BRITISH COLUMBIA ENTOMOLOGICAL SOCIETY.

MIDSUMMER MEETING, 1913.

THE first midsummer, semi-annual meeting of the British Columbia Entomological Society was held in the Court-house, Vernon, B.C., on July 18th and 19th, 1913. Between fifty and sixty individuals were present at the meetings during the session, and these included representatives from Vancouver Island, Lower Mainland, Salmon Arm, Kootenay, and Okanagan Districts. The President, Mr. G. O. Day, of Duncan, was in the chair, and the meeting was called to order at 1.45 p.m. on July 18th, 1913.

The President: I am very pleased indeed to see the splendid number of enthusiasts present here to-day at this opening meeting of the first special semi-annual gathering of this Society. I will reserve my few words of welcome to a later occasion on the programme and, without further delay, will ask Mr. John Davidson, Provincial Botanist, to present his paper on "Entomology from the Standpoint of the Botanist."

ENTOMOLOGY FROM THE STANDPOINT OF A BOTANIST.

By J. Davidson, F.L.S., F.B.S.E., Provincial Botanist.

In the course of one's botanical experience there are many occasions when some knowledge of entomology is absolutely necessary, just as to the entomologist it is necessary to know something about plants. In the short time at my disposal I propose to summarize the interrelationship of plants and insects, and if I can stimulate some of those present to make observations and notes of the interrelationships which are to be seen in our own Province, I shall be glad to render them further assistance and obtain their co-operation.

Insects spread Plant-diseases.

It is well known that insects play a very important part in the distribution of disease, and it must be remembered that most of our contagious and most dreaded diseases belong to the vegetable kingdom. In addition to bacteria, mould, and other fungi carried by contact, we find that insects such as some of the Diptera suck the putrid deliquescent mass of spore-tissue of such fungi as belong to the Phallineæ (the Stinkhorn Fungus family) and other groups. This fluid is charged with myriads of minute spores which pass uninjured through the insect, and are distributed in its excreta.

Claviceps purpurea, the ergot fungus which attacks rye and other grasses, is similarly distributed, the fungus forming a sweetish fluid, attractive to flies. During their visits the flies are liberally smeared with spores, and these on being carried to healthy grasses spread the disease.

We do not find, however, that insects are much interested in the benefit done to the fungus in spreading its spores, or in the injury done to the host in spreading the disease. The insect is more concerned about the maintenance of the individual and the propagation of its species.

In connection with the egg-laying operations of insects, there is much that is interesting regarding the indirect results. For example, some of the Coleoptera are

held responsible for much of the larch-disease (*Dasyscypha willkommii*). Beetles in boring or inserting the ovipositor into the fungus-infested tissue of diseased trees carry the minute ascospores to healthy trees and set up infection there, just as mosquitoes are believed to carry infection from one human being to another.

INSECTS PRODUCE MALFORMATIONS.

Again, the *Cecidomyia* and other gall-forming insects cause the formation of wonderful and often beautiful structures on the leaves and branches of many of our native plants. This subject is much in need of working-up. What plants do you find galls on? What insect is responsible for each? Does one species of insect produce galls on more than one species of plant? If so, are the resulting malformations similar? It is interesting to examine the structure of these galls and note the abnormal growth which has taken place, compared with the natural growth of an unaffected part. It is believed that when the egg is deposited a little fermentive fluid is exuded which stimulates the cells in the immediate neighbourhood to absorb more nourishment; this nourishment is absorbed by the young larva, which is capable of stimulating a larger number of cells to ultimately form these curious malformations known as galls.

INSECTS DESTROY MUCH VEGETABLE LIFE.

As to the depredations of the larvæ of butterflies and moths, sawflies, etc., the systematic botanist is perhaps not so severe as the economic entomologist. These insects require food, just as our cattle and horses do. Insects may be responsible for the destruction of much vegetable life, but man himself is the greatest of all sinners in this respect. Nevertheless, the botanist is interested in the causes which lead up to these depredations, which come home to him in other ways besides the increased cost of living.

We find that in nature such depredations leave us with a greater proportion of plants more able to resist attack, and if insects prefer cultivated plants rather than native plants, it is because the cultivated ones are unnatural, abnormal. Indeed, to the systematic botanist, most of our farm and orchard crops are freak specimens, which, on account of their long isolation from their natural environment, are less able to resist the attacks of their natural enemies, and without the aid of man to keep them as they are they would revert to their natural condition, or become exterminated altogether.

BATTLE BETWEEN PLANTS AND INSECTS.

All through nature we have this constant battle between plants and insects. It is not a one-sided battle; sometimes the insects win, and sometimes they lose.

Insects win.—Most people are familiar with the depredations of caterpillars, and many believe that the vegetable kingdom is pretty much at the mercy of the animal kingdom, but this is not so. We are all dependent on the vegetable kingdom, and seeing that the plant world has supported the population of the animal world for many thousands of years, it is only natural that insects should select the best food they can get from the enormous menu at their disposal.

Plants win.—Comparatively few people, however, are familiar with the depredations of plants on insects. Take, for example, the common house-fly. One of the most deadly diseases of this far too common insect is a fungus known as *Empusa muscæ*. In the north of Scotland, where this is common, I have seen within an area of two or three square yards hundreds of dead flies attached to the stems and leaves of small plants such as grasses and shepherd's purse.

The spores of this fungus are extremely small, and have a viscid coat around them. They are shot off from the ends of minute fungus-threads, and float about readily in the air. If one should come into contact with a fly, it sends a small sucker into its body and gradually begins to grow in the interior of the insect. Finally, the fly becomes weakened and settles down to rest; the fungus then pushes

out a whole mass of fine threads and fastens the fly to its last resting-place. From a layer of fungus-threads all over the body of the fly thousands of these minute spores are again shot into the atmosphere, until all the food substance in the fly is exhausted.

Some of you may have seen a dead fly on the window-pane with a halo of white around it; this halo is composed of the many threads of fungus-hyphæ fixing the fly to the glass, while it liberates its spores.

I presume that most of those present have reared larvæ of Lepidoptera. Have you ever found that some of those larvæ which pupate in soil did not go through their whole metamorphosis, but died in the pupa stage; that on the pupa a white coat appeared accompanied by minute outgrowths? This is another plant known as *Isaria*, whose spores are found in some soils. The larva when attacked is usually not killed until after it has pupated.

There are other insect-diseases of equal interest; perhaps the most curious one is what has been popularly termed the "vegetable caterpillar." This, it is explained, is an organism which at one stage of its life is actually a creeping caterpillar, and at another stage is a plant, having a root in the ground and a stem bearing fruits above the ground.

This marvellous creation is in reality a caterpillar attacked by a disease known as *Cordyceps militaris*, a fungus closely allied to *Claviceps* (the ergot-disease of grasses). In this case, however, the fungus fills up all the available space inside the caterpillar without destroying the vital organs, and the caterpillar grows to practically its full size. When it descends into the soil to pupate, the fungus kills it, and proceeds to absorb all the remaining food material. This results in the whole interior being filled by a hard woody substance composed of fungus-threads.

Later on, from one end of what was a caterpillar, a stem-like structure grows to a few inches above the surface of the ground, and this bears thousands of spores which lie about, or are blown from place to place, infecting other larvæ.

This particular species of *Cordyceps* is common in New Zealand, but is found, along with several other species, in North America.

PARASITISM V. INTRODUCTION OF DISEASE.

We have heard a good deal about parasitism as a means of combating orchard pests, but I am always sceptical as to the ultimate result of introducing new species of animals into a country, and more particularly when you introduce one lot to get rid of another.

By introducing other insects, you are introducing the food of other animals which prey on these. There is a risk of nature restoring the balance by the increase of insectivorous birds, and, as is well known, birds are recognized agents in spreading disease and insect pests, so that we may ultimately find ourselves worse in the end than we were at the beginning.

As I already mentioned, the majority of our most dreaded contagious diseases belong to the vegetable kingdom. It would be interesting to see what could be done in introducing parasitic fungi to combat insect pests. The introduction of disease amongst rats has been responsible for great havoc in reducing their numbers, and we may yet be able to treat our insect pests in a like manner.

FRIENDSHIP BETWEEN PLANTS AND INSECTS.

In the midst of the battle between plants and insects, let us not forget that there are many friendships. There is some good business transacted between the two kingdoms. I need only refer to the arrangement existing between certain insects and certain flowers, whereby the insect acts as a pollen-bearer in return for the nectar which the flower provides.

I cannot possibly enter into the various schemes, devices, and dodges adopted by flowers to attract certain insects and keep out others; this would take several days.

But I should like to refer to some very interesting partnerships where not only a temporary acquaintance is made with each other, but where both insect and plant have found it to their mutual advantage to live friendly.

Ants protect Plants.

Perhaps the most outstanding example is to be found in Mexico. The mere mention of that country may give a clue to the reason for the partnership. In Mexico there is an *Acacia* (*Acacia sphærocephala*) which is subject to the attacks of herbivorous quadrupeds. A common means of protection against these has been adopted by converting the stipules into spines. This not being sufficient, an arrangement has been made for a fierce race of stinging-ants to act as a standing army, which the *Acacia* has undertaken to keep, in peace or war.

The ants pierce the bases of the spines and eat out the interior; this stimulates the spines to increase in size, sufficient to accommodate several of these soldiers in each cavity. The *Acacia* has compound pinnate leaves, and at the tips of the leaflets small grain-like food-bodies are produced. The ants are continually running over the plant attending to these, picking and eating them when matured.

In addition to free board and lodgings, the ants are provided with free drinks, in the form of nectar exuded by minute saucer-shaped nectaries borne on the midrib of the leaf.

Altogether, the ants have some reason to defend this hospitable *Acacia*, and, in return, unwelcome visitors are accorded such a warm reception that it has proved a quite successful means of defence.

Plants protect Ants.

In tropical forests ants often find difficulty in keeping their accumulations of debris together on account of the liability of being washed away by heavy rains. These heaps are usually formed on the branches of trees because the surface of the earth is more or less swampy, but the ants have found that by including seeds and small portions of certain plants an abundance of roots ramify throughout the heap, and help to keep it together; whilst the mass of foliage covering it is sufficient to break the force of the rain, or help in diverting it from the ant's home. We find that many plants grow best in such situations, and on this account are included amongst the myrmecophilous, or ant-loving, plants.

One genus of plants, round in Malacca and New Guinea, has been named *Hydnophytum formicarum* on account of its symbiotic relationship with ants. The plant is epiphytic (living on the branches of trees), and at an early stage in its development it is attacked by black ants, who eat their way into the tuber. Ultimately a large irregular-shaped ball-like structure develops, through which a whole mass of galleries and passages ramify and anastomose, serving as a home with many doors for entrance and exit. One can readily understand that the tuber now transformed into an ant's nest will be well looked after by the inhabitants.

Ingenuity of Methods of Higher Plants.

I can only briefly refer to the insectivorous plants, and if I had time to describe the ingenious traps of *Dionæa*, *Nepenthes*, *Utricularia*, *Drosera*, and others, I think you'd agree that truth is certainly stranger than fiction.

To hear how some plants set miniature rat-traps to instantaneously capture insects; how others tempt insects by intoxicating fluid, and that when under its influence they are drowned and utilized as food; how other plants lure the unwary insect to partake of an imaginary feast only to find that the apparent drops of nectar were viscid glands on the ends of sensitive hairs which, like the arms of a gigantic octopus, envelop the struggling creature, I am sure you'd agree that their ingenuity would be hard to beat.

Many of the methods adopted by plants to prevent undesirable insects are well known, but there are many of our native plants which deserve to be more fully studied, in order to ascertain the full relationship between the entomologist and the botanist.

OPPORTUNITIES FOR ENTOMOLOGIST AND BOTANIST.

We want to know what insects are responsible for the pollination of our native plants, and what are the food-plants of their larvæ. I feel that in this particular subject much good work might be done by the co-operation of entomologist and botanist. We may see other parts of the subject from different standpoints, but it is good for us to occasionally meet on the same ground, to compare notes, with the hope that our observations may be mutually beneficial.

Mr. T. Wilson: In regard to the relation of the animal to the vegetable kingdom, in one of Darwin's writings we find that he claims that the success of the clover-crop depends on the number of cats in the district. He deduces that crops most abundant in seed occurred near villages, and that the crops were lightest some distance away. He found that the cats killed the mice, the mice destroyed the bumble-bees' nests, and as the bees were necessary to fertilize the clover, consequently the crop depends on the number of cats. Mr. Davidson also mentioned the relation of insects to plants. I remember some experiments that were carried on in regard to insectivorous plants. They took the Venus fly-trap in order to prove its carnivorous habits. Seedlings were raised, some under bell glasses, some open, and some were fed beef and scraps. The result of the experiment proved that the carnivorous diet was merely an acquired habit.

Mr. Brittain: The disease known as fire-blight is well known to be carried by insects. Bees are perhaps the greatest factor. I have found centres of blight-infestation in very isolated spots well away from other districts already infested to a marked degree. Birds will also carry the disease, for we find the blight occurring at points geographically isolated. The green aphis also spreads the disease on trees from fruit-spurs to the twigs. The apple-leaf hopper (*Empoasca mali*) is another medium of spread. Many wound-parasites, such as flies, etc., also help to spread the disease.

The Chairman (Mr. Day): Any further remarks? Before closing, I would like to say that on Vancouver Island we find many caterpillars affected with fungous diseases. The same also with ground-insects. I will now call on Professor Wilson, who has come to us to-day from the Corvallis Agricultural College in Oregon. I take great pleasure in welcoming him here to-day and introducing him to the members present.

COMBINATION SPRAYS AND RECENT INSECTICIDE INVESTIGATIONS.

BY H. F. WILSON, ENTOMOLOGIST, OREGON AGRICULTURAL EXPERIMENT STATION, CORVALLIS, OREGON.

Mr. Chairman, Members of the British Columbia Entomological Society, and Friends,—It is indeed a pleasure for me to be able to meet with you at this time, and I wish to publicly thank Mr. Brittain, your Provincial Entomologist and Plant Pathologist, who so kindly extended to me the invitation to attend this meeting. Mr. Brittain also kindly suggested my subject for me, and he tells me that it is one in which you are intensely interested.

COMBINATION SPRAYS AND RECENT INSECTICIDE INVESTIGATIONS.

I deem it advisable to explain in general and in detail the factors which have led to the study of this subject.

(1.) I consider this to be the most important problem before the farmers and fruit-growers of to-day.