MR. BRITTAIN—Importers would be only too glad to import infected stock to be cleaned here. Has anyone had any experience in fumigation by dry heat?

MR. TREHERNE—Certain experiments in the States, where mill and grain insects have been subjected to 122 degrees of dry heat have shown that all eggs, larvæ, and adults have been killed.

MR. WILKINSON—My experience with the use of CS2. in Victoria has been that it is very satisfactory. I remember fumigating a carload of beef scraps from Chicago which was alive with predaceous beetles of all kinds. The gas was highly satisfactory.

MR. LYNE—The United States will not allow raw hides coming from Australia through Vancouver into their country unless accompanied by a certificate of ours certifying that the hides have been duly fumigated by CS2.

MR. DAVIDSON—How long do you expose to fumes?

MR. LYNE—Thirty-six hours is full exposure. Less will not guarantee to kill all eggs of all species and the Mediterranean Flour Moth is also not affected by a lesser time.

MR. TAYLOR—What effect in comparison would Hydrocyanic Acid gas have?

MR. LYNE—The two gases have opposite properties in many respects and the differences account for their respective uses. Hermetically sealed cocoons of the Brown Tail Moth are not penetrated by Hydrocyanic Acid gas and many borers in root or stem or larvæ confined in their coccoons are immune the same way.

MR. CHAIRMAN—I now take great pleasure in calling upon Mr. Brittain for his paper and at the same time introducing him and welcoming him to this Province. He has recently been appointed Provincial Entomologist and Plant Pathologist for this Province and we hope as years go on he will be able to further our knowledge on British Columbia insects.

BENEFICIAL INSECTS.

by

W. H. BRITTAIN,

Provincial Entomologist and Plant Pathologist.

If we look into the history of our insect enemies we find that as far back as our records go they have been a source of annoyance and financial loss to those who make their living from the soil. As to

whether the San Jose scale and the codling moth were present in the Garden of Eden, history is silent, though some cynic has suggested that Eve presented the historic apple to Adam because she found a worm in it. However that may be, away back 1500 years before the Christian era, we hear of the ancient land of Egypt undergoing a succession of plagues, not the least trying among them, being those due to insects. Several centuries later the prophet Joel makes this pensive complaint: "That which the palmer worm hath left hath the locust eaten, and that which the locust hath left hath the canker worm eaten, and that which the canker worm hath left hath the caterpillar eaten."

Insect pests at the present time levy a heavy tax upon the farmer and horticulturist. Aside from the injuries they do our crops, they are harmful in numerous other ways. Scarcely a single product of man's activity—from lead pipes to tobacco—is immune from their ravages. In summer they transform the quiet woodland places into veritable torture chambers, and as carriers of disease they have justly acquired an evil reputation. Even in these days man's own person is liable to be invaded by several disgusting pests.

It is therefore a relief to turn from this gloomy picture and consider insects in another relation—that of man's friend and ally.

Of all the beneficial insects, the parasitic and predaceous forms are probably the most important. Those of you who have had experience in rearing insects realize to what an extent natural parasitism occurs, and those with practical orchard training are well aware of the important part played by Lady Bird beetles in keeping down plant lice. It has been said, and we have no reason to doubt it, that if it were not for the insectivorous birds the world in three years' time would be converted into a howling wilderness. However true this may be, it is certainly a fact that if it were not for the work of insect allies, all vegetation would soon be destroyed by the countless hordes of injurious forms, kept in check at present, by these silent but effective friends of mankind. The terrible depredations of the Gypsy and Brown Tail Moths in the Eastern States is evidence of how an insect, of comparatively little importance in its native home, may become a serious scourge when removed from the attentions of its own peculiar parasites.

The *Hemiptera, Neuroptera, Lepidoptera, Coleoptera, Diptera, Hymenoptera* and a few other orders contain parasitic or predaceous forms. Among the *Hemiptera* the Masked Bedbug Hunter (*Opsicaetus personatus*) is of service in destroying bedbugs and other injurious insects. In the *Neuroptera* the members of the order *Chrysopidae* (aphis lions) are probably best known. The order *Lepidoptera* contains only a few—*Feneseca tarquinius*, the larva of which feeds upon

the woolly alder aphis, is a well known species. In the *Coleoptera* the chief predaceous families are the *Coccinellidae,* the *Carabidae,* and the *Cicindelidae.* In the Diptera many species of *Tachina* flies are useful parasites, while numerous species of *Syrphidae* are predaceous on aphides. The order *Hymenoptera* probably contains more parasitic forms than all others, members of the orders *Ichneumonidae, Braconidae, Chalcidae, Proctotrupidae* and others taking part in this useful work.

Any stage in the life of the host insect may be attacked. Among the parasites of most service to man, those which attack the egg are not the least important. Hubbard, in 1880, found that a minute parasite, *Trichogramma pretiosa,* alone and unaided, almost annihilated the fifth brood of the cotton worm in Florida, 90% of the eggs being attacked. A tiny Proctotrupid, *Telenomus orgyae,* has been reared from the eggs of the White-marked Tussock Moth and *Telenomi* are known to attack the eggs of fourteen species of Lepidoptera in America. The elm leaf beetle which for several years had proved a serious pest to the elms in the vicinity of Paris, was in one season almost wiped out by an egg parasite, *Tetrastichus xanthomelaenae.* Numerous egg parasites of the Gypsy and Brown Tail have been imported into the Eastern States and have there become established.

The larval stage is particularly susceptible to attack from parasites. A Braconid *Apanteles glomeratus* has done good work against the imported cabbage worm, it having been imported from England for that purpose. Another important parasite of the same pest is a chalcis fly, *Pteromalus puparum.* The larvæ of nearly all the leaf eating caterpillars are attacked by numerous hymenopterous or dipterous parasites. Even when apparently well protected larvæ are frequently discovered and attacked by their parasites. The larva of the May Beetle (*Lachnosterna fusca*) feeding under ground upon the roots of grasses is often parasitized by a tiny Scoliid (*Tiphia inornata.*)

Though not so numerous as larval parasites, pupal parasites are, nevertheless, frequently found. The Ichneumon, *Pimpla conquisitor,* is parasitic on several species of Lepidoptera, and is an important pupal parasite of the Tussock Moth.

The imagoes of injurious insects are subject to attack from numerous predaceous forms.

Take the history of any insect pest over a number of years and it will be found to be one of epidemics alternating with periods of comparative immunity. This is due chiefly to the work of its parasites. As the host insect increases in numbers the parasites also multiply with the greater supply of food, and ultimately succeed in reducing the numbers of their host, sometimes almost to the verge of extermination.

The parasites have thus destroyed their food supply, and as they themselves are often subject to parasitism, their own numbers will be greatly reduced. The pest insect will then breed up ahead of its parasites and we eventually have another epidemic. The fact that secondary parasites are not uncommon and that tertiary and even quaternary parasitism may sometimes occur greatly complicates this whole process. On the average, however, a balance will be struck between host and parasite, the former never reaching such numbers as to destroy its food supply, and the latter never increasing so rapidly as to exterminate its host.

The utilization of parasites in insect control is a new and promising field in economic entomology. The signal success attending the introduction of the Australian Lady Bird Beetle into California, where it succeeded in checking the ravages of the dreaded fluted scale (*Icerya purchasi*), and a like happy result from the introduction of the same parasite into several other countries, gave a great impetus to this work. A determined attempt has been made by the United States Department of Agriculture and the different State legislatures concerned, to introduce and establish European parasites of the Gypsy and Brown Tail Moths. Though many parasites of these pests have been successfully introduced and much valuable work accomplished, the same degree of success has not been attained as was the case in the instance already cited. It was, of course, scarcely to be hoped that one specific parasite could be found that would be as efficient for these highly specialized insects as was the *novius* against the fluted scale. The reasons for this, as pointed out by Dr. L. O. Howard in his bulletin on the subject, are plain. The *novius* is an active insect, crawling actively as a larva and capable of flying from place to place as an adult. It is a very rapid breeder, having at least two generations to every one of the host. It feeds upon the eggs of its hosts, and, strange to say, it seems to have no parasites of its own. Its host, on the other hand, except when newly hatched, is entirely motionless and has no means of escaping or of defending itself against its enemy. These are things which do not hold good in very many cases and consequently it was hardly to be expected that such immediate results could be obtained. Those engaged in the work are convinced that the desired result will be attained when they have secured a sequence of parasites, of egg, larva, and pupa; and of forms differing among themselves in life history and method of attack, all working harmoniously together towards the same end.

The whole subject of insect parasitism, however, is so large that to discuss it any further in a paper of this general character would be out of place and would take up altogether too much time. I will therefore proceed to the next topic.

In any discussion of beneficial insects those that act as pollenizers deserve a large place. Bees, wasps, moths, butterflies, a number of bugs, some flies, and a few beetles take part in this work, so essential to most plants of economic importance. The red clover for instance cannot set its seed without the aid of the bumble bee, while the apple, pear, and many other *Rosaceous* plants depend very largely upon the honey bee for pollenation. The benefit that insects do in this way is incalculable and does much to counterbalance the ravages of injurious forms. Darwin was the first to prove experimentally that as a rule cross-fertilization is indispensable to the vigour of plants, and in his great work, Cross and Self Fertilization in Plants, cites many marvellous instances of plant adaptation to insure cross-fertilization by insects. A study of these adaptations, and of the part that insects have indirectly played, in the evolution of the plant kingdom is one of great fascination. It is, however, outside the scope of my present subject.

As scavengers insects are also of considerable service to man. They destroy vast quantities of dead and decaying animal and vegetable matter which, if left to accumulate, would soon render the globe uninhabitable. By breaking down organic matter in this way, as well as in many other respects, insects play important parts as makers of soil. They open it up to the action of the air by burrowing through it in all directions, bring up subsoil to the surface, carry vegetable matter below ground, and on dying yield their own bodies to further influence the changes that go on in the soil.

The work of insects in destroying noxious weeds is also worthy of mention. An interesting case of this came under my notice last fall. In attempting to collect a supply of seeds of the common Canada thistle I found every head the habitat of a small maggot, and had difficulty in getting a sound seed in the whole district.

Examples of this class are: The milkweed butterfly (*Anosia plexippus*); the thistle butterfly (*Pyrameis cardui*) and the purslane Sphinx moth (*Deiliphila lineata.*)

Commercially, insects and insect products have a varied and extensive use. Furnishing us with an article of dress and forming the basis of an important industry, we have the silkworm (*Bombyx mori*). The dessicated bodies of a scale insect, *Coccus cacti,* yields us cochineal, and another scale insect, *Tacchaldia lacca,* supplies us with the lac of commerce.

This subject would be incomplete without some mention of insects and their products as food. The first insect that naturally suggests itself in this connection is the honey bee, which is one of our oldest domesticated animals. Locusts from time immemorial have been

used by semi-civilized people as food. The great New Testament prophet John the Baptist is reputed to have subsisted on an exclusively insectivorous diet—locusts and wild honey. The eggs of a water bug, *Corixa,* in Mexico, are said to be much relished by the natives of that country. The manna upon which the Children of Israel fed on their long journey through the wilderness on the way to the Land of Promise is said to have been the secretion of a scale insect, and it seems safe to say, that in the insect world are to be found many undeveloped culinary possibilities, only awaiting exploitation.

The subject of insects as food for fishes is a separate study in itself. In this capacity insects are of considerable indirect benefit to man.

Still another way must be mentioned in which insects are useful to man. Even the injurious forms are not an unmixed evil. They may stimulate the farmer to more careful methods of culture. They may force him into a systematic crop rotation, which otherwise, to the detriment of his soil, he would not follow. A prominent fruit grower once told me that the advent of the San Jose scale to his district was the best thing that ever happened it, for it drove the lazy and careless men out of the business and enabled the careful growers to make some profit for their pains. There is undoubtedly something in this attitude. Though it is no argument in favour of letting foreign pests gain a foothold in our orchards, still it is encouraging to note that even the worst of them have been brought under control by the methods of modern applied entomology.

I am well aware that the facts that I have here brought to your attention are already well known to all of you. Nevertheless, the subject of pests looms so large in our daily horizon, that at least it will do no harm to review in this way the other side of the question. So that while we strive by every means in our power to rid the country of its injurious forms, we do not forget that many of our humble insect friends are doing their best in a quiet way to make the world a better place for man to live.

MR. TREHERNE—The principles of entomology relating to insect parasitism ranks in the forefront of entomological practice today. I fully expect to see the day when our systems of spraying will be reduced and our principles of breeding and distributing insect parasites will be increased. The greatest movement in the past few years has taken place with imported parasites of imported insects, but I believe we will see the day when more use will be made of such native parasites as we have. Spraying at the best is an unnatural process, but we dare not at the present day advocate otherwise.

MR. ANDERSON—I have been interested in what has been said and cannot add much. Today the Oak Tree Caterpillars are hard to find and I have no doubt their natural enemies are checking them. Fungus diseases play an important part in the natural control of insects.

MR. WILSON—In 1900 we had a severe infestation of the Cutworm, *Peridromia saucia.* Following this outbreak 90% were parasitized.

MR. ANDERSON—Yes. That was a severe outbreak. Daylight habits were adopted by the larvæ although a noctuid.

MR. BUSH—They could be heard feeding.

DR. HADWEN—I hope to have some slides to show tonight of the mite parasitism of Horn Flies.

NOTES ON XANTHIA PULCHELLA, SMITH.

This species appears to be increasing in numbers in the Quamichan district of Vancouver Island. Five years ago odd specimens only were taken, whereas in 1910, 11, and 12, it was not unusual to see five or six in an evening at "sugar." A female thus taken on October 9th, 1911, laid eggs about October 15th. The ova were deposited in batches and clusters in a chip box. Color at first greenish yellow, changing after a few days to a light grayish brown. Eggs round, with base slightly broader and top somewhat flattened. Surface shining, well sculptured by lines running from base to top where they finish in a well pronounced micropyle. Hatched February 25th to March 5th, 1912. Young larvæ with jet black shining head; body with series of spines. Head the broadest; body tapering posteriorly fairly evenly. General colour a dirty white with faint indications of lemon colour. For half the length from the head there is a distinct lavender shade which fades away gradually towards the tail. Eggshell not eaten. The young larva rests on the two anal pairs of legs and with head in the air. As soon as the young larva begins to eat the lavender shade goes and the colour becomes a uniform glaucous green. From a number of plants presented to the larvæ, rose was chosen, but chickweed and another kind of weed were nibbled at. The appearance of the larva changes considerably after the first moult. The black shining head gives place to a green one, and three whitish stripes appear, running the entire length of the body—one in the middle of the back—the others a short distance away on each side—the three enclosing the dorsal area. The spines not so conspicuous as in the first instance. They are emitted from small warts—two above the legs, two between first white line and the median line, and the same of course on the other