growth would be so checked and disarranged that the trees had to be cut back or reset. In cabbage, turnip, and tomato fields they were very destructive, and in strawberry-beds a great deal of harm was done. In the strawberries the injury was principally on the roots and crowns of the plants. I really think that we have little idea of the great damage done by the cutworms.

Amongst the most common species that we have in the Interior are the red-backed (*Paragrotis ochrogaster*), the greasy (*Agrotis ypsilon*), the variegated (*Peridroma saucia*), and the zebra caterpillar (*Mamestra canadensis*). Some twelve species of cutworms are known in Canada, and our list might be extended to include the following: Yellow-headed (*Hadena arctica*), spotted (*Noctua c. nigrum*), brown (*Nephelades minians*), W. marked (*Noctua clandectina*), common striped (*Euxoa tessellata*), white climbing (*Carneades scandiens*), spotted legged (*Posograti velusta*), and dingy (*Feltia subigothica*).

The poison bait is possibly the best all-round material to control the cutworms. It is best made by using 1 lb. of paris green, 50 lb. of bran, and about 3 lb. of sugar. The best way to make it is to first moisten the bran a little to cause the paris green to adhere better to it; then add the paris green and mix well. Where large quantities are needed a canvas sheet is a good article upon which to mix the paris green and bran thoroughly. Just spread the moistened bran on the canvas, sprinkle over it the paris green, and mix well by the use of a garden-rake. Then add the sugar as sweetened water. The bait should be considerably sweeter than the plants which the worms are feeding upon. I found much the best results where the bait was well sweetened and well poisoned. Apply the mash fairly dry, just so that it will almost crumble through the fingers, and apply it in the evenings. About 25 to 50 lb. of the mixture should suffice for an acre of vegetables and fruit. Where fruit-trees only have to be treated much less will be required. It is a wise precaution here to keep the mixture well away from the trees or plants, as the arsenic in the mixture will cause scalding of the bark, and in many cases I have seen trees girdled by the effects of the paris green. In the case of fruit-trees and larger plants the use of tanglefoot has given good results in some districts. Just place about an inch strip of the tanglefoot around the trunk of the tree about 6 inches to 1 foot from the ground. This has to be watched closely, lest the dust from cultivating or windstorms might destroy its effectiveness. There was a sticky tree-oil sent out by a Tacoma firm, but it did not give good results, as it melted with the heat of the sun and then crystallized. Banding the trees with cotton batten has also been used to very good advantage. Just take a tuft of batten and fasten it around the trunk of the tree, leaving it loose on top, and the worms will not climb over it. Running chickens in the orchard is also very effective in controlling the cutworms.

Cultivation methods can also be practised to assist considerably in controlling the cutworms. If we could have all weeds and plants cut down each fall a great many of the larvæ and eggs would be destroyed. Cover crops where they have to be left over winter as a protection crop is often bad for harbouring the cutworms, and when ploughed under in the spring the worms flock to the trees in the orchard. By sowing the cover crops a little later the eggs might be destroyed before the cover crop is sown. The worms make their appearance about the middle of May and are bad until the end of June. They then pupate and the egg-laying should be over about the end of August. If these dates are correct the cover crops and protection crops could be sown late in August, when they would not be likely to harbour the worms.

ECONOMIC ORNITHOLOGY.

BY LIONEL E. TAYLOR, F.Z.S., M.B.O.U.

The best definition I can find of "economic ornithology," the title of this paper, is given by Mr. T. S. Palmer in the U.S.A. Year-book of the Department of Agriculture of 1899: "Economic ornithology has been defined as the study of birds from the standpoint of dollars and cents. It deals with birds in their relation to agricul-

ture, horticulture, trade, and sport; it treats of species important to the farmer, the fruit-grower, the game-dealer, the milliner, and the sportsman; in short, it is the practical application of the knowledge of birds to the affairs of every-day life. The study of the relations of birds to agriculture is as intricate and difficult as it is broad and comprehensive. Its successful prosecution presupposes not only an accurate knowledge of classification, distribution, migration, and habits, but also an acquaintance with the measures which have been adopted for the preservation of useful or the destruction of noxious species. Theoretically, it should be one of the first branches of ornithology to receive attention; in reality, it has been one of the last."

It is as regards the value or otherwise of birds to the farmer that I wish to direct your attention. I do not claim to be an entomologist, and I do not intend to analyse the food of insectivorous birds to try and prove that this species feeds on harmful insects, and that one on useful ones. Such information is readily obtainable from the numerous valuable bulletins on the food of birds published by the Biological Survey of the U.S.A. Government and other publications. I am anxious rather to plead for a more general treatment of the subject; that is, from the standpoint of the balance of nature, to show how important it is to consider the matter from this point of view and how easily one can be led astray by ignoring it.

To first of all take the case of seed-eating birds, there is no doubt that almost any one can be shown to be a destroyer of millions of weed-seeds during the course of a year. Many people naturally think that it would only require a sufficient number of certain birds to entirely rid them of certain weeds. Nature, however, has made other arrangements by which the weeds shall remain in spite of even plagues of birds. A certain number of seeds are permitted to pass through the birds' alimentary system unharmed. Professor Collinge has recently shown this in the Journal of the Board of Agriculture, where he gives the result of experiments in the germination of seeds from bird-excrement as follows: 133 weeds of 7 species were grown from 38 droppings of the house-sparrow, 52 of 7 species from 38 droppings of the greenfinch, and 96 plants of 9 species from 50 droppings of the bullfinch; proving that seed-eating birds are greater distributers of weed-seeds than is generally supposed. He finally says: "We cannot rely on weeds being kept down by birds, and the expense of cultivation to eliminate weeds is, I believe, not reduced in the slightest by the action of birds." In conclusion, he states that he cannot regard seed-eating birds as beneficial.

Now, to take the case of insect-eating birds, I cannot do better than quote from a review of recent literature on the subject of economic ornithology in the *Auk* for January, 1913, where the writer compares the value of controlling insect pests by natural and artificial means. He says: "There is a deep-seated and persistent (because founded on love of ease) idea that if natural enemies are only sufficiently encouraged and protected, crop-production free from the annoyance of insect pests will be assured. That this is a dream impossible of fulfilment is evident from the fundamental interrelations of living things. Natural enemies have developed because there was an excess of individuals of certain species that could be destroyed without any permanent decrease in the numbers of the species as a whole. In creatures with annual or shorter generations, as is the case with most insects, all but an exceedingly small proportion of the offspring must die without participating in reproduction; the way of their taking-off is unimportant. They may as well be eaten as to starve, dry up, or freeze. Whatever happens to the supernumeraries, a small but fecund minority remains. The average number of the species is about the same from year to year. If there is an excess of individuals, under natural conditions, that satisfies the demands of enemies, without endangering the existence of the species. What an overwhelming excess of a species there must be where we give over acres or hundreds of acres to pure cultures of its favourite food-plant. No wonder there are constantly recurring outbreaks with which natural enemies are unable to deal." He further states: "When we consider the degree of insect-control necessary to the commercial

success of crops, it is evident that man must invariably depend upon his own efforts. He must know about natural enemies, give them all due credit and protect them, but we must beware of exaggerating their services. People are only too easily misled in this direction, but the final result of too great faith in natural enemies is disappointment. Let the student of natural economics see, therefore, that blame for such disappointment cannot be justly laid upon him."

These remarks are particularly applicable to fruit-growing, where hundreds of acres are planted in a confined area, furnishing an inexhaustible food-supply for scores of insect pests, which can only be controlled by artificial means and not by natural enemies, because the balance of nature has been upset. To think that any number of birds could control an attack of aphides, for instance, where ideal conditions for the feeding and propagation of these insects has been created, is out of the question. One has only to think of Huxley's well-known calculation, that one single aphis would produce in ten generations "more ponerable substance than five hundred million of stout men; that is, more than the whole population of China." It is obvious that if the birds left one or two individuals in the orchard, and nature had not provided the means for destroying them, either natural or artificial, there would not be much orchard left.

It is without thinking of these matters, certainly through want of knowledge, that there are more periodical agitations here and in many other parts of the world for the introduction of exotic birds as aids to the farmer. The question of the Government introducing birds into this Province is brought up at Farmers' Institute meetings and other meetings every year. As you are probably aware, the Government sanctioned the introduction this year of several hundred songbirds from England by the Natural History Society of Victoria. I protested as strongly as I could to the Government against such importation, but without avail, and the birds have since been liberated. The birds introduced were the European skylark, goldfinch, linnet, robin, and blue-tit.

I will now briefly put before you some facts in connection with the economic standing of these birds in other countries. In the U.S.A. Year-book of the Department of Agriculture for 1898 there is an instructive article by Mr. T. S. Palmer, of the Biological Survey, on "The Danger of Introducing Noxious Animals and Birds," in which the author says: "Species usually regarded as beneficial in their native home, such as the European skylark, green linnet, etc., are likely to prove injurious in new countries. The skylark confines its injuries mainly to turnips, eating the seed soon after it is planted. The green linnet is similarly injurious to grain. In New Zealand linnets have spread to other islands five and six hundred miles away." The following is an extract from a leading article in the *Morning Post* on the subject of the "Plague of Birds": "The green linnet is a serious nuisance to the hop-grower, settling on the hops just as they get ripe and tearing them to pieces in order to extract seed, until the whole ground is green with the fallen petals. The common or green linnet is usually regarded as a quite harmless eater of weed-seeds, but in the eastern counties he often takes heavy toll from the grower of turnip and radish seed, settling in great flocks upon the fields as the crops ripen and while they are being harvested. One Norfolk grower this autumn stated that the linnets had taken at least one-third of one of the crops of swede-seed which the weather had forced him to leave out rather longer than usual." In the guide to the birds in the British Museum (Natural History), written by Mr. W. R. Ogilvie Grant, now head of the Bird Department and one of the leading ornithologists of the day, the following occurs under the description of "Blue Titmouse" (*Parus cæruleus*): "Insects and their larvæ form the principal food, and though this diet is supplemented in autumn by fruit, the small damage done in gardens is compensated for by the wholesale destruction of insect pests." Professor Collinge, in the above-mentioned work, quotes the following charge brought against the blue-tit by one of his correspondents: "Ten years ago I should have said that a blue-tit was deserving of all protection, for its food consisted almost entirely of insects. Recently, however, I have had

cause to change my opinion of this bird, for it now picks holes in apples, pears, and strawberries, and causes a considerable amount of damage."

Mr. Collinge, however, speaks in favour of the blue-tit in spite of all that has been chronicled against it, although he arrives at this conclusion by balancing its good and its evil deeds. This is all very well for the ordinary farmer, but it is cold comfort for the fruit-grower.

From the above it will be seen that there is a chance of the skylark, linnet, and blue-tit being injurious to the farmer, and the general opinion in all countries where the acclimatization of foreign birds and animals has been attempted is that it is not wise to introduce any birds or animals of whose characters there is the slightest suspicion. Personally, I think it very unwise to introduce any seed-eating bird, such as the goldfinch and linnet, and I cannot see the object of introducing blue-tits into this country where we have several closely allied species of the same genus (*Parus*)—namely, the chickadee, already resident in enormous numbers in this Province.

In order to obtain further information on this subject, I wrote to Mr. J. Lewis Bonhote, secretary of the British Ornithologists' Union, a well-known authority on birds, asking for his opinion on the advisability of importing these birds into British Columbia. The following is Mr. Bonhote's reply: "*Re* the importation of the birds you mention, I am strongly against any such practice. Nature is so carefully balanced that one can never tell how far-reaching may be the effect of importation; in most cases, if not in all, where the imported species have thriven, the results have been bad, and the useful economic purposes for which the introduction was made have not been successful and many harmless and useful indigenous species killed off. To attempt, therefore, such a dangerous experiment for mere æsthetic purposes is, I should say, to run far too great a risk, and I would certainly advise you to oppose the suggestion as strongly as you can. To take the actual species you mention, it is difficult without knowing the country to give any definite advice; seed-eaters (goldfinch and linnet) are always risky, as, although in England those birds feed chiefly on the seeds of weeds in uncultivated districts, yet, if they did not find suitable weeds in Canada, they would soon turn their attention to the cultivated grain; where mustard is grown in any quantity, as in the fens of Cambridgeshire, the linnets do considerable damage. The robin is practically harmless, but he is a terrible fighter, and would be nearly sure to dislodge more useful native insect-eating birds. Beware of tits, especially in a fruit-growing country; they all attack the buds of fruit-trees, and also, though to a lesser degree, ripe fruit and many kinds of seeds. Larks seem to me the most harmless on your list, but, of course, they are largely seed-eaters, and I quite believe that they might do more than good. One has to remember that each country has its own fauna—which lives on each other—special flowers being fertilized by special insects, which in turn are kept in check by special birds. To introduce any strange animal, therefore, must upset the balance, and it is impossible to tell you what the effects will be. I cannot call to mind a single case of successful introduction, though there are many that have been harmful, and I am sure you would be well advised in opposing this suggested introduction as strongly as you can." This letter speaks for itself, and fully bears out my contention that there is an element of risk, and that the Government should not take any chances in allowing the importation of any foreign birds whatsoever.

The cause of all trouble where introduced animals and birds have become pests is the upsetting of the balance of nature. The reason for this was given by the Hon. John Cockburn, K.C.M.G., in a paper read by him on bird legislation in Australia at the Fourth International Ornithological Congress: "The equilibrium of life is less stable in a new country than an old. The limits of food-supply and natural enemies do not afford so rigid a check to propagation, and consequently any newly introduced form of life may, under favouring conditions, run riot throughout the land."

I think, from the remarks and quotations given, that you will agree with me that there is a chance of these so-called birds becoming a pest and upsetting the

balance of nature. Such being the case, it is the duty of scientific societies, such as this one, to protest to the Government against permission being granted to introduce any exotic birds into this country, either from æsthetic or economic considerations.

Mr. Tom Wilson: On the North Thompson the grouse is a destructive bird in orchards, as it attacks growing buds of trees. Pheasants are also a curse, and this is accentuated by the fact that they are not allowed to be shot except in season. I am a little opposed to the introduction of birds into the Province, and partly also to game birds.

Mr. Cunningham: In confirmation of Mr. Wilson's remarks, I wish to evidence the importance of destroying wild crab-apple on the Island and around Vancouver. These trees breed the oyster-shell scale. A few years ago I advocated this, but a great protest arose, accompanied by press writing. The extermination of wild crabs would materially affect the grouse, which feed on these trees. The fruit-grower was not considered.

Mr. McCubbin: There is also, I believe, a bounty on horned owls. These birds prey on mice and rats. They also destroy these game birds.

Mr. Tom Wilson: I recollect an instance when 75 per cent. of an orchard was girdled by mice and the man obtained good money for owls.

Mr. Taylor: This bounty on owls has since been removed. In regard to the mice question, in 120 acres a man had to replant 60 acres. This was not, however, the fault of the owls; the orchard was in poor shape. The starling in England is a fairly harmless bird. When introduced into Australia and New Zealand it began to feed on grapes, the natural food being absent. Cecil Rhodes in South Africa introduced the same bird. In six years it spread enormously and fed again on the grape. There is now a bounty on starlings in that country.

Mr. Creese: I must say a word to support the blue-tit. In England this bird feeds on woolly aphis and the currant bud-mite. It will also attack eggs of insects in winter.

Mr. Taylor: Quite true. Possibly 95 per cent. good and 5 per cent. harm; but to me there appears to be no object obtained in this country. The native chickadee belongs to the same genus and has the same habits; why not patronize them? Besides, the blue-tit may become dangerous.

Mr. Day: I quite agree with the folly of upsetting nature.

Mr. Winslow: Our Department in Victoria when asked for an opinion replied that, while we admitted the sentimental gain, we took the stand that the possible harm outweighed the possible good.

A member: Why not protest against the granting of permits?

Mr. Day: It is now too late to make any protest. We might draw up a resolution to present later.

It was moved and seconded, "That this Society, in view of recent researches into the economic value of introduced birds in other countries, disapproves of the practice of granting permits for the introduction of any exotic birds in this Province." Carried unanimously.

THE ECONOMIC IMPORTANCE OF CANADIAN IPIDAE.

BY J. M. SWAINE, DOMINION DIVISION OF ENTOMOLOGY, ASSISTANT ENTOMOLOGIST FOR FOREST INSECTS.

Among the Canadian species of the family Ipidæ (bark-beetle and ambrosia-beetle) are many of greater or less economic importance. Their destructive activities are along several lines in accord with their varied habits.

The bark-beetles breed in the inner bark or between the bark and the wood of healthy or dying trees. A few species prefer living trees; others prefer dying bark, but attack and kill green timber when in immense numbers; and still others are found almost solely in rapidly dying bark, or with a few species in bark that is dead and fairly dry; both coniferous and deciduous trees are attacked, but the former