper, the president of the Association, R. W. Marsh, remarked on the great damage to fruit plantations in south-west England; he considered that one hare does as much damage as twenty rabbits in orchards. Dr. H. C. Gough spoke of the serious grazing of winter cereals; of 14,000 acres of winter corn in Hertfordshire last year, 25–30 per cent was a failure or severely damaged by rabbits. It is estimated that only 3–10 rabbits an acre are needed continually to graze and kill cereals. Little is known of the natural incidence of rabbit diseases, and there is no convincing evidence of population cycles in rabbits in Britain.

Dr. J. W. Evans, a vice-president of the Association, then put forward for discussion his view of birds in relation to agriculture. He gave short accounts of the reported harmful activities of the wood pigeon, rook, jackdaw, carrion crow, magpie, jay, blackbird and sparrow, and examined some of the claims that have been made that birds are of value in reducing the numbers of insect pests. An impression is widely held that, because most birds that damage crops also eat insects, the harm they cause to agriculture is to a large extent balanced by the benefits they confer. Statements are often made, for example, that rooks are a factor of significance in wireworm control, yet it is certain that the proportion of the wireworm population that they may eat in a field is so small as to be of negligible importance.

Dr. Evans suggested that birds ought to be protected because they are a part of our heritage, but not on the unproved grounds of their usefulness to agriculture or horticulture. In Great Britain enough food cannot be grown for the population, nor can we really afford to import all the food at present bought abroad. Because of this, any creature that on occasion causes substantial damage to the crops should be prevented from so doing—if possible, by driving them off; and if this is impossible then they should be destroyed, not by methods of wholesale slaughter, but by reducing their numbers in areas where damage is being caused.

Economic ornithology at present rests on so much assumption and approximation that it cannot claim to rank as an exact discipline of biological science. Although knowledge exists about the control of birds, some of it is of a slender nature. After giving particulars of control measures by the use of scarers, traps and narcotics, Dr. Evans made a plea that birds should be considered on the same basis as other organisms that threaten crops and not be placed in a special category for reasons based largely on sentiment. The only way in which the present position can be changed is by the establishment of a body of fact based on scientific investigation. Excellent work of this nature is being done at the Edward Grey Institute of Field Ornithology, Oxford, and Mr. P. H. T. Hartley was to have given an account of his investigation on titmice, but a sudden illness unfortunately prevented his attendance. However, a considerable amount of discussion followed Dr.

Evans's paper, and it was obvious that the plea to dispense with sentimentality when considering birds in relation to agriculture met with general approval.

Dr. F. Raw gave an example of the reduction of an outbreak of chafers by birds; but it was agreed that birds seldom effectively reduce an outbreak of insects or rodents. Dr. C. B. Williams thought it possible that certain birds might prevent the development of outbreaks. A. Roebuck and F. H. Jacob stated that the killing of hawks and owls, in addition to stoats and weasels, in game preserves, leads to great increases in rodent populations. It was emphasized that much work needs to be done on the qualitative and quantitative estimations of bird damage, on the influence of birds on insect populations, and on the mode of action and effectiveness of bird scarers.

The importance of rodent and bird pests to agriculture was made very clear at this meeting; but it was equally obvious that both the farming community and the man of science are very ignorant on many aspects of the problem. The work done during the past ten years, however, gives confidence that the problems are not being neglected, and it is hoped that the education of the farmer will keep pace with the discoveries of science. L. B.

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SCIENCE MASTERS' ASSOCIATION

ANNUAL MEETING OF THE SCOTTISH BRANCH

THE annual meeting of the Scottish Branch of the Science Masters' Association was held in the University of Glasgow during March 28–31. Prof. J. W. Cook, regius professor of chemistry in the University, was president of the meeting, which opened with a lecture by Prof. C. M. Yonge on "The Biological Exploration of the Sea". Prof. Yonge traced the development of this study from the earliest times to the present day, and outlined some of the work being done at the marine biological stations at Naples, Millport, Plymouth and Woods Hole, Massachusetts. The great oceanographic voyages of the *Beagle* and the *Challenger* were referred to, and time was also found for mention of the work of some research voyages recently completed.

The remainder of the morning was devoted to the annual business meeting of the Branch, and in the afternoon members and guests visited the Departments of Natural Philosophy and Chemistry of the University.

In the Natural Philosophy Department, the chief point of interest was undoubtedly the 300-million volt synchrotron and its associated controls, now nearing completion. Visitors were also shown experiments on resonance effects of nuclei, using the million-volt proton accelerator, and neutron experiments using the 50-kilovolt deuteron accelerator. Research work on the methods of detection of tracks of ionizing particles is going on in the Department, and methods demonstrated included photography of tracks in the Wilson cloud chamber, tracks in photographic emulsions, scintillation counters, electronic counting methods, and a powerful 18-ton electromagnet was seen in action with proportional counters. The teaching laboratories were also visited, and the demonstration of student experiments aroused great interest.

The Department of Chemistry staged a comprehensive demonstration of work in micro-analysis, X-ray crystallography, the reactions of tropolone (a seven-membered carbocyclic compound with aromatic properties), the determination of deuterium and the study of crystal growth. The latest desk-type of Philips Eindhoven electron microscope was another centre of interest throughout the afternoon.

In the evening there was a discussion on "Should modern ideas of the structure of the atom be taught in Scottish schools, and if so, to what extent and at what stage?" The discussion was opened by Prof. J. S. Rankin, of the Royal Technical College, Glasgow, and it was continued by others putting the views of chemistry teachers, physics teachers, training college lecturers and university lecturers. While there was general agreement that modern ideas of atomic structure should be taught, there was divergence of opinion as to the stage in the curriculum at which it should be introduced and the extent of the instruction.

The second day of the meeting (March 29) opened with a lecture by Prof. J. Monteath Robertson on "Chemistry and Crystallography". Recent applications of the 'new' crystallography to organic and inorganic chemistry were discussed. This was followed by a lecture by Mr. D. Hamilton-Schaschke, engineer-in-charge, Westerglen B.B.C. transmitting station, on "The Teaching of Sound". Pointing out that the reproduction of sound, good and bad, pleasant and unpleasant, impinges on our lives to a much greater degree nowadays than it did thirty years ago, Mr. Hamilton-Schaschke made a plea for the teaching of some of the basic principles in the secondary course in schools. The topics discussed included wave motion, harmonics, pitch, intensity, timbre, reverberation and acoustics of rooms. The lecture was illustrated by the use of a double-beam cathode ray oscilloscope, loud speakers of various designs and B.B.C. turntable equipment, with special records.

On the afternoon of March 29 members of the Association were the guests of the Lord Provost and magistrates at a civic reception in the City Chambers, and in the evening some of the latest science teaching films were shown. These included "L'Oeuvre Scientifique de Pasteur" (French), "Extraction of Magnesium from Sea-water" and "The Gift of Green —Photosynthesis" (American), and three short films on the teaching of electricity (British).

On March 30 the Royal Technical College opened its doors to the Association, and Mr. James E. Matthews, of the Electrical Engineering Department, gave a lecture on "Lightning". This lecture will long be remembered by all who were present as a model of perfect timing of speech, slide projection and demonstration with high-tension A.C. voltages. The apparatus used was constructed in the College workshops and the demonstration team handled it with precision. The spark-over demonstrations were spectacular and awe-inspiring, a fitting preliminary to the visit to the Loch Sloy Hydro-Electric Scheme which followed on March 31.

The last lecture of the meeting was given by Prof. Philip I. Dee, regius professor of natural philosophy. Prof. Dee gave a description of some of the research problems being investigated in his Department, with particular emphasis on the important general features of nuclear physics illustrated by them. He gave a description of the 300-million volt synchrotron shown to members on the first day, and outlined some of the experiments he and his staff hoped to do with it. He dealt at some length