Ontario Department of Agriculture

Sixty-First Annual Report

OF THE

Entomological Society of Ontario

1930

PRINTED BY ORDER OF

HON. T. L. KENNEDY, Minister of Agriculture

TORONTO
Printed by the Printer to the King's Most Excellent Majesty
1931

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Entomological Society of Ontario

OFFICERS FOR 1930-31

President—DR. J. D. DETWILER, University of Western Ontario, London, Ont.

Vice-President—DR. W. H. BRITTAIN, Macdonald College, Ste. Anne de Bellevue, P.Q.

Secretary-Treasurer—REG. H. OZBURN, O.A. College, Guelph, Ont.

Curator and Librarian—MISS ROSE KING, O.A. College, Guelph, Ont.

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Auditors—L. CAESAR, O. A. College, Guelph; A. W. BAKER, O. A. College, Guelph.

FINANCIAL STATEMENT

FOR THE YEAR ENDING OCTOBER 31ST, 1930

Receipts		*Expenditures*	
Cash on hand, 1929	$ 548.47	Printing	$1,440.00
Subscriptions	646.90	Annual Meeting	18.97
Dues	193.90	Expense	85.71
Advertisements	94.92	Cuts	9.16
Back Numbers	258.27	Salaries	290.00
Government Grant	1,000.00	Reprints of Back Numbers of Canadian Entomologist	215.03
		Exchange	17.36
		Balance on Hand	666.23
	$2,742.46		$2,742.46

Respectfully submitted,

REG. H. OZBURN,
Secretary-Treasurer.

Auditors—L. CAESAR, W. E. HEMING.

Entomological Society of Ontario

REPORT OF COUNCIL

The Council of the Entomological Society of Ontario begs to present its report for the year 1929-30.

The sixty-sixth annual meeting of the Society was held at the University of Western Ontario, London, Thursday and Friday, November 21st and 22nd, 1929.

The public lecture was held in Convocation Hall.

The morning and afternoon meetings were held in the lecture amphitheatres of the Natural Science Building, the public lecture in Convocation Hall.

The faculty of the University entertained the members of the Society and their friends at a very enjoyable banquet held in the University Cafeteria.

The smoker was held in the University Cafeteria at the close of the public lecture. Dr. Dearness and Mr. Saunders, two of the older members of the Society, were present at the smoker and gave very interesting reminiscences of the early days of the Society.

The meetings were well attended by the members of the Society and a number of visitors.

The Canadian Entomologist, the official organ of the Society, completed its sixty-first volume in December last. The volume contained 293 pages, illustrated by twelve full page plates and thirty-three original figures. The contributors to these pages numbered forty-seven and included writers in Ontario, Quebec, Manitoba, Alberta, British Columbia, New Brunswick and also thirteen of the United States.

REPORT OF THE CURATOR AND LIBRARIAN

The Society's collections have been examined from time to time and the necessary steps taken to prevent injury from museum pests. At the present time they are in good condition.

Many additions have been made to the Society's library. Several new exchanges have been effected with foreign periodicals and a few missing back numbers of periodicals already in the library have been secured. The work of re-arranging and indexing the whole library has been continued.

R. KING.

REPORT OF THE MONTREAL BRANCH

The 57th Annual Meeting of this Branch was held on May 10th, 1930, in the Lyman Entomological Room, Redpath Museum, McGill University, Montreal.

The usual eight meetings were held during the season in the Lyman Entomological Room, and at the residences of Members, with an average attendance of ten. These meetings were very successful, many interesting specimens being exhibited by the members, as during the summer a number of them were keen collectors.

The following papers were read during the year:

"Systematic Entomology"—Geo. A. Moore.

"Insects attacking Garden Products"—J. T. Beaulne.

"A New species of Microlepidoptera (*Scythris winnelli*)"—A. F. Winn.

"Remarks on a Collection of Insects from Wood's Hole"—A. F. Winn.

"Hemiptera at Peake's Island during 1929"—G. A. Moore.

"The Pandora Moth (*Coloradia pandora*)"—A. F. Winn.

"Light emitted by Fireflies"—G. H. Fisk.

"*Craesus varus* (*DeVillaret*)"—J. W. Buckle.

"Review of Myer's Book 'Singing Insects' "—G. A. Moore.

"Hemiptera at Bondville"—G. A. Moore.

"Colours and Pigmentations of Butterfly Wings"—Prof. D. L. Thompson.

"Strepsiptera"—A. F. Winn.

"Relations of the Entomologist to the Doctor"—G. H. Fisk.

"Mirinae"—G. A. Moore.

The Treasurer's Report showed a balance on hand of $204.89.

The following officers were elected for the year: President, Geo. A. Moore; Vice-President, G. H. Hall; Secretary-Treasurer, J. W. Buckle; Council, A. F. Winn, G. Chagnon, A. C. Sheppard and G. H. Fisk.

J. W. BUCKLE,
Secretary.

REPORT OF THE BRITISH COLUMBIA BRANCH

(Entomological Society of British Columbia)

The British Columbia branch held its 29th annual meeting on Saturday, March 8th, 1930, in the Vancouver Hotel, Vancouver, B.C.

The programme consisted of the following papers:

Presidential Address—J. W. Winson.

"The Apple Curculio as a Pear Pest in British Columbia"—E. R. Buckell.

"New Methods of Collecting Beetles"—H. Leech.

"Observations on a Nest Building Wasp"—W. B. Anderson.

"Notes on *Phalacrocera* sp., an Aquatic Crane Fly"—G. J. Spencer.

"Notes on the Earwig in Vancouver"—R. Glendenning.

"Beetles Emerging from Timber in Buildings"—G. J. Spencer.

"Insects of the Season in Point Grey"—G. J. Spencer.

"Insect Notes of the Past Season"—R. Glendenning.

"Notes on *Aphelinus mali*, a Parasite of the Woolly Aphis"—E. P. Venables.

"Insect Notes of the Year on Vancouver Island"—W. Downes.

Officers for the year 1930-1931—Hon. President, Francis Kermode; President, J. W. Winson; Vice-President for Coast, W. Downes; Vice-President for Interior, E. P. Venables; Advisory Board, Messrs. Buckell, Eastham, Larnder, Spencer and Whittaker; Hon. Secretary-Treasurer, R. Glendenning, Agassiz, B.C.; Hon. Auditor, J. W. Eastham.

INSECTS OF THE SEASON 1930 IN ONTARIO

By Messrs. Caesar, Ross, Stirrett, Dustan, Hammond, Hall, Hudson, Baird and Schedl.

Orchard Insects

Codling Moth (*Carpocapsa pomonella* L.)—Owing to the very dry warm season and a larger percentage of a second brood, there was more sideworm injury than usual.

San Jose Scale (*Aspidiotus perniciosus* Comst.)—The dry, warm season caused considerable increase of this scale.

Plum Curculio (*Conotrachelus nenuphar* Hbst.)—Though abundant early in the season very few curculios were to be found by autumn.

Apple Maggot (*Rhagoletis pomonella* Walsh)—Though present to some extent in every fruit district there does not seem to have been any increase of apple maggot this year. It is still, however, abundant enough to require special attention.

Rosy Aphid (*Anuraphis roseus* Baker)—and Apple Aphid (*Aphis pomi* DeGeer)—Both species were very scarce.

Fruit Tree Leaf Roller (*Cacoecia argyrospila* Walker)—This leaf roller on the average seemed to be less abundant than in 1929, but egg masses have been found this fall in large numbers in a few orchards in Hastings and Norfolk.

Bud Moth (*Spilonota ocellana* D. and S.)—With rare exception the bud moth was not so destructive as in 1929.

Apple and Thorn Skeletonizer (*Simaethis pariana* Clerck.)—Contrary to our expectations this new pest was less numerous than in 1929.

Rose Chafer (*Macrodactylus subspinosus* Fab.)—In Norfolk, Essex, and Kent the rose chafer was more abundant than last year.

Climbing Cutworm (*Euxoa messoria* Harr.).—At Ruthven, Kent County an eight acre orchard of two year old peach trees was almost totally defoliated by this cutworm in May.

Gray Snout Beetle (*Anametis granulatus* Say).—Young peach trees set out last spring in a field that had been in weeds and sod the previous year were severely attacked by the beetles in May, and all the buds on several hundred trees were devoured. The beetles cannot fly and therefore

must have been present in the grass or weeds as they occurred widely over the field, which was 50 acres or more in extent. Slight injury was done in a few apple orchards, and took the form of eating the bark off the smaller branches and twigs.

ORIENTAL PEACH MOTH (*Laspeyresia molesta* Busck.).—There was a large decrease in the percentage of fruit infested by this species. The decrease was brought about by natural factors, of which aphis lions, imported parasites, and the common native egg parasite, played an important part.

PEAR PSYLLA (*Psyllia pyricola* Forst.).—This pest did very little damage this year.

EUROPEAN RED MITE (*Paratetranychus pilosus* C. and F.).—This mite was not quite so numerous as in 1929.

SILVER LEAF MITE (*Phyllocoptes schlechtendali* Nal.). — The worst outbreak of this leaf mite that has ever occurred in the province took place this year. Many thousands of trees in the Niagara district had a silvery appearance as a result of the feeding of the mite on the surface of the foliage.

GRAPE AND BUSH FRUIT INSECTS

ROSE CHAFER—See under Orchard Insects.

RASPBERRY CANE BORER (*Oberea bimaculata* Ol.).—Both raspberry and rose canes were attacked in larger numbers than usual here and there over much of the province.

SNOWY TREE CRICKET (*Oecanthus nigricornis* Walker)—Numerous egg punctures were present, especially on raspberries in the Niagara district.

RASPBERRY FRUIT WORM (*Byturus unicolor* Say.)—This beetle was more abundant than usual in the Niagara district.

RED SPIDER (*Tetranychus telarius* L.)—As one would expect in a dry season, there was considerable damage from this mite, though it was not so abundant as in some previous seasons.

VEGETABLE AND FIELD CROP INSECTS

TARNISHED PLANT BUG (*Lygus pratensis* Linn.)—In 1929 the tarnished plant bug was very abundant all over the province. This fall it was very scarce and did almost no damage. The factors which caused the reduction are not known.

SPINACH LEAF MINER (*Pegomyia hyoscyami* Panz.)—A very severe attack occurred in the Niagara district in May and June, causing thousands of dollars of loss to spinach growers. One man lost twenty-five acres.

TURNIP AND CABBAGE APHIDS (*Rhopalosiphum pseudobrassicae* Davis and *Brevicoryne brassicae* L.)—Both cabbage and turnips, especially turnips, over a large part of the counties west of Toronto, were severely injured and in some cases ruined by aphids. The insects were most abundant and destructive in September and October. *R. pseudobrassicae* seemed to be the more common, at least on turnips.

SMARTWEED FLEA BEETLES (*Systena hudsonias* Fors.)—This species was more numerous than usual and attacked a wide range of vegetable and garden plants.

PEA APHIS (*Illinoia pisi* Kalt.)—In the district around Ottawa the pea aphid was abundant. There was also some damage reported from Prescott and points East of Ottawa. Elsewhere there seems to have been little or no injury.

MEXICAN BEAN BEETLE (*Epilachna corrupta* Muls.)—Only two small infestations, one at Walsingham in Norfolk and the other at Fonthill in Welland County, were found. The insect seems to be making no headway in the province.

WIREWORMS—Severe injury was done to corn, tobacco, potatoes, tomatoes and oats in Essex, Kent and Norfolk. In the first two counties the species involved were *Ludius* and *Melanotus*.

WHITE GRUBS (*Phyllophaga* spp.)—A very heavy outbreak took place in the eastern part of the Province. In the rest of Ontario white grubs were not more numerous than in the average year.

GRASSHOPPERS—The dry, warm season has led to a decided increase in numbers. The most common species so far as observed was *Melanoplus femur-rubrum* D. and G.

ONION MAGGOT (*Hylemyia antiqua* Meigen)—This insect was less troublesome than in 1929.

CABBAGE MAGGOT (*Hylemyia brassicae* Bouche)— Less injury was done than in the average year.

CARROT RUST FLY (*Psila rosae* Fab.)—Only an occasional complaint of injury was sent in. Apparently the heavy infestation of the last few years is passing away.

SEED CORN MAGGOT (*Hylemyia cilicrura* Rond.)—A field of corn was completely destroyed in Norfolk County. The field had been in clover the previous year. At Kemptville poor germinating corn was severely injured. In Kent several fields of beans were so heavily infested that they had to be re-sown.

TOBACCO STALK BORERS or WEBWORMS (*Crambus luteolellus* Clems. and associated species)—Considerable damage was done by these webworms to corn and tobacco in Essex and Kent, some fields having to be replanted several times. In the Arcand Settlement near Kemptville the Sod Webworm (*Crambus caliginosellus* Clems.) cut off twenty-five per cent. of the young corn plants in the fields examined.

STORED GRAIN INSECTS

SAW-TOOTHED GRAIN BEETLE (*Oryzaephilus surinamensis* L.),

GRANARY WEEVIL (*Sitophilus granariae* Linne),

CONFUSED FLOUR BEETLE (*Tribolium confusum* Duval)—These three insects, in the order given, have been increasingly destructive the last few years in mills, farm granaries and flour and feed stores.

SHADE TREE INSECTS

WALNUT CATERPILLAR (*Datana integerrima* G. and P.)—This pest seems to be on the increase, at least in the extreme south-western Peninsula.

BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella* Cham.)—The birches in Muskoka were more heavily infested than for several years.

LECONTE'S SAWFLY (*Neodiprion lecontei* Fitch)—Larvae were very common on Austrian pine at Plantagenet and defoliated 60 per cent. of a group of pine trees near the Provincial Nursery.

POPLAR BORER (*Saperda calcarata* Say.)—The aspen trees in a woodlot near Berwick were heavily infested. More than 25 per cent. were killed and it is expected that the mortality will reach 75 per cent. in two years.

MISCELLANEOUS INSECTS

GLADIOLUS THRIPS (*Taeniothrips gladioli* Moulton)—This new, or at least recently named, thrip was very common and destructive to gladioli the last two years. It has been found in several cases wintering on the corms in storage.

PRAYING MANTIS (*Mantis religiosa* L.)—Many specimens were to be seen this summer at Belleville and across the Bay in Prince Edward County.

INSECTS OF THE SEASON 1930 IN NOVA SCOTIA

F. C. GILLIATT,

Dominion Entomological Laboratory, Annapolis Royal, N.S.

ORCHARD INSECTS

APPLE APHID (*Aphis pomi* DeG.)—It has been several years since this province has been so free of this species.

ROSY APPLE APHID (*Anuraphis roseus* Baker)—There was a moderate infestation of this insect over the entire Annapolis valley. Considerable damage was done in some orchards.

PEAR PLANT BUG (*Lygus communis* Knight)—There was a decided increase in the prevalence of the pear plant bug in eastern Kings county, while in Annapolis county the infestation was about normal.

BROWN TAIL MOTH (*Nygmia phaeorrhoea* Don.)—In scouting in 1929-30 no winter webs of this insect were found. It appears quite conclusive that this pest has been exterminated.

GREEN BUD WORM (*Argyroploce variegana* Hbn.)—This bud worm was less prevalent than for the past few years.

CIGAR CASE BEARER (*Haploptilia fletcherella* Fern.)—This species caused no defoliation during the present season such as occurred in small areas during 1929.

CODLING MOTH (*Carpocapsa pomonella* L.)—There has been a decided increase of codling moth over the entire Annapolis valley.

APPLE SUCKER (*Psyllia mali* Schmid.)—The winter eggs of this insect were prevalent in the spring, but it was only in a few isolated orchards that damage occurred.

EASTERN TENT CATERPILLAR (*Malacosoma americana* Fab.)—This insect was more prevalent than usual in all parts of the province.

OYSTER SHELL SCALE (*Lepidosaphes ulmi* L.)—Injury from this scale in Nova Scotia orchards was negligible.

EYE-SPOTTED BUDMOTH (*Spilonota ocellana* D. & S.)—It is quite evident that there is a downward swing of the cycle in relation to this insect. The side injury to the fruit during the present season was comparatively light.

GRAY-BANDED LEAF ROLLER (*Eulia mariana* Fern.)—This leaf roller is slowly becoming established and spreading into new districts, more especially in the sod mulch orchards. There was considerable damage to fruit in the Berwick district.

EUROPEAN RED MITE (*Paratetranychus pilosus* C. & F.)—Winter eggs of this mite were numerous in the Annapolis valley in the spring of 1930. About mid-summer it was noticed that the mites were rapidly diminishing in numbers; a plant bug was discovered feeding upon all stages of the insect. This plant bug, has been determined by Mr. G. S. Walley, of the Entomological Branch as *Diaphnida pellucida* Uhl. It was apparently responsible for the reduction.

THE DUSKY LEAF ROLLER (*Amorbia humerosana* Clem.)—This is slowly becoming established in sod orchards. It is more prevalent in the western part of the Annapolis valley.

OBLIQUE-BANDED LEAF ROLLER (*Cacoecia rosaceana* Harris)—This leaf roller has been present in about the usual numbers, no material damage occurring.

PLUM CURCULIO (*Conotrachelus nenuphar* Hbst.)—There has been a heavy infestation of plum curculio in gardens about Annapolis town, Deep Brook, and Bear River, resulting in considerable loss to plums and cherries.

TUSSOCK MOTHS (Rusty and White Marked)—Both species of Tussock moth have been abundant, the latter probably causing more injury.

THE PALE APPLE LEAF-HOPPER (*Typhlocyba pomaria* McA.)—A notable increase of leaf-hoppers has occurred in all orchards. In the Berwick district the insect has been particularly numerous. In 1930 the pale apple leaf-hopper *Typhlocyba pomaria* McA. far outnumbered the rose leaf-hopper and it now appears that this species has probably been our most common form.

APPLE AND THORN SKELETONIZER (*Hemerophila pariana* Clerck.)—A marked decrease has occurred in the numbers of this insect in Kings county. In Annapolis county there was some defoliation in neglected trees, but much less than in 1929.

APPLE MAGGOT (*Rhagoletis pomonella* Walsh)—The adult flies began to emerge at Annapolis Royal on June 30, this being the earliest date on record. This insect has increased in recent years.

THE LESSER BUD WORM (*Recurvaria nanella* Hb.)—This budmoth has been on the increase for the past two years and was the cause of many inquiries in 1930.

APPLE SEED CHALCID (*Syntomaspis druparum* Boh.)—The apple seed chalcid was quite prominent in many parts of the Annapolis valley.

FALL WEB WORM (*Hyphantria cunea* Dru.).—There was a general infestation of this species which caused more defoliation than usual.

PEAR SLUG (*Eriocampoides limacina* Retz)—This sawfly was in epidemic form at Deep Brook. It was also more numerous than usual in other districts.

CLOVER MITE (*Bryobia praetiosa* Koch.)—This mite was found for the first time in Nova Scotia orchards in 1930. The winter eggs were quite numerous in the spring.

GREEN FRUIT WORMS (*various species*).—The larvae of the various green fruit worms were more numerous than usual.

BLUEBERRY MAGGOT—Blueberries from Kings, Shelburne, Lunenburg and Yarmouth counties were found to be infested with a maggot fly belonging to the family Trypetidae. One authority has determined the adult fly as *Rhagoletis pomonella* Walsh.

FIELD AND GARDEN INSECTS

CARROT RUST FLY (*Psila rosae* Fab.)—There was less than the normal amount of injury from this insect.

CORN EAR WORM (*Heliothis obsoleta* Fab.)—The distribution of the corn ear worm was general over Nova Scotia. No serious infestations were reported.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say.)—The infestation of potato beetles was severe in 1930, particularly in parts of Lunenburg county.

TARNISHED PLANT BUG (*Lygus pratensis* L.)—This plant bug was particularly numerous in the Wolfville district and other districts, attacking many plants.

CUCUMBER BEETLE (*Diabrotica vittata* Fab.)—There was about the normal cucumber beetle population.

ZEBRA CATERPILLAR (*Ceramica picta* Harr.)—In the Wolfville and Kentville districts this insect was conspicuous, many late fields of turnips being injured and some practically destroyed.

EUROPEAN CORN BORER (*Pyrausta nubilalis* Hbn.)—Scouting revealed this insect to be present in rather greater numbers in the western part of the province than last year. It was also found in the centre of the province in Cumberland county.

POTATO FLEA BEETLE (*Epitrix cucumeris* Harr.)—Flea beetles were very numerous in 1930 on a variety of plants.

TURNIP APHID (*Rhopalosiphum pseudobrassicae* Davis). — Turnip aphids were numerous and injurious in many fields in Annapolis, Kings, Hants and Cumberland counties.

CUTWORMS.—In most parts of Nova Scotia there was an increase in the cutworm population, with more damage to seedling plants in the spring than for several years. The variegated cutworm, *Lycophotia margaritosa* Haw., was reported from Meteghan as feeding upon beets, mangolds, and other garden crops during the late summer.

IMPORTED CABBAGE WORM (*Pieris rapae* L.).—This species was abundant on cabbage and an outbreak occurred on turnips. In many fields the tops were from 25 per cent. to completely defoliated, in Digby, Annapolis, Kings and Lunenburg counties.

POTATO STEM BORER (*Hydroecia micacea* Esp.).—Many reports were received of this insect.

GARDEN SLUGS (*Limax* sp.).—Owing to the extremely dry season slugs were extremely scarce.

FOREST AND SHADE TREE INSECTS

BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella* Chamb.).—There was a severe outbreak of the birch leaf skeletonizer throughout Nova Scotia this year.

ALDER FLEA BEETLE (*Haltica bimarginata* Sax.).—In the wooded areas south of Annapolis Royal alders were in some instances completely defoliated.

SATIN MOTH (*Stilpnotia salicis* Linn.).—The satin moth was discovered for the first time in Nova Scotia at Annapolis Royal and in Digby and Yarmouth counties and in the eastern part of the province in the vicinity of Amherst. The larvae were heavily parasitized at Annapolis, one species recovered being *Compsilura concinnata* Bouche, a species liberated at several points in Nova Scotia some years ago.

BEECH SCALE (*Cryptococcus fagi* Baerns.).—In western Nova Scotia the beech scale has become quite epidemic. If the present status of this insect continues for another year or so, many valuable stands of beech will be lost.

LARCH CASE BEARER (*Haploptilia laricella* Hbn.).—In western Nova Scotia where the larches showed brown from this forest insect in 1929 there has been about a total absence of defoliation in 1930.

MISCELLANEOUS INSECTS

Campylomma verbasci Meyer.—A few years ago this mirid was observed in practically all parts of the Annapolis valley. There are two broods and the first brood adults migrate from apple to potato, where they remain for some time. In 1930 in the Wolfville district the adults literally swarmed upon potato plants and were apparently responsible for some tip burn.

IMPORTED CURRANT WORM (*Pteronidea ribesii* Scop.).—There was rather more defoliation due to the currant worm than usual, it being particularly troublesome about Amherst.

Horse and Cattle Flies were a serious pest to stock this season, being reported extremely bad in the eastern part of the province about Amherst.

There was an epidemic of Dog Fleas at Annapolis Royal.

EARWIG (*Labia minor*).—This species of earwig was taken in a house at Annapolis Royal during the year.

INSECTS OF THE SEASON 1930 IN NEW BRUNSWICK

R. P. GORHAM, L. J. SIMPSON AND G. P. WALKER

Dominion Entomological Laboratory, Fredericton, N.B.

FIELD CROP AND GARDEN INSECTS

In general, insect injury to hay, grain, turnip, mangel and corn crops was less than average; that to potatoes, peas and beans about the same as in other years and to cucumber, strawberry and ornamentals somewhat greater than average.

ARMYWORM (*Cirphis unipuncta* Haw.).—No record was received of an outbreak of army worm in 1930. Occasional specimens of larvae were found feeding on corn silk in the Maugerville-Sheffield area in early August.

BRONZE CUTWORM (*Nephelodes emmedonia* Cram.).—The outbreak of bronze cutworm on the Tantramar dyke lands appeared to be nearly ended in its third season. Less than 100 acres of grass was stripped, and that in an area somewhat isolated from the major portion of the marsh.

CABBAGE FLEA BEETLE (*Phyllotreta vittata* Fab.).—Flea beetles attacked seedling cabbage plants in seed beds and newly set plants during the last week of May in the Maugerville district.

CARROT RUST FLY (*Psila rosae* Fab.).—Larvae of the carrot rust fly caused less injury than in 1929.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say.).—The Colorado potato beetle was somewhat more abundant than in 1929 but was controlled by growers of potatoes without special difficulty.

CORN EARWORM (*Heliothis obsoleta* Fab.).—Corn ear worm occurred in the more southern portions of the province in limited numbers.

CUTWORMS.—In general, cutworms gave little trouble. They were locally abundant on a few individual farms.

DIAMOND-BACK MOTH (*Plutella maculipennis* Curtis).—This insect was seen only in small numbers.

EUROPEAN CORN BORER (*Pyrausta nubilalis* Hbn.).—Corn borers found in 1930 numbered approximately one-third the number found in 1929. Larvae, pupae, or traces of injury were found on six farms scattered over three counties; total stalks infested or injured, twenty.

HORSE-RADISH FLEA BEETLE (*Phyllotreta armoraciae* Koch.).—Horse-radish flea beetle was found abundant on horse-radish foliage in a Fredericton garden early in May, the first record of the insect's presence in the region.

IMPORTED CURRANT WORM (*Pteronidea ribesii* Scop.).—This usually common insect was conspicuous by its absence in 1930.

IRIS BORER (*Macronoctua onusta* Grote.).—A field of wild iris on the shore of Cocagne bay, Kent county, was found infested in July, the first occurrence of iris borer noted in the province.

ONION MAGGOT (*Hylemyia antiqua* Meig.).—This common pest was not seen at Fredericton in 1930. One report of injury was received from Bathurst, N.B.

PEACOCK FLY (*Straussia longipennis* Wied.).—Larvae of peacock fly caused considerable injury in the stems of garden sunflowers at Fredericton.

PLANT BUG (*Cosmopepla bimaculata* Thomas.).—This bug appeared in large numbers on the flower stems of snapdragon at Fredericton in August.

POTATO FLEA BEETLE (*Epitrix cucumeris* Harr.).—Potato flea beetle was present through the St. John valley district.

ROSE LEAFHOPPER (*Empoa rosae* L.).—Many roses were seriously injured by rose leafhopper. It appeared at Fredericton May 12th, and continued active over a long period.

SEEDCORN MAGGOT (*Hylemyia cilicrura* Rond.).—Seedcorn maggot was very scarce at Fredericton.

STRAWBERRY WEEVIL (*Anthonomus signatus* Say).—Weevils caused severe injury to the buds of strawberry on one Prince Edward Island farm and were reported from other places on the Island and in New Brunswick. They also cut the buds from raspberry, causing a marked loss of crop.

STRIPED CUCUMBER BEETLE (*Diabrotica vittata* Fab.).—Cucumber beetles caused severe injury to cucumbers and squash in the Maugerville and Sheffield districts.

TARNISHED PLANT BUG (*Lygus pratensis* L.).—Tarnished plant bug was more abundant and injurious than in other years. Dahlias and Centaurea were most seriously injured.

WHITE GRUBS (June bettles) (*Phyllophaga* sp.).—While present in many places, no special injury by white grubs was noted. An extensive flight of June beetles, *Phyllophaga anxia* Lec. occurred.

ZEBRA CATERPILLAR (*Mamestra picta* Harr.).—This insect was seen in small numbers in many places, chiefly on low marsh lands. It caused no particular damage.

FOREST AND SHADE-TREE INSECTS

BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella* Chamb.).—The birch leaf skeletonizer appeared in outbreak form this season, its distribution being quite general throughout the province.

BIRCH SAWFLY LEAF-MINER (*Phyllotoma nemorata* Fallen).—The birch sawfly leaf-miner appeared but the infestation appears to be decreasing in New Brunswick this season.

Dreyfusia piceae Ratz.—In the southern part of the province, *Dreyfusia piceae* Ratz. on balsam trees has become quite noticeable.

FELTED BEECH COCCUS (*Cryptococcus fagi* Baernsp.).—The beech coccus appears to be still in outbreak form in Westmorland and Albert counties and is spreading slowly.

FALL WEBWORM (*Hyphantria cunea* Drury).—The fall webworm appeared throughout the province and seems to be increasing in abundance.

LARCH CASE BEARER (*Coleophora laricella* Hb.).—The outbreak of larch case bearer has decreased considerably this season in New Brunswick. Very little damage to larch trees was observed.

LARCH SAWFLY (*Lygaeonematus erichsoni* Hartig).—No injury to larch trees was observed in New Brunswick this season.

MOTTLED POPLAR AND WILLOW BORER

(*Cryptorhynchus lapathi* L.).—The mottled poplar and willow borer caused considerable injury to Carolina poplars at the Goold Nursery in Sussex.

ORCHARD (EASTERN) TENT CATERPILLAR (*Malacosoma americana* Fab.).—The orchard tent caterpillar was quite abundant throughout the province and appears to be increasing.

PINE BARK APHID (*Pineus strobi* Htg.).—Young white and red pines in the provincial nursery were heavily infested with this species this season.

SPINY ELM CATERPILLAR (*Euvanessa antiopa* L.).—The infestation of spiny elm caterpillar on elm in New Brunswick was about average. No severe defoliation was reported or observed.

SATIN MOTH (*Stilpnotia salicis* L.).—The satin moth appeared in outbreak form on Carolina poplars in the city of Moncton, the trees in some cases being completely defoliated. A survey showed the insect to be present at Sussex and St. Andrews in small numbers.

SPRUCE GALL APHIDS (*Adelges* spp.).—Spruce gall aphids were very abundant during the season on young growth spruce trees throughout the province.

UGLY-NEST CATERPILLAR (*Cacoecia cerasivorana* Fitch).—The ugly-nest cherry tortrix appeared this season in outbreak form in certain localities and appears to be increasing.

FRUIT INSECTS

APPLE APHID (*Aphis pomi* DeG.).—The apple aphid was present in outbreak form generally throughout the province and in many sections caused considerable injury to the fruit.

APPLE LEAFHOPPER (*Empoasca mali* LeB.).—A general outbreak of apple leafhopper was experienced throughout New Brunswick this year. The infestations were particularly severe in the lower St. John river valley and on the north shore.

APPLE AND THORN LEAF SKELETONIZER (*Simaethis pariana* Cl.).—This insect appeared in heavy outbreak form near St. Stephen, Charlotte county, and French lake, Sunbury county. It also appeared in lesser numbers in several other sections.

APPLE LEAF SEWER (*Ancylis nubeculana* Clemens).—The apple leaf sewer has apparently increased considerably, especially in the French Lake section of Sunbury county and in Northumberland and Kent counties. The infestations have not as yet reached serious proportions.

APPLE MAGGOT (*Rhagoletis pomonella* Walsh).—The apple maggot was found in several sections of the province, in small numbers, where it has never been noted before. The older infestations were apparently increased over 1929.

BUFFALO TREEHOPPER (*Ceresa bubalus* Fab.).—A few new egg scars of buffalo treehopper were noted at French lake, Sunbury county, and at Cambridge. A number of minor infestations in other sections have died out.

CIGAR CASE BEARER (*Coleophora fletcherella* Fern.).—Several light infestations of this insect were noted in Sunbury county at Burton and French lake, and in Charlotte county on the 'Ledge' road.

CODLING MOTH (*Carpocapsa pomonella* L.).—The codling moth has increased considerably in untreated orchards throughout the province.

EASTERN (ORCHARD) TENT CATERPILLAR (*Malacosoma americana* Fab.).—Noted as generally increased throughout the province.

EUROPEAN RED MITE (*Paratetranychus pilosus* C. & F.).—The European red mite is present in apple orchards throughout the province. Although the infestations increased very rapidly from 1928 to 1929 there is a decided decrease in some sections this year.

EYE-SPOTTED BUD MOTH (*Spilonota ocellana* D. & S.).—Quite heavy infestations of eye-spotted bud moth were noted in untreated orchards of Sunbury county and Northumberland county. There has, apparently, been a noticeable decrease in the St. John river valley.

FALL WEBWORM (*Hyphantria cunea* Drury)—A decided increase has occurred in the abundance of the fall webworm in New Brunswick this year. It has been very prevalent in orchards and on roadside chokecherries.

FALL CANKER WORM (*Alsophila pometaria* Harr.).—The fall canker worm was not noted in New Brunswick this year nor were any reports of its presence received.

FRUIT WORMS—A further increase in the prevalence of these fruit feeders has been noted this year.

GREEN APPLE BUG (*Lygus communis* Knight).—Although the green apple bug has decreased in several sections of the province, it has increased to a noticeable extent at Douglas, York county.

LESSER APPLE WORM (*Laspeyresia prunivora* Walsh).—Somewhat decreased generally, especially where increases were noted last year at French lake, Sunbury county, and Springhill, York county.

OYSTER-SHELL SCALE (*Lepidosaphes ulmi* L.).—The oyster-shell scale has not increased appreciably this year anywhere in the province but has apparently decreased in some sections.

PEAR LEAF BLISTER MITE (*Eriophyes pyri* Pagnst.).—Minor outbreaks of pear leaf blister mite have been noted at French lake and Burton in Sunbury county; Maple Glen and Douglasfield in Northumberland county; and at Douglas and Mouth of Keswick in York county.

PEAR SLUG (*Eriocampoides limacina* Retz.).—Plum trees at Maple Glen, Northumberland county, and English cherries at French Lake were heavily infested with pear slug this year.

RED-HUMPED CATERPILLAR (*Schizura concinna* S. & A.).—Only a few scattered clusters of red-humped caterpillars were noted in the St. John river valley.

WHITE-MARKED TUSSOCK (*Hemerocampa leucostigma* S. & A.).—The white-marked tussock has been on the increase in New Brunswick for several years but in 1930 was present in fewer numbers than in 1929.

YELLOW-NECKED CATERPILLAR (*Datana ministra* Drury).—This insect was generally more abundant than for several years, especially in the St. John river valley.

INSECTS OF THE SEASON 1930 IN QUEBEC

C. E. PETCH, HEMMINGFORD, P. Q. AND G. MAHEUX, QUEBEC, P. Q.

WHITE GRUBS (*Phyllophaga anxia* Lec.).—White grubs caused important injury over southern, central and western Quebec during the year. An important June beetle flight occurred over the district north of Montreal, extending between Beaconsfield, Oka and St. Jerome. Injury from first year white grubs, which developed from eggs deposited by the beetles in June, appeared in sod during the latter part of the summer. Second year grubs were general in the Gatineau valley, where they caused important local injury.

GRASSHOPPERS (*Melanoplus femur-rubrum* DeG. et al.).—Grasshoppers were destructive to grains and grasses at Hemmingford, Clarenceville and several points just north of Montreal Island. Tobacco was seriously injured in the Yamaska valley and young apple trees were severely injured near Hemmingford. Grasshoppers were numerous on sandy soils all over the province but not much damage was done in eastern Quebec due to lateness in development.

ZEBRA CATERPILLAR (*Ceramica picta* Harr.).—Damage to field turnips, cabbage, buckwheat, potatoes and strawberry plants were estimated at from 10% to 50% in the counties of Nicolet, Drummond and Arthabaska due to this insect.

CARPENTER WORM (*Prionoxystus robiniae* Peck).—This wood-borer is especially injurious to soft maple (*Acer saccharinum*) in the district of Montreal. It appears to cause some trouble wherever soft maple is growing in the southern part of this province.

FALL WEBWORM (*Hyphantria cunea* Drury).—The increase was very marked over 1929. They were found commonly in Hemmingford, Clarenceville, Lachute, Oka and around Montreal. Fall webworm tents were very numerous in the Laurentian Mountain district of Terrebonne, Montcalm and Argenteuil counties in August and early September.

CALLOUS BORER (*Conopia acerni* Clem.) causes trouble by enlarging and preventing wounds on maple caused by carpenter worms from healing properly. It was quite common on the Island of Montreal.

POPLAR BORER (*Saperda calcarata* Say.).—This borer is widely distributed throughout the province causing injury to poplars.

CRANBERRY ROOTWORM BEETLE (*Rhabdopterus picipes* Oliv.).—The adults were conspicuous on black alder, wild grape and certain other shrubs at Hemmingford, while at Oka the beetles were very common on wild grape.

LARCH SAWFLY (*Lygaeonematus erichsoni* Hartig.).—The larvae were observed at Hemmingford and Clarenceville and in the latter place completely defoliated a four-acre stand of larch.

SMALL BRONZE BEETLES (*Brachys* spp.).—These small bronze beetles were very common on the foliage of linden (*Tilia americana* Z.) in the vicinity of Hemmingford and Oka.

BIRCH LEAF MINER (*Fenusa pumila* Klug).—The injury of this species was observed at practically every point in the central, southern and western sections of the province this year, where stands of scrub birch were common.

TENT CATERPILLARS (*Malacosoma* spp.)—are on the increase around Montreal, whereas the white-marked tussock moth (*Hemerocampa leucostigma* S. & A.)—is decreasing around Quebec. The Poplar Aphis (*Pemphigus betae* Doane) was reported as troublesome in several localities and the spiny elm caterpillar (*Aglais antiopa* L.) injured trees to an extent of 25 % in Parc Lafontaine, Montreal, and 5% around Quebec City.

LARKSPUR LEAF MINER (*Phytomyza delphiniae* Frost).—The injury at Hemmingford was severe this year. Both larkspur (*Delphinium sp.*) and monk's hood (*Aconitum* sp.) were attacked but the injury to the latter was unimportant.

MOSQUITOES (various genera and species).—Attacks from mosquitoes were very severe this year, extending to a much later date than ordinarily.

PEAR SLUG (*Eriocampoides limacina* Retz.).—Injury was observed at Lacolle and Oka to groups of trees growing close together.

APPLE MAGGOT (*Rhagoletis pomonella* Walsh).—This insect occurred in every apple growing district. The most serious injury was at Covey Hill and Franklin Centre.

APPLE CURCULIO (*Tachypterellus quadrigibus* Say).—This curculio continues to be the most troublesome insect in many orchards. The plum curculio has not been very injurious for a number of years.

CODLING MOTH (*Carpocapsa pomonella* L.).—In the vicinity of Quebec it is on the increase, whereas, in the Montreal area it is stationary.

BUDMOTH (*Spilonota ocellana* D. & S.).—This insect is on the decrease around Quebec and increasing in Montreal orchard areas.

CIGAR CASE-BEARER (*Haplotilia fletcherella* Fern.)—caused 5% injury to apple at Oka, whereas the Cherry Case-bearer (*Haplotilia pruniella* Clem.) was greatly reduced in Ville LaSalle.

RASPBERRY CANE-BORER (*Oberea bimaculata* Oliv.).—The beetle was very abundant over a wide section of southern Quebec.

STRAWBERRY WEEVIL (*Anthonomus signatus* Say).—This weevil did damage on the Island of Orleans and the Beaupre Coast varying from 10 to 30 per cent.

CABBAGE MAGGOT (*Hylemyia brassicae* Bouche) was common over the province causing a loss of 10 per cent. and the imported cabbage worm (*Pieris rapae* L.) caused from ten to fifteen per cent. damage.

ONION MAGGOT (*Hylemyia antiqua* Mg.)—caused damage estimated at 10-20 per cent. and the carrot rust fly (*Psila rosae* Fabr.) caused 5-10 per cent. injury to carrots in the Montreal district.

CUTWORMS destroyed tobacco in the northern part of the province to the extent of 5-10 per cent., in the southern area 10 per cent., but in the county of Vercheres 50 per cent.

PEA APHIS (*Macrosiphum pisi* Kalt.).—This insect was very injurious to canning peas in the counties of Napierville and St. Johns.

STRIPED CUCUMBER BEETLE (*Diabrotica vittata* Fabr.).—This insect caused injury, north of Montreal, to cucurbids.

INSECTS OF THE SEASON 1930 IN MANITOBA

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FIELD CROP INSECTS

GRASSHOPPERS.—These insects are increasing in numbers. The clear-winged grasshopper *Camnula pellucida* Scudd., the lesser migratory grasshopper *Melanoplus mexicanus mexicanus* Saussure, the two-striped grasshopper *Melanoplus bivittatus* Say and the red-legged grasshopper *Melanoplus femur-rubrum* DeG. are the most common. It is possible that in a few restricted areas crops may be injured next year. The autumn was dry and warm which favored the laying of numerous eggs.

GREEN BUG (*Toxoptera graminum* Rond.).—This with us is a new pest recorded in Manitoba for the first time this year. Its attack was wholly confined to late oats. The loss while severe locally, did not exceed a few thousand dollars. The species seems to have been confined to the western portion of the province although it was found in the Bowsman locality.

ENGLISH GRAIN APHID (*Macrosiphum granarium* Kby.).—This was common on oats.

WHITE GRUBS (*Phyllophaga* sp.).—There was a heavy flight of beetles and the many patches of dead grass in pasture fields indicated that there had been an unusual number of larvae present in 1929.

TRIANGULAR FLEA BEETLE (*Disonycha triangularis* Say).—The most serious limiting factor to sugar beet tonnage per acre in Manitoba was the triangular flea beetle which cleaned off the beets as soon as they appeared above the ground at Lilyfield and probably at other places north of Winnipeg.

BEET WEBWORM (*Loxostege sticticalis* L.).—Reports of great numbers of these larvae were received from a few localities including Lauder. One group of larvae was one eighth of a mile long.

CUTWORMS.—The red-backed cutworm, *Euxoa ochrogaster* Guen., and others were present over a wide area and were more or less injurious to field crops in all the western half of the province from a line drawn from Morden to Portage La Prairie and then north and west to Swan River.

BERTHA ARMYWORM (*Barathra configurata* Walk.).—This insect was conspicuously scarce in 1930.

WHEAT STEM MAGGOT (*Meromyza americana* Fitch).—This insect was much less conspicuous this year.

WHEAT STEM SAWFLY (*Cephus cinctus* Nort.).—The area over which this insect occurred was greater than last year, this being due to the relatively larger acreages of spring wheat over durum wheat. The loss from this insect was light.

GARDEN INSECTS

SIX-SPOTTED LEAFHOPPER (*Cicadula* 6-*notata* Fall.).—This insect attacked turnips in the vicinity of Treesbank.

TRIANGULAR FLEA BEETLE (*Disconycha triangularis* Say.).—These insects were more numerous than usual. They attacked spinach, garden beets, sugar beets and mangels and were found at Winnipeg, Birds Hill, Oak Bank and Warren from June 11 to July 2.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata* Say.).—The Colorado potato beetle was moderately abundant throughout the province and showed an increase over last year.

ROSE CURCULIO (*Rhynchites bicolor* Fab.).—At the Treesbank laboratory more complaints were received about this insect than about any other pest. It was a widespread insect.

CUTWORMS.—Garden plants were attacked in many parts of the province from Winnipeg westward. They were more numerous than in 1929.

COLUMBINE BORER (*Papaipema purpurifascia* G. & R.).—It was rather widespread and troublesome to columbine growers.

IMPORTED CABBAGE WORM (*Pieris rapae* L.).—It was widespread and destructive doing most harm in the southern part of the province.

ONION MAGGOT (*Hylemyia antiqua* Meig.).—This insect was probably not quite so abundant as in 1929, although it was still widespread but local.

TURNIP MAGGOT (*Hylemyia cruciferа* Huck.).—Turnips, cabbages, and cauliflowers were attacked in the Winnipeg area. Turnips were badly scarred when harvested.

SEED CORN MAGGOT (*Hylemyia cilicrura* Rond.).—Eleven acres of beans in East Kildonan grown for a canning factory were entirely destroyed by this insect. The insect was also reported in beans at Morden.

FRUIT INSECTS

CURRANT APHID (*Myzus ribis* L.).—This insect was widely distributed and moderately destructive.

CURRANT FRUIT FLY (*Epochra canadensis* Loew.).—Reports of injury to currants were received from Norwood and Cracknell.

RED SPIDER (*Tetranychus telarius* L.).—The dry summer favored the development of red spider with the result that black currants, red currants and raspberries were again severely injured. Innumerable other plants were attacked including such vegetation as spruce trees, cucumbers, peas and dahlias, as well as low shrubs and herbaceous plants in woodlands.

FOREST AND SHADE TREE INSECTS

CARAGANA PLANT BUG (*Lopidea dakota* Knight).—Caragana hedges in Winnipeg and Neepawa vicinity were injured through the feeding habits of this red colored plant bug.

PINE NEEDLE SCALE (*Chionaspis pinifoliae* Fitch).—Spruce were injured at Carberry, Virden and Winnipeg and doubtless at many other points as this insect is widely distributed over the province.

ASPEN POPLAR LEAF BEETLE (*Lina tremulae* Fab.).—This insect is on the increase.

WESTERN WILLOW LEAF BEETLE (*Galerucella decora* Say.).—Willows were defoliated over rather a wide area in the north from Dauphin to Swan River.

FALL CANKERWORM (*Alsophila pometaria* Harris).—In the Winnipeg area especially, cankerworms defoliated thousands of street, park and woodland trees. Selkirk, Winnipeg Beach, Dauphin, and Swan Lake were other points where cankerworms were injurious.

LIME TREE SPANWORM (*Erannis tiliaria* Harris).—The outbreak of this insect mentioned in previous reports apparently has entirely subsided.

SPRUCE BUDWORM (*Cacoecia fumiferana* Clem.).—Larvae were collected from spruce on the grounds of the Manitoba Agricultural College. This is not a serious pest here at present.

BOXELDER LEAF ROLLER (*Gracilaria negundella* Cham.).—Considerdamage was done by this insect to box elder in shady situations.

BIRCH LEAF SKELETONIZER (*Bucculatrix canadensisella* Cham.).—This insect almost wholly defoliated birch trees in the Spruce Woods Timber Reserve near Onah.

BROWN-HEADED SPRUCE SAWFLY (*Pachynematus ocreatus* Harrington).—It is widespread in its distribution and injurious to the needles of spruce.

HOUSEHOLD AND LIVESTOCK INSECTS

MOSQUITOES.—Immediately outside of the Winnipeg area which was continuously and thoroughly oiled, mosquitoes were numerous and troublesome. In the western part of the province in general they were not troublesome except in the vicinity of marshes.

FUNGUS GNATS (MYCETOPHILIDAE).—Reports of injury to house plants were received from Arden, Franklin, Kirkfield, Moline, Strathclair and Winnipeg. This insect is an important pest on house plants.

BULL DOG FLIES (TABANIDAE).—They were abundant in the vicinity of bogs and marshes.

STABLE FLY (*Stomoxys calcitrans* L.).—An unusually severe outbreak of this livestock pest was experienced over an extended area.

HORN FLY (*Haematobia irritans* L.).—They were very plentiful, causing much annoyance to cattle.

BOT FLIES (*Gastrophilus* spp.)—All three species of bot flies were plentiful.

OX WARBLE FLY (*Hypodermis bovis* De G.).—This pest seems to have been more troublesome than usual.

ANTS.—Lawns were injured, plants were infested and houses were invaded throughout the summer. Inquiries were received concerning the control of these pests from at least nine widely scattered towns in Manitoba.

INSECTS OF THE SEASON 1930 IN SASKATCHEWAN

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In Saskatchewan, the outstanding feature of 1930 entomologically, and a very important matter to general agriculture, was the outbreak of cutworms, involving chiefly the pale western cutworm in prairie areas, and the red-backed group through the forested belt. Wireworms and the wheat-stem sawfly were also, as usual, major pests. Grasshoppers, though markedly increasing, and now threatening scattered outbreaks, were not yet of major importance.

The exceptionally high rate of damage by many pests was evidently connected with weather conditions, which were generally dry and otherwise unfavourable to crops.

FIELD CROP PESTS

Preliminary estimates indicate that the general rate of damage by the major insect enemies of field crops in 1930 approached, or exceeded, that of 1926, and was much greater than during any of the intervening seasons. Cutworms accounted for nearly half of this, a matter of over four percent, (average for Saskatchewan as a whole). Of this amount, somewhat more than half was due to the extensive and severe ravages of the pale western cutworm, it is very roughly estimated. Wireworms caused approximately the same rate of crop damage as usual (about two percent). The wheat stem sawfly was responsible for a little more than three percent loss to the wheat crop, a definite decrease from the average of the preceding year.

PALE WESTERN CUTWORM (*Agrotis orthogonia* Morr.).—Not only was the 1930 outbreak of this cutworm, in several areas, by far the most intensive that has ever occurred anywhere in Saskatchewan, but also the species had so greatly extended its range that "commercial" damage occurred at points as much as 100 or even 150 miles beyond the previously recorded limits of its economic importance. In view of the evidently close association of outbreaks of the pale western cutworm with areas of former grassland, it is rather believed that, except in southeast Saskatchewan, the species has now very nearly reached what are probably its limits of potential economic status. The most severe losses were recorded in south-central Saskatchewan, where the pest had been somewhat troublesome for several years previously. It was estimated that in the district from Indian Head to Balcarres, comprising some two hundred square miles where there was scarcely a field that entirely escaped injury, on an average fully half of the seeding done before June 20th was destroyed by this cutworm. Around Regina and for quite a distance both west and south (as far as Assiniboia), the infestation was also very heavy.

*Grateful acknowledgment is given for seasonal and distributional records received from the following, for incorporation in this report:—Mr. S. H. Vigor, and other officers of the Field Crops Branch, Regina, information relating especially to cutworn and grasshopper conditions; C. F. Patterson, Professor of Horticulture, University of Saskatchewan, extensive notes chiefly concerning insects of vegetables and fruits; Messrs. Norman Criddle and P. C. Brown of the Entomological Branch, data covering southeast Saskatchewan.

The percentage estimates of damage presented are, as in previous years, made possible through the cordial co-operation of the Statistics Branch, Saskatchewan Department of Agriculture; it is believed that they will rather closely approximate the final figures.

RED-BACKED CUTWORM (*Euxoa ochrogaster* Gn.).—This species was abundant rather generally in the "bush" country (jackpine and aspen), the "park" belt (aspen poplar) and the adjoining prairie. Very heavy infestations were found in the bush country just north of Prince Albert, especially after summerfallow and in the lighter sandy soil. This outbreak extended west to the Alberta boundary. Probably the most severe damage occurred in southeast Saskatchewan, doubtless owing in part to the much drier conditions which prevailed there than in other parts of the wooded country. Greater rainfall and other conditions more favourable to crop growth, were doubtless in part responsible for the fact that though infestation by the red-backed cutworm was more widespread, the damage was generally not nearly so intensive as that occurring in districts infested by the pale western cutworm.

WIREWORMS.—Wireworms caused severe losses of grain in the usual localities. The rate of damage during the cooler weather was undoubtedly increased by the drouth and the generally unthrifty condition of the crop. A feature was the unusually great importance of *Cryptohypnus nocturnus* Esch. which in many fields outranked *Ludius tinctus* Lec. in importance.

WHEAT STEM SAWFLY (*Cephus cinctus* Nort.).—Although the infestation due to wheat sawfly, was believed to be in general somewhat higher than in the previous year, the ratio of damage was very low, so that the average loss showed a decrease. The average infestation recorded was some thirteen per cent; the average damage, for approximately the same area, was slightly below four per cent.

GRASSHOPPERS.—Although there were no reports of very material damage by them in 1930, grasshoppers were definitely on the increase and more numerous than for several years. In the Estevan area, *Camnula pellucida* Scudder was recorded as the most common species; in stubble fields at Swift Current, *Melanoplus mexicanus* Saus. was the more prominent.

GREEN BUG (*Toxoptera graminum* Rondani).—Although the presence of this pest was suspected in 1926, the 1930 outbreak was the first definite record for the species in this province. The determination was confirmed by Mr. W. A. Ross. The damage was widespread, and the infestation so severe in southeast Saskatchewan, that many fields of late oats were completely killed; barley of similar age was undamaged.

WHITE GRUBS (*Phyllophaga* sp.).—Several reports from northeastern Saskatchewan indicated white grub injury to wheat. In one report a twenty per cent. loss in a one hundred acre field was estimated. The killing out of large patches of native sod was reported in another instance. Although damage to potatoes and gardens has occasionally been recorded in this area, white grubs were not previously known to have been of economic importance to grain crops.

WHEAT-STEM MAGGOT (*Meromyza americana* Fitch).—In several instances there were received specimens of wheat, showing injury apparently typical of the work of *Meromyza americana* Fitch, indicated rather widespread damage of this sort.

EARLY CUTWORM (*Euxoa tristicula* Morr.).—This species was present last spring, and is again numerous this fall, in a large area probably comprising the southwest quarter of the province. Very little damage by it was recorded.

Vegetable Garden Insects

Cutworms were likewise the most serious pest of the year in gardens, the average loss being probably the highest recorded in several years.

Wireworms were more troublesome than usual in gardens, not only relative to the crops, such as potatoes and lettuce, that are always severely injured, but also attacking those which seem ordinarily to suffer little from their activities, such as, tomato plants and sunflowers.

Beet Webworm (*Loxostege sticticalis* L.).—This species was very abundant. Vegetable gardens were seriously damaged, and one report noted the loss of five acres of sunflowers.

Potato Beetle (*Leptinotarsa decemlineata* Say).—Moderate damage was caused, at about the same rate as in 1929.

Green Cabbage Worm (*Pieris rapae* L.).—This pest was unusually abundant, causing severe losses generally in the province.

Diamond-backed Moth (*Plutella maculipennis* Curt.).—The larvae of this species were very much more abundant than the preceding year, especially so in western sections.

As usual the following pests caused considerable damage:—The cabbage maggot (*Hylemyia brassicae* Bouche), especially to late cabbage and cauliflower, which the drouth prevented from recovering from its attacks; the onion maggot (*Hylemyia antiqua* Meig.); the red turnip beetle (*Entomoscelis adonidis* Fab.); and blister beetles (*Lytta nuttalli* Say) attacking beans as well as Caragana hedges. There was evidently considerable variation between different localities, so that the data are too meagre to permit any estimation of general changes in abundance.

Pests of Shade and Ornamental Plants

Spider Mites.—In its ravages on spruce, (*Tetranychus ununguis* Jac.) was the most serious shade tree pest of the season. Rose plants of certain varieties suffered much more than usual from the attacks of *T. telarius* L. A severe local outbreak of an *Eriophyes* mite occurred in transplant plots of spruce at the Indian Head Forest Nursery Station; some of the permanent planted trees were also more or less infested.

Aphids generally caused somewhat greater damage than usual. The box elder plant louse (*Chaitophorus negundinis* Thom.) was one of the most important. The american elm aphid (*Schizoneura americana* Riley) appears to be making advances, and some very heavy infestations were noted in 1930, causing severe disfigurement in midsummer to a large proportion of elm foliage. The black willow aphid, (*Melanoxantherium smithiae* Monell), was abundant, especially on Russian poplar, though perhaps not more so than in 1929. The gall-forming aphids of poplar, *Pemphigus populitransversus* Riley and *Mordwilkoja vagabunda* Walsh, were particularly destructive. The spruce gall aphid (*Adelges cooleyi* Gill.) and the spruce pineapple gall (*Adelges abietis* L.) was very prevalent in the south, and in some cases trees were materially weakened; while not yet of any great importance in northern Saskatchewan, they are becoming more widespread, and each year doing more damage. A woolly aphid on larch, probably *Adelges strobilogius* Kalt, was abundant in the Indian Head district. The delphinium aphid seems to be steadily increasing in importance.

SAWFLIES of a number of species were troublesome. The yellow-headed spruce sawfly (*Pachynematus ocreatus* Harrington), was recorded from a number of localities, causing in some instances severe defoliation. The spruce sawfly (*Neodiprion abietis* Harr.) was, in the north, more common than in 1929, doing considerable damage to balsam fir. The poplar leaf-folding sawfly (*Pontania bozemani* Cooley) was rather abundant generally. The larch sawfly (*Lygaeonematus erichsoni* Hartig) was present in smaller numbers than in 1929.

FOREST TENT CATERPILLAR (*Malacosoma disstria* Hbn.).—The outbreak in northwest Saskatchewan continued, districts north of Battleford being infested. *M. americana* Fabr. infested certain species of *Prunus* and *Ribes*, but probably to a lesser extent than in 1929.

BOX ELDER LEAFROLLER (*Gracilaria negundella* Cham.)—The box elder leafroller increased decidely over the very low ebb of 1929; it is distributed over a wide area. Galls of the box elder gall-fly (*Cecidomyia negundinis* Gill.), were, as in 1929, generally abundant.

The cottonwood blotch miners (*Zeugophora* spp.) were active in a large number of localities. The pine leaf scale (*Chionaspis pinifoliae* Fitch) showed a decided increase this year, and was reported from several new districts. The birch leaf skeletonizer was probably widespread; a moderate outbreak on white birch took place at Indian Head and in the Qu'Appelle valley, and complete defoliation of birches occurred in the Spruce Woods Timber Reserve.

FRUIT INSECTS

In many plantations during 1930, as in 1929, the larvae of the currant fruit fly (*Epochra canadensis* Loew.) were responsible for the loss of a large percentage of the crop. The imported currant worm (*Pteronidea ribesii* Scop.) and the currant aphid (presumably *Myzus ribis* L.) cause much injury each year, though perhaps somewhat less abundant in 1930 than ordinarily.

TWO-SPOTTED SPIDER MITE (*Tetranychus telarius* L.).—This spider mite was very abundant on red raspberry plants, and most plantations were very severely injured by it.

HOUSEHOLD AND STORED PRODUCT SPECIES

Insects of stored products seem to be increasing each year, and are becoming quite serious pests.

MEDITERRANEAN FLOUR MOTH (*Ephestia kuehniella* Zell).—There were several reports which indicated severe infestations in various foodstuffs.

INDIAN MEAL MOTH (*Plodia interpunctella* Hbn.).—A very heavy infestation was found at Saskatoon, seriously damaging samples of various cereals which had been received for grading.

BEDBUG (*Cimex lectularius* L.).—Sixty inquiries relating to bedbug control, were received.

Livestock Pests and Miscellaneous

Black Flies (*Simulium* probably *simile* Malloch).—Black flies were very abundant in the districts near the Saskatchewan River. Several reported losses of animals, mostly cattle and sheep, in one instance (at Naicam, Sask.) amounting to 50 head of cattle, from the attack of this pest.

Mosquitoes.—Mosquitoes were generally scarcer than in 1929. In the northern woods, where precipitation was about normal, there was the usual abundance of mosquitoes.

INSECT CONDITIONS OF THE SEASON 1930 IN CENTRAL ALBERTA

E. H. Strickland,
University of Alberta, Edmonton, Alberta

Insects, generally speaking, were present in unusually small numbers in the vicinity of Edmonton. This was possibly to be accounted for by a blizzard at near zero temperature on May 21st, followed by an exceptionally cool June accompanied by torrential, though brief, rain and hail storms.

Red-backed Cutworms (*Euxoa ochrogaster* Gn.).—The season was, however, marked by an extensive and severe outbreak of the red-backed cutworm. This centered around Edmonton to Lacombe but extended well into the Peace River district. Heavy losses were recorded in gardens and several grain fields had to be reseeded. A repetition of the outbreak in 1931 is not considered to be imminent.

Wheat-stem Sawfly (*Cephus cinctus* Nort.).—Although abundant in stubble during the winter of 1929-30, wheat stem sawfly failed to mature in large numbers and less trouble was experienced than had been anticipated. Losses were not heavy, but this insect has been steadily increasing since 1927 when its numbers were at a minimum.

Wireworms.—Wireworm damage was less severe than usual though this insect continues to be the chief entomological problem of the Peace River District.

Grasshoppers.—Grasshoppers, particularly *C. pellucida,* are increasing in numbers in several districts. While it is not anticipated that they are sufficiently numerous to occasion immediate alarm, if 1931 is favourable, control measures may be required in 1932.

Diamond-backed Moth (*P. maculipennis* Curt.).—The diamond-backed moth was present in unprecedented numbers throughout the northern half of the province. Cabbages were very heavily attacked.

Root Maggots.—No complaints were received regarding the work of root-maggots in cabbages though we observed moderately heavy infestations in the vicinity of Edmonton. Reports were, however, received from districts in the Peace River District to the effect that something was killing out stinkweed. A sample of some 200 plants was sent to the laboratory from Hinton Trail. Every plant was infested with what appears to be cabbage root-maggot. It is claimed that dense patches of stinkweed were almost completely destroyed before freeze-up, and that there was comparatively little damage in cabbages though turnips were rather severely infested in the district from which this sample was sent.

BLACK WILLOW APHID (*C. smithiae*).—The black willow aphid continues to be very abundant on groves of cottonwoods. This outbreak has now lasted for three years. Many groves have died out, almost completely, during this period. While this can be attributed, in part, to lack of moisture it would appear that the aphids have been an important contributory factor.

At Fleet potatoes are stated to be severely infested in a number of fields with a large white caterpillar. At the time of digging one was sent to the laboratory for identification, but, unfortunately, succumbed before maturation.

INSECTS OF THE SEASON 1930 IN SOUTHERN ALBERTA

BY H. L. SEAMANS,
Dominion Entomological Laboratory, Lethbridge, Alberta

FIELD CROP INSECTS

WESTERN WHEAT STEM MAGGOT (*Hylemyia cerealis* Gill.).—Reports of western wheat stem maggot injury to spring grain were first received from Granum, Alberta. Two fields in this district were seriously injured. These fields were three miles apart with no injury found between them. One field of 160 acres was completely destroyed in the Carmangay district and two fields were injured near Diamond City. No other fields were found or injury reported in this portion of Alberta but one large field of spring wheat was destroyed near Drumheller. This is the first time this insect has been reported since a single 40 acre field of spring wheat was destroyed at Coaldale in 1923.

WHEAT STEM SAWFLY (*Cephus cinctus* Nort.).—The wheat stem sawfly was plentiful in the Drumheller district. The wheat stem sawfly was more abundant this year than it has been since 1926. The extreme drought conditions caused the losses from sawfly infestation to be somewhat underestimated.

PALE WESTERN CUTWORM (*Agrotis orthogonia* Morr.).—Pale western cutworm which was forecast last season as increasing, caused serious losses in the Drumheller section this year.

EARLY CUTWORM (*Euxoa tristicula* Morr.).—The early cutworm was reported from sugar beet fields very early in the season.

WIREWORMS.—Several different species of wireworms were abundant throughout Alberta. The reports of injury caused by these insects were about normal although the dry spring prevented the wheat plants from making any recovery.

RED-BACKED CUTWORM (*Euxoa ochrogaster* Gn.).—The red-backed cutworm was abundant in the fields over much of the parkland portion of the province. The limits of the outbreak corresponds with the limits of native bush and tree growth.

FALSE CHINCH BUG (*Nysius ericae* Schill.).—The false chinch bug caused apprehension among some of the farmers by so injuring the first leaves of spring wheat as to make the entire fields turn brown. This injury is very prevalent in some years, but the plants soon outgrow it and no damage is done.

Vegetable and Garden Insects

Diamond-back Moth (*Plutella maculipennis* Curtiss).—The diamond-back moth was unusually abundant this season. Large acreages of cabbage and cauliflower were completely destroyed by this pest. Turnips also suffered severe losses.

Onion Maggot (*Hylemyia antiqua* Meig.).—The onion maggot was a pest in all onion patches but did not do as much damage as previously.

Cabbage Maggot (*Hylemyia brassicae* Bouche).—The cabbage maggot was reported generally injuring cabbages, radishes and turnips in the market gardens around Lethbridge.

Lesser Bulb Fly (*Eumerus strigatus* Fall).—The lesser bulb fly was very abundant in some irrigated gardens. The larvae of this insect destroyed a large number of carrots and were also found infesting, turnips, beets and sugar beets. The carrots suffered the greatest damage and some of the gardens showed a 75 per cent. loss. This insect was reported from this laboratory several years ago as being found in onions infested by the onion maggot. At that time experiments indicated that it only attacked unhealthy onions. This year it has attacked and destroyed healthy, sound carrots.

Alfalfa Looper (*Autographa californica* Speyer).—The alfalfa looper was found causing serious losses to lettuce. In many of the gardens the lettuce crop was practically destroyed by this insect.

Small Fruit Insects

A red spider mite was the most injurious of the small fruit pests this season. This mite attacked raspberries to such an extent that the leaves were dry and brown by the middle of July. Practically no fruit was formed on any of the raspberry patches in southern Alberta.

Currant Fruit Fly (*Epochra canadensis* Loew.).—The currant fruit fly was especially injurious to black currants this season. Practically all the fruit this season was "wormy" and was destroyed.

Currant Span Worm (*Cymatophora ribearia* Fitch).—The currant span worm was not so abundant as it has been in the past few years.

Shade Tree Insects

The various species of aphids on shade trees were the most severe pests and appeared to be more plentiful than any time during the past several years. These include the box elder plant louse (*Chaitophorus negundinis* Thom.), the elm aphis (*Schizoneura americana* Riley), the black willow aphid (*Melanoxantherium smithiae* Monell) and the gall forming aphids on cottonwoods (*Pemphigus populitransversus* Riley, *Mordwilkoja vagabunda* Walsh, and *Pemphigus betae* Doane).

Cottonwood Leaf-folding Sawfly (*Pontania bozemani* Cooley).—This species was more abundant than any time during the last six years. Few leaves escaped the attack of this insect though no serious damage seemed to result from it.

Cottonwood Blotch Miners (*Zengophora* sp.).—Blotch miners were very plentiful in the Lethbridge and Macleod areas.

Caragana Blister Beetle (*Lytta muttali* Say).—This blister beetle was abundant all over southern Alberta. Ornamental and windbreak hedges were seriously defoliated in some localities.

Caragana Scale (*Lecanium* sp.).—The caragana scale was very abundant in Lethbridge. Some of the older hedges made very little growth due to the serious infestation of this insect.

INSECTS OF THE YEAR 1930 IN BRITISH COLUMBIA

By E. R. Buckell,
Entomological Laboratory, Vernon, B.C.

Forest Insects

Douglas Fir Tussock Moth (*Hemerocampa pseudotsugata* McD.).—This species has been very numerous and has defoliated large areas of Douglas fir in several sections of the province.

Hemlock Looper.—The larvae of this moth has done very extensive damage to hemlock on the British Columbia Coast. It is closely related to, and possibly the same as, the oak looper (*Ellopia somniaria* Hulst.)

Tip Moth (*Peronea variana* Fern.)—The Tip Moth has also been in outbreak form on the hemlock and Douglas fir on the British Columbia Coast.

Bark Beetles.—The Bark beetles have been unusually destructive this summer, particularly so in the case of *Dendroctonus monticolae* Hopk. This beetle kills the Western Yellow Pine and the Lodgepole Pine.

Tent Caterpillars.—The forest tent caterpillar (*Malacosoma disstria* Hbn.) and the eastern tent caterpillar (*M. americana* Fabr.) are again on the increase in the province especially in the coastal sections.

Satin Moth (*Stilpnotia salicis* Linn.).—The Satin Moth continues to spread on Vancouver Island and throughout the mainland in the lower Fraser valley.

Tree-Fruit Insects

Codling Moth (*Carpocapsa pomonella* Linn.).—The Codling Moth, while now present in most of the orchard sections of the province, was unusually scarce this season.

Oyster-Shell Scale (*Lepidosaphes ulmi* Linn.).—This scale, which is one of our major pests of the apple orchards, was below its normal abundance this season.

Tarnished Plant Bug (*Lygus pratensis* Linn.).—This bug has been very common for some years in the Okanagan Valley and has done a lot of damage in some orchards. It is the cause of a serious malformation of peaches known as "catface." Pear and apple buds are attacked; in some cases seriously affecting the crop. Orchards in covercrops are usually worst attacked or those close to open range land.

Aphis. The Woolly Apple Aphis (*Eriosoma lanigerum* Hausm.) has been unusually scarce this season. It is a very important species in the Okanagan Valley owing to its association with the disease of apple trees known as Perennial Canker.

All other aphids, both upon wild and cultivated plants, have been unusually abundant this season.

Lesser apple worm (*Laspeyresia prunivora* Walsh.).—The insect appears to be unusually rare this season. In some seasons severe injury to apples occurs in the Okanagan Valley.

Peach twig borer (*Anarsia lineatella* Zell.).—The peach twig borer is very scarce this year.

CIGAR CASE BEARER (*Haploptilia fletcherella* Fern.).—This insect is fairly common this season, especially at Kelowna.

BLISTER MITE (*Eriophyes pyri* Pagen.).—This mite was very bad some years ago, but for the past few years it has been scarce, but is showing signs of increasing.

CHERRY FRUIT FLY (*Rhagoletis fausta* O.S.).—This fly extended its area considerably around Kootenay Lake during 1929 and 1930; now occurring at Ainsworth, Boswell, Wynndel and Creston. It has, in 1930, been found on the Arrow Lakes at Robson, 60 or 70 miles west of the Kootenay Lake infestations.

MEALY BUG.—This insect is increasing in the province. It covers an area from Nelson west along the fruit orchards situated on the west arm of Kootenay Lake as far as Balfour, and was taken in small isolated infestations at Salmon Arm, Kelowna and Penticton.

CHERRY SLUG (*Eriocampoides limacina* Retzius.).—Generally scarce throughout the province this season, but recorded as fairly common in the coast sections and in the Kootenays.

SMALL-FRUIT INSECTS

IMPORTED CURRANT BORER (*Synanthedon tipuliformis* Linn.).—During the past season several black currant patches came to my notice where considerable damage had been done by these borers.

CURRANT FRUIT FLY (*Epochra canadensis* Loew.).—From my own observations I would say that this insect was less abundant than for many years.

IMPORTED CURRANT WORM (*Pteronidea ribesi* Scop.).—This sawfly was, on the whole, less abundant than usual.

RANGE AND GRASS INSECTS

GRASSHOPPERS.—The general grasshopper situation of the province is that we are now approximately at the bottom or lowest ebb of a cycle of grasshopper abundance. I would place the lowest point in the cycle in 1928.

This season showed indications of an increase in grasshoppers from the United States boundary to the Peace River area in northeastern British Columbia. In the Okanagan Valley *Melanoplus mexicanus mexicanus* (Saussure) and *Anabrus longipes* Caudell are increasing. In the Kamloops-Nicola area *Melanoplus mexicanus mexicanus* (Saussure) has been numerous and *Camnula pellucida* (Scudder) is increasing. In the Chilcotin area the cattle ranges have been quite heavily infested for the past two years with a mixed infestation consisting of *Camnula pellucida* (Scudder) *Bruneria brunnea* (Thomas) *Metator nevadensis* (Bruner) and *Cratypedes neglectus* (Thomas). In the Bulkley and Nechako valleys in Central British Columbia reports of grasshopper increase have come from several sources. In the British Columbia Peace River Block reports come that grasshoppers are again increasing rapidly.

Several areas have taken advantage of the new Provincial "Grasshopper Control Act" and formed themselves into Control Areas.

Vegetable Insects

Soil insects were unusually abundant and destructive.

Wireworms.—The annual damage to crops by wireworms this season was worse than usual and particularly severe injury was reported from the Okanagan Valley, the Fraser Valley and the Bulkley Valley. The most injurious appear to be *Pheletes canus* and *Limonius discoideus.*

Onion Maggot (*Hylemyia antiqua* Meig.) and Cabbage Maggot (*Hylemyia brassicae* Bouche.).—These insects did rather more damage than usual.

Cutworms.—Cutworms were very scarce this season and less damage from them was noticed than for many years.

Colorado Potato Beetle (*Leptinotarsa decemlineata* Say.).—This beetle has been present in the British Columbia valleys immediately to the north of Montana, Idaho, and eastern Washington for a number of years.

A recent survey of the situation shows that it is well under control in its southern limits and successfully eradicated where it had spread northward in small numbers some years ago.

White Grubs.—Reports indicate that they have been in about their normal abundance this season.

Imported Cabbage Worm (*Pieris rapae* Linn.).—This cabbage pest has, on the whole, been less abundant than usual.

Diamond-back Moth (*Plutella maculipennis* Curtis.).—This insect has been extraordinarily bad this season throughout the province. It caused an almost total loss of cabbage and cauliflower plants in the east Kootenay districts, especially at Nelson, Creston, Cranbrook, and throughout the Columbia Valley.

False Chinch Bug (*Nysius ericae* Schill.).—This is the first season that this bug has been recorded as doing serious damage in the province. In the Kootenays considerable damage has been reported on potatoes and cherries and at Summerland attacking asters.

Flower Garden Insects

European Earwig (*Forficula auricularia* Linn.).—Appears to be slowly extending its area in the British Columbia Coast cities. Reports indicate that overwintering adults were scarce this spring, due probably to the very severe winter temperatures, and the pest was not very noticeable until late in the summer when the second brood was present.

Rose Sawflies.—These seemed to be unusually abundant this season, and a number of enquiries were received from the vicinity of Vancouver.

Miscellaneous Insects

Ants are unusually abundant throughout the province, and the wood-boring ants and dry-wood termites appear to be doing considerable damage to house timbers in Vancouver. Wasps are scarce.

THE INSECT SITUATION IN MICHIGAN

By R. H. Pettit and Ray Hutson

It is not my intention to bore you with a mere catalogue of insects about which we have received inquiries during the year. Such a recital would doubtless sound much like a page from a Canadian entomologist's journal, which could be read more profitably at leisure. We have had, however, several insect outbreaks that were of a more or less special interest. I shall present a few of these instances for your consideration and comment.

During the past two years the cherry case-bearer, *Coleophora pruniella*, has become a rather spectacular pest of cherry about Traverse City, Michigan. A survey during the past summer around Grand Traverse Bay, particularly the peninsula extending into the Bay, was the focus of the trouble. This peninsula is, roughly, 25 miles long by one to two miles wide, and has numerous cherry orchards. There are one or two other small infestations outside this area. Damage by this insect is caused by the feeding between the two surfaces of the leaves by the leaf-mining first-stage larvae, and the feeding of the older stages on the foliage in the well-known case-bearer way. In addition, the injury caused by these insects, which normally spend the winter in cases attached to the twig near the buds, is aggravated by the fact that they attack the opening leaves. This damage, coupled with the fact that the eggs are laid in July, and that the first and second stage larvae are active during the period when the plant is storing up food for the next season, make the damage potentially great. This is especially true as most of the cherry plantings in Michigan are upon rather light soil, in which it is necessary that the plant have all the leaf area possible. The effect of the feeding of the young case-bearers are that the leaves become affected with yellow borderd brownish spots, sometimes mistaken for cherry leaf-spot; with the eventual dropping of from three to six per cent. of the leaves. Certain experiments, which have been carried on in other states, indicate that the insect can be controlled by the use of an eight per cent. lubricating oil emulsion in the dormant period. However, the lubricating oil emulsion has not been as satisfactory as was at first hoped, because of damage to the trees. We have a number of experiments under way, and it would seem that we are well on the way to a solution of the problem.

During the past summer we have had unusual outbreaks of the fruit-tree bark-beetle *Scolytus rugulosis*. This outbreak is correlated somewhat with the effect of extremely dry weather in weakening trees, but the outbreaks investigated have always showed the presence of orchard debris, either on the stump, on the ground, or in piles in close proximity to the area infested. Growers have sometimes refrained from burning such material in the hope of utilizing it for frost protection. The habit of this insect, of breeding in dying wood of various fruit trees, and then going into healthy trees to feed, is responsible for the inquiries which we received. The most noticeable symptom of the injury caused by this insect in feeding upon healthy trees is the exudation of gum from the stone fruit trees. It is especially noticeable on sweet cherry trees, and as a usual thing the appearance on healthy trees is more startling than the actual damage, although indicative of the abundance of the insects, which may in extreme cases kill the trees. The effect on apple trees is not so noticeable, but is more injurious in the case of young trees. The feeding of *Scolytus rugulosis* on apples is confined largely to attacks about the buds in the leaf axils. In the case of young, three or four year old trees, alongside of

heavily infested brush-piles the trees assume the appearance of very severe drouth injury, for which it is usually mistaken until investigated closely. The control of this insect has invariably resulted when it was possible to get enough of a neighborhood to clean up brush-piles and dying trees. One of the most spectacular cases involved the breeding of this insect in corded peachwood from an orchard which had been "pulled."

Investigation of several borer outbreaks in fruit and shade trees during the summer placed most of them as due to the flat-headed apple-tree borer, *Chrysobothris femorata.*

During the past year Mr. G. S. Tolles, of the Department of Entomology, has conducted experiments against the fruit-tree leaf-roller, *Archips argyrospila,* which has been gradually becoming a major pest in the fruit-growing region of western Michigan. His findings indicate that this insect can be very suitably controlled in Michigan with a six per cent. lubricating oil emulsion. Field tests indicate that treatment is capable of a 98% control. The field tests further indicate that the chief problem in applying this material for the control of the fruit tree leaf-roller lies in the difficulty of getting an adequate coverage of the extreme tops of the trees.

The past season was not very favorable for the increase of the Oriental peach-moth, first found in Michigan in 1928. In the infested area which should by this time have built up a heavy infestation, we had approximately 10% injury in the varieties from Elberta on, as determined by dissected fruit. Parasites are present notably *Macrocentrus,* although we have recovered a few specimens of *Glypta,* as well as Chalcids. Several new infestations of Oriental peach-moth have been discovered during the past year, in addition to the infestations in Lenawee, Monroe, and Washtenaw counties previously reported. The lightness of infestation in the Washtenaw area, where insecticide tests were conducted, was doubtless responsible for the inconclusiveness of the tests, although there was some reduction of the twig infestation through the use of hydrated lime, as recommended by the Ohio station.

During the summer there were numerous reports of damage to red raspberries by a mite, which on investigation was found to be distinct from the red spider, that we had expected to find from the reports. Specimens of this mite submitted to E. A. MacGregor, of the U.S. Department of Agriculture, were determined by him as belonging to the same group as the *Paratetranychus* feeding on the Michigan holly, *Ilex verticillata,* but is distinct from it. The damage caused by this mite is largely through defoliation, brought about by the withdrawal of the contents of the leaf cells, which in turn causes the leaves to dry up and fall from the plant. The injured plants present the appearance of bare canes with a mere tuft of young leaves at the tip in mid-summer, whereas, normal raspberry plants in the same area retain their leaves until October. The foliage damage of the mite delays the normal ripening, and in severe infestations prevents ripening of the fruit. In addition, the presence of the mites upon the ripe fruit is not inviting. The problem of controlling this mite is circumscribed somewhat by the fact that the raspberry plant is comparatively intolerant to sulphur, which is usually considered as a mite specific. A successful control of the mite was finally brought about through the use of a derrisol-soap solution, using the derrisol at the rate of about 1 to 800, with ivory soap at the rate of about four pounds to the hundred U. S. gallons of water. This application was made at a pressure of 200 pounds, with the indication that earlier tests in controlling the pest had fallen down because of inadequate pressure.

The pine Lecanium, *Lecanium numismaticum*, is a pest in many Michigan ornamental pine plantings, the females being found on the twigs and the males upon the leaves. As the usual thing the low branches are affected first by this insect. The winter is passed as a partially grown, impregnated female. Since the immature scale starts growing just before the new growth of the tree appears, it would seem that the late dormant period would be a very good time to undertake control measures. To test out this hypothesis, in the spring of 1930, fifteen Austrian pines at Ann Arbor were sprayed with "Kleenup" oil emulsion, one to thirty, just before growth started, using a standard sprayer operating at a pressure of 400 pounds. Examination of these trees in September showed that only an occasional live scale could be found, while the nearby unsprayed check was heavily infested.

In addition to the pests noted, we have had the usual number of inquiries concerning what we might call our staple pests, which are, as you probably know, very much the same as those found in Ontario. As the result of these inquiries, a total of several thousand letters was written during the season, 1200 being written during the month of June alone. Altogether it would appear that the insect situation in Michigan for the year 1930 was rather a busy one.

ENTOMOLOGY AND THE ARTS CURRICULUM

PRESIDENTIAL ADDRESS—DR. J. D. DETWILER
University of Western Ontario, London, Ont.

A discussion of what should or should not find a place on the Arts curriculum at once brings us to the century-old pastime, the criticism of our educational system—a system which, I fear, is still more symptomatic than systematic.

In opening the discussion may I express my firm conviction that we as a part of the English comity of nations have a heritage in a national tradition of education so fundamental that we cannot build without it and so vital that our destiny hinges on it.

It seems a far cry, as one writer has expressed it, to return to the remote and dimly seen figure of Alfred the Great but not too far to recognize in outline the true vision which sees in education that single system which prepares citizens to serve a united nation. It is true that most of his time was occupied in the struggle for existence but this did not prevent him from seeing what his people needed. "When I began to reign," said Alfred, "I cannot remember one south of Thames who could explain the service-book in English." To remedy the ignorance he found, he borrowed teachers from abroad; he caused the best textbooks of the age to be translated: he founded schools and sent to them the sons of his leading men; he desired that at least every free-born youth who possessed the means should "abide at his book until he can understand English writing." He resolved that the knowledge, which was until then limited to the clergy, should become the possession of his people at large. He apparently felt that the people should have a common culture and that the object of education was the betterment of the state.

This policy of national education, national in this sense that it trains the individual to a realization of the claims of the community of his services, was indeed slow to crystalize into anything like a system. So much

happened by the way: Any event, war, invasion, the dominance of privileged classes and of the church, anything that interfered with the unity of the people, militated against it. But in looking back over the history of the people, one cannot help but see that the system, whatever it was, contained a few basic principles that gradually expressed themselves as national traits. Among these is the national sense of right and justice. British justice has become proverbial. So universal is its acceptance that foreign peoples appeal to it with confidence even against a British Government.

Discipline may be said to be an almost equally outstanding characteristic. So profoundly does it at times express itself that the uninitiated call it stupidity. This mental attitude is a fruitage of a rigid training in obedience and the English schools were ever strong in exacting it. This principle of obedience is rather a "hard saying" in the present day of perverted teaching in child psychology.

A third characteristic, and one which is most evident in those who have been best able to profit by the educational process is the ability to make proper use of leisure. This is a characteristic of a cultured intellect and strange to say, the achievement of this, the cultured intellect, as a conscious objective in education, did not crystalize out until relatively late. In one of the testimonials which accompanied Samuel Arnold's application for the headmastership of Rugby the writer stated it as his conviction that if Mr. Arnold were elected he would change the face of education all through the public schools of England, and nobly was this somewhat hazardous pledge redeemed for it has been said of him that he was the first Englishman who drew attention in the public schools to the historical, political and philosophical value of the ancient writers. The classics were taught from a new point of view, the cultural. Furthermore, French, mathematics and history were added to the ancient classical curriculum.

And last, but not least, we would call attention to the instinct of fair play. This trait could not help but be engendered by the unique position that sport occupied as an educational instrument. England taught the world to play games and the spirit in which they should be played. They were to be played as a means to an end and not an end in themselves. They were supposed to be a preparation for life in its more serious aspects. Wellington well epitomized this when he said that the battle of Waterloo was won on the playground of Eton.

These traits, so briefly discussed, may be said to be expressions of the main features of the English tradition of Education—a tradition most ably expressed by Cyril Norwood when he says: "I put forward the ideal of the highest English tradition of that education which trains a generation through religion and discipline, through culture of the mind and perfection of the body to a conscious end of service to the community." (1)

But what, one might ask, has this to do with the question of the inclusion of entomology in the Arts curriculum? Just this, that the principle involved should determine the content of the Arts curriculum. Any subject, of course, that fails to contribute materially to the traditional educational ideal should be looked at askance.

Entomology in being a branch of one of the natural sciences shares with them the means of the cultural training common to the study of any science. This training, I am inclined to believe, can be ascribed in the main to the mental processes involved in interpretation. It is then that all the facts bearing on the problem under consideration are marshalled before the mind's eye, so to speak, and judgment passed upon them. It is a kind of

philosophy which is immediately put to the test. And insects, in the multiplicity of their species, outnumbering that of all the other classes of animals taken together; in their ubiquity, thriving wherever life can be sustained, and in their economic relationship to man, present problems which should provide an intellectual discipline of rare opportunity.

And in lighter vein, when wandering afield or engaged in pleasureable contemplation, what can afford more instant joy than the animated, aimless plight of the gaudily coloured butterflies or the multifarious ways of the six-footed as they go about their various duties. Their problems are ours and ours theirs and in interpreting theirs in the light of our own experience we beget a wider sympathy. Thus, insects readily provide a way of profitably spending our leisure hours, and a study of them greatly aids, even intensifies, the joy of our avocation.

One may inquire, however, as to whether the body of organized knowledge contained in entomology is sufficiently broad to warrant the subject being treated as a separate course in our Arts colleges. In all, in even the most prosaic of the orthodox Arts subjects, there are divisions and gradations in which more difficult courses follow the more elementary, and so it is in biology, we give the general principles first and then follow with the more complex. Entomology has accumulated a great mass of information, and although this is rather specialized it illustrates somewhat more profoundly the general biologic principles. We have, for example, insect comparative anatomy, taxonomy, histology, embryology and physiology, the last mentioned of which we know almost nothing and a knowledge of which is most important in our defence against the relatively few harmful species.

But this brings us dangerously near the question of vocational courses, scarcely welcome on our Arts curriculum. Fundamentally, however, all knowledge is vocational in its application to life. What an Arts curriculum cannot abide, and that quite rightly so, is any utilitarian course taught in a purely utilitarian spirit. It could not, for example, tolerate a course in economic entomology listing the insects concerned, no matter in what order, with a brief account of their life histories and bald methods of control. There would be little, if any, culture of the intellect and therefore would be considered ignoble. It could, however, accept a course on the fundamental principles of economic, or applied, entomology in which studies of particular insects were made to illustrate principles. The acceptance of even such a course might cause considerable misgivings in the minds of classical reactionaries, but the broad basis of the traditional educational concept has made provision for advancement and adjustment to national requirements. The Arts curriculum has, as we have pointed out, in part, had its evolutionary stages. The educational tradition which it should serve is quite in harmony with the principle of adjustment to the changing conditions of life. And here I might add that in the present stage of intensive agriculture and with a knowledge of the role that insects play in the affairs of man, the study of entomology has become of such prime importance that the public weal demands the services of our teachers and investigators.

Furthermore, I might also state that although the foundations of entomology were laid as early and as truly as those of any other biological science and although many of its contributors were men of sound ability and training, I think the immediate future of entomology has more real achievement in store than the immediate past has given. On account of the sudden and fairly recent appreciation of the economic importance of

insects, economic entomology offered, what might be called, virgin soil and it attracted many men with limited scientific preparation. I do not refer to the naturalists whose work has a beauty and value all its own, but to the inadequately prepared men whose meagre training in chemistry, physics, biology and mathematics prevented them from attacking, from even seeing, the deeper problems. Straight life-history work noting the stages from egg to egg, the time involved and a few readily observable phenomena will soon be the smaller part of a scientist's job. The evaluation of the factors of the environment, taken separately and together, and the physico-chemical effects will not only supplement the life-history studies (which we must admit are of fundamental value) but will form the much more important and more difficult phases of entomological research. In stressing a knowledge of the factors of the environment, however, I do not wish to be understood as though advocating a kind of super-course, that of ecology. It, as an abstraction, constitutes the most perfect mongrel course I can imagine. No wonder that its devotees have felt compelled to organize its subject matter to such an extent that the pigeon-holing is more difficult to master than the matter.

Among the fundamental sciences enumerated above it may have been noticed that mathematics was included. I believe that an adequate training in this subject has been somewhat neglected. As a minimum of college mathematics a course in statistics should be required for all students in Honour Biology. I fear that a great deal of data is laboriously collected which is never adequately interpreted. From this discussion it will be seen that students in entomology require a thorough grounding in the basic scientific subjects—a requirement that can be particularly well met in an Arts college.

Before concluding this, all too general discussion, I should like to say that the more I contemplate the content of courses in the light of our educational objective, the more I am convinced that the particular kind of course does not matter quite so much as the manner in which it is given. We wish our students to think and to think straight, to think beyond the boundaries of any course, to think as citizens and as citizens of a coordinated state. Fundamentally, we should use the courses of the curriculum, one and all, as a means to an end and not an end in themselves. In this way only can we meet the demands of our traditional educational ideal, the ideal that teaches for citizenship. For my part, I can accomplish this best in the biological courses, and I believe that entomology enriches my possibilities.

(1) Norwood, Cyril: The English Tradition of Education, London, J. Murray, 1929.

NOTES ON THE PALMER WORM (*Dichomeris ligulella* Hub.) AND THE RED BANDED LEAF ROLLER (*Eulia veluntinana* Walker)

By J. Allan Hall

Dominion Entomological Laboratory, Vineland Station, Ontario.

The Palmer Worm

Since I have been employed by the Branch, I have only on one or two occasions heard any mention of the palmer worm. In 1929 besides seeing an occasional moth in the orchard, I reared several adults from larvae found on the apple, but I gave it no serious attention until the summer of 1930.

In looking over the records, I find that there has been some confusion among workers and writers as to the identity of the species. Chambers Encyclopaedia (1878) states that, "The Palmer-worm is a name given to many large kinds of grub, the larvae of coleopterous insects, destructive to vegetable substances of various kinds. It also states, that it has been regarded by some Bibical translators as a kind of locust; that others have been undecided as to whether it was a Coleopterous or a Lepidopterous larvae; and that Palmer-flies are much used by English anglers as a lure for trout." It is now recognised as a species of Lepidoptera named *Dichomeris ligulella* Hubner. (var. *pometella* Harris.)

Outbreaks of this insect have occurred only at long intervals of time. Slingerland and Crosby report outbreaks in the New England and New York States in 1791, 1853 and 1900.

In Canada it does not appear to have attracted the attention of entomologists prior to 1900. In 1901, James Fletcher reported it as doing appreciable injury to apples at various points along the north shore of Lake Ontario, and that it had been reared from the apple at Ottawa by Mr. C. H. Young.

Prof. Caesar reported a local outbreak near Stoney Creek and a lighter infestation in a number of Ontario orchards in 1911. In a letter of recent date he states, "Since then I have only seen a very rare specimen."

During the past season this insect, while not occurring in outbreak form, was quite common in Norfolk county orchards, being much greater numerically than in 1929.

Descriptions, Life-History and Habits

The adult has a wing expanse of 5/8 of an inch. The fore-wing is about four and one half times as long as wide, normally fuscous brown with a purplish or golden reflection and dotted with small dark scales. In *pometella* Harris the costa is typically broadly cream colored. The hind wing is notably shorter, bluish and deeply fringed. The winter was apparently passed in this stage.

The egg, which I did not positively identify, was laid on the underside of the leaf in early May. The larva emerged toward the end of May. It did not vary a great deal in color, markings in the different instars of which there are five. When full grown the larva is from 1/2 to 5/8 of an inch in length; the head is yellow-brown with black ocellar spots; the proshield is concolorous with the head or may have a dark posterior margin. The general body color is olivacious or brownish-green, with two addorsal, narrow and two lateral, wider whitish longitudinal lines. The tubercles are sooty-black on the dorsal and thoracic segments and each bears a single pale, slender seta. When disturbed the larva would drop on a silken thread in a manner similar to that of the cankerworm. If taken in the hand it moved in rapid contortions which reminded one of a trout out of the water. It fed on the leaves and fruit for twenty-five to thirty days and then pupated.

The injury consisted in the eating of holes in the young fruits and the skeletonizing of the leaves during June and early July.

The pupa is about 5/8 of an inch in length, rather slender and of a light brown color. Those observed were all inside of rolled leaves. The pupal period was of approximately fourteen days duration.

The moths emerged during the whole month of July and were taken in bait pails from July 7 to August 11. They are nocturnal in their habits, reclining during the day on the leaves and branches or in the grass. They were frequently seen resting on the screen of the insectary in the early morning. A number were caged but no eggs were laid this fall.

The Red Banded Leaf Roller
(*Eulia velutinana* Walker)

While this insect is common and generally distributed, it has seldom attracted attention as causing serious injury to any of the many plants upon which it feeds. It has only been mentioned in a casual way as though not considered of much economic importance.

In Norfolk County, the injury to apples attracted my attention in 1929. Some of the larvae were then brought to the insectary and they, with their progeny, have been studied.

There was a full first, second and a partial third generation this season. The winter was passed in the pupal stage, rolled in dead leaves, both on the ground and attached to the twigs by the webs of the larvae.

Moths of the spring brood emerged from April 28 to May 9. Those of the first generation from July 4 to 26, and those of the second generation from August 13, to September 2nd.

The eggs were laid in roughly-oval masses of four to seventy (average 25) along the midrib on the upper side of the leaves. They resemble those of the oblique-banded leaf roller. Early in the season they required 17 to 18 days for incubation. Later this period was reduced to as low as 8 days.

The larvae hatched from May 24 to mid-September. Pale amber of honey-yellow head capsules and pale greenish-yellow body colour were characteristic of the five instars of each generation. When full grown they are only about ½ inch in length, being one of the smallest of the leaf-roller group. Those of the first and second generation fed principally on the leaves which they skeletonized. Larvae of the third generation fed to quite an extent upon the fruit. The injury, which is very conspicuous in late September and October, is done by eating the skin and underlying pulp off a considerable portion of the apple. The attack is most frequently made around the stem or calyx but is not uncommon at other points.

The growth period of the larvae was from 25 to 30 days and was followed closely by transition to the pupal state.

The small pupae were quite green in color at first, but later turned to a bright brown. The majority were found in the rolled leaves. A few were seen in the axils of spurs and twigs.

The pupal period of the overwintering generation lasted from October to May, while only 9 to 12 days was required by the summer broods.

The adult is an inconspicuous moth, of ½" expanse. The red-brown markings are striated with black and shaded with purple-gray. A fascia begins at the middle of the costa and widens toward the inner margin, of which it covers the outer third. Beyond this is a blackish triangle on the costa and a more or less distinct gray patch in the pale apical area left by the two markings. The hind wings are mouse-gray, with a buff fringe.

In summing up it would appear that these two insects are ordinarily kept under control by climatic conditions, natural enemies and the usual orchard practises, but that under favorable conditions they may become pests of some importance.

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PYRETHRUM, THE LOCATION IN THE PLANT OF THE POTENT PRINCIPLE

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(ABSTRACT)

Plants of *Chrysanthemum cinerariaefolium* grown at Vineland Station, Ontario, in 1928, under the direction of Mr. Ross, Entomologist in charge, were forwarded to the Annapolis Royal Station, in the fall of the following year for analysis. At that time, only insecticidal tests of extracts from the various stages of the plant were undertaken. Later on as opportunity permitted, the ground samples were evalued chemically in the laboratory of the Division of Chemistry, at Ottawa.

The samples were harvested at three stages of growth, the small bud stage with stems attached, partly open flower stage with attached stems, and when the flowers were fully open but not "overblown," with attached stems. The stems and flower heads of the several stages of growth were evalued separately.

Extracts of the ground samples were prepared from methyl alcohol and diluted so as to conform to ¼ lb., ½ lb., 1 lb., 2 lb., and 5 lb. of the plant to 100 gallons of spray, and biological experiments conducted with green apple aphids.

Strength of Spray (lbs. per 100 gallons)	STAGE OF PLANT															
	Small bud Stage		Stems from Buds		Partly open Flower		Stems from Flowers		Fully open Flower		Stems from Flowers		Commercial Sample		Check	
	P & D %	S or N %	P & D %	S or N %	P & D %	S or N %	P & D %	S or N %	P & D %	S or N %	P & D %	S or N %	P & D %	S or N %	P & D %	S or N %
¼	5	95	—	98	10	90	5	95	15	85	—	99	15	85	Only few dead	
½	5	95	5	95	15	85	5	95	15	85	—	99	20	80	"	
1	7	93	5	95	30	70	2	98	35	65	—	99	35	65	"	
2	10	90	20	80	60	40	5	95	80	20	5	95	80	20	"	
5	10	90	30	70	70	30	5	95	90	10	5	95	90	10	"	

CATEGORIES—P & D, Paralyzed and dead.
S or N, Slightly or not affected.
Observations made 24 hours after spraying.
Alcohol alone—similar results to check.

General Observations

From a careful observation of the mortality taken place it appeared that the extracts from the blossom heads increased in toxicity as maturity was reached.

That the stem extracts decreased in toxicity as maturity of the plant was reached—the extracts of stems from the small bud stage were more toxic than extracts of stems from the fully open flower.

That extracts of the stems are measurably less toxic than the bud extracts.

Chemical Data

Stage of Plant	Pyrethrin I %
Open flower	0.30
Stems from open flower	0.04
Semi-open flower	0.25
Bud stage	.....
Commercial powder	0.27

Samples of other stages of the plants were not available.

CORN BORER SITUATION IN ONTARIO IN 1930.

By L. Caesar—Agricultural College, Guelph

In discussing the corn borer situation I shall refer first to the area outside the twenty-four counties in which the Act is in force. In this area no special attention has been given to control measures and any clean-up that has been made has been brought about solely by the example of neighbouring counties under the Act, or by the educational work carried on by the press and by government publications.

Situation in the Areas Not Under the Act.

It was our intention this fall to inspect all counties adjacent to those under the Act to see the status of the borer in these, but just as we were ready to begin it was decided that the inspectors could be used more profitably in examining orchards east of Toronto to determine the status there of the apple maggot and thereby aid the Federal Fruit Inspectors in preventing any apples infested by this pest from being exported. Hence I have very little reliable data on the corn borer situation in the counties in which there was no compulsory clean-up. All I can say is that a sweet corn grower in Manitoulin Island wrote to me that, unless the Act was applied there at once, sweet corn could no longer be grown. Another correspondent from Southampton in Bruce County, stated that sweet corn in the vicinity of his town and of other towns on the Lake, was almost ruined this year by the borer. On the other hand the agricultural representative in Bruce wrote in reply to my request for more data that so far as field corn was concerned there had been very little injury and that he had received no complaints of the borer from the farmers. In the southern part of Lennox and Addington we inspected seven fields and found a rather heavy infestation—33%. In the southwestern part of Peterboro county I personally inspected twenty-six fields and found a low average infestation

of 2.9%. One very early small plot of sweet corn in the suburbs of Peterboro city had 21%. In Frontenac county, Dominion Scouts report one field of sweet corn as having 32% infestation and the average sweet corn around Kingston 16.6%. In the southern part of Leeds county they report the infestation as averaging 18.6%, one garden plot at Escott having 100%. Roughly speaking it looks as if sweet corn growing in counties not under the Act will ultimately be ruined in most counties unless the Act is applied to them, or some less costly method is adopted of bringing about locally an annual clean-up of all sweet corn remnants. The situation is rather perplexing because the cost of enforcing the Act in some of these counties or places like Manitoulin Island, where only a little corn is grown and this scattered widely, would likely be more than the corn itself would be worth.

The Situation Under the Act.

Eight counties have now been under the Act for four years and sixteen for three years. We had expected to be able to have the necessary data from all these twenty-four counties to show the results of the operation of the Act this year and to compare these with the results of previous years, but unfortunately the amount of time required for inspecting orchards for apple maggot left us only sufficient to inspect seven counties in whole and ten others in part. The following table shows the percentage stalk infestation of the seven counties for 1930 and preceding years:—

TABLE SHOWING RESULTS OF THE CORN BORER ACT IN SEVEN COUNTIES

County	1926	1927	1928	1929	1930
Essex	83.0*	64.7	41.7	35.9	16.7
Kent	78.7*	48.8	35.0	21.4	22.2
Lambton	34.0*	56.9	21.4	14.2	7.4
Middlesex	28.5*	36.2	18.3	9.9	9.0
Elgin	40.0	37.1	24.0	20.9	9.0
Norfolk	16.6	10.0	19.7	6.1	5.1
Prince Edward	.....	.....	.....	21.3	27.8

Note 1.—Pelee Island, which is a part of Essex county but has not been included in it because we wanted a separate record for it, was all inspected and showed a decrease from 23.6% in 1929 to 4.8% this year. This was the largest decrease in the Province.

Note 2.—The year 1926 was the last year previous to the coming into force of the Corn Borer Act. The figures in it marked with an asterick were obtained by the Federal Entomologists, all other figures are our own (Provincial).

It is not necessary to give the figures for the ten counties which were only partially inspected. It will suffice to state that they indicated decreases in Northumberland, Durham, Ontario, Peel, Wentworth, Lincoln and Wellington and increases in Hastings and Welland and possibly in Halton. On the average these ten counties showed a decrease.

No figures are available for the other seven counties in which no inspection was done, but there is no reason to believe that there was not on the average a decrease in them also.

Comments on the Above Table.

Returning to the table your attention is called to the fact that it includes seven of the eight counties longest under the Act and that these seven include the heaviest infested counties of the Province, in fact they contain all the area where husking corn is grown. In all of these counties except Prince Edward and Kent there have been decreases this year. In Elgin, Lambton and Essex the decreases have been large. The increase in Kent looks small but as the acreage there was about one-quarter more than

last year, it is greater than the figures indicate. You will naturally wonder whether the increases in Kent and Prince Edward were caused by an inferior clean-up in them. I am satisfied that this was not the reason; for Prince Edward was well cleaned and so was most of Kent, though I am told that in one or two localities there was a number of somewhat dirty fields left. I feel almost certain that it was weather conditions in July and early August which caused Essex to have a large decrease, Kent a moderate increase and Prince Edward a rather large increase. Experience seems to show that if July and early August are very hot and dry there will be great mortality of young larvae and this of course helps to bring about a decrease of the infestation. We had such weather in 1925 in Elgin County, followed by a large decrease of the borers that year. We have had the same thing in Essex and several other counties this year with a consequent large decrease. You would expect therefore that the decreases or increases would largely coincide with the amount of moisture on the plants and in the air in July and August. In Essex we find that the records at Harrow show only 4 showers in July and 5 in August,—a very hot, dry period. In Kent the records at the Dominion Entomological Laboratory at Chatham show 11 showers in July and 8 showers in August, or a total of 19 showers compared with a total of 9 in Essex. The total precipitation at Harrow in Essex was .92 inches compared with 2.30 inches at Chatham in Kent. There was, therefore, apparently twice as much moisture in parts of Kent at least as in parts of Essex. That this was an important factor in the difference in the percentage of infestation in the two counties would seem to be borne out also by the fact that when Mr. G. M. Stirrett, and Mr. R. W. Thompson, and the writer, inspected the two counties at the end of July, the greater amount of feeding holes in the corn leaves in Essex led us to believe that Essex was going to have the heavier infestation, but the reverse happened. Another factor that may have favored to some extent the increase in Kent was that a larger percentage of the corn there was planted earlier than in Essex, though most of Essex corn also was early.

We have not weather records for Prince Edward but we have them for the Parasite Laboratory at Belleville which is only two miles away, and so far as crops of grain and hay are indications there was much the same kind of weather in Prince Edward as around Belleville. These records show that there were 17 showers in July and 19 in August, with a total precipitation for the two months of 4.05 inches, which is more than four times as much as at Harrow and nearly twice as much as at Chatham.

Remarks on Weather as a Factor in Control

It is perhaps worth while to diverge from my subject for a couple of minutes to refer to the influence of weather on the borer. From the observations of Dr. Babcock in Europe and from my own observations in Elgin in 1925 and in several counties this year, and from the fact that in the United States the very dry areas of Ohio and most of Michigan had reductions in the borer infestation this year while the moister areas of Eastern New York had an increase corresponding to the increase in Prince Edward county, there seems almost no doubt that a very hot, dry July and early August is very unfavorable to the borer. There is also very little doubt that this is due chiefly to the mortality of the young larvae soon after hatching, while they are still exposed on the leaf or among the anthers of the tassel, to the weakening effects of heat and drought. In the very dry year of 1925 in Elgin we found that 93.6% of the larvae died before they were two weeks old, compared with only 77.7% in the year 1924. At

Chatham, Mr. G. M. Stirrett found that the larval mortality this year was 92.5%, and at Toledo, Ohio, Mr. Caffrey and his assistants found it was a little over 97%. The normal mortality seems to be about 80%. This means that out of every 100 eggs laid in a normal season, 20 larvae live to maturity. This year at Toledo, Ohio, scarcely 3 larvae survived, and at Chatham scarely 8. So that a very dry July and August are a boon to us so far as corn borer is concerned.

There is good reason, moreover, to believe that hot, dry weather in July acts in another helpful way,—namely by lessening the length of life of the moths and thereby lessening the number of eggs laid.

It also, as was observed in 1925 in Elgin, causes a considerable number of egg clusters to fall off the leaves and these almost certainly perish.

Low temperatures are also probably factors in natural control. Mr. G. M. Stirrett and others have found that on nights when the temperature dropped to 57 degrees F., the moths neither flew around nor laid eggs. Therefore it is probable that a period of several successive cold nights soon after the emergence of large numbers of the moths would result in a lessened number of eggs.

We have spoken above about moisture being favorable to the borer and lack of it unfavorable, but moisture at times may be very unfavorable, for their is little doubt that heavy deluges of rain, such as we get from time to time, wash off great numbers of the young larvae before they have entered the plant and secured protection there. For instance about three years ago at Chatham, Mr. A. B. Baird reported to me that a certain field of corn had had great numbers of eggs laid upon it, and yet when examined in September it was found to be much more lightly infested than expected. The only explanation that year seemed to be the heavy deluges of rains that had occurred at critical times and washed the young larvae off and destroyed them.

From the above remarks and from what has happened this year, especially in Prince Edward county, it would appear that the weather is so great a factor that in spite of the best practical clean-up in a county the borer will some years be so favored by ideal weather that it will increase. Fortunately our four years' experience of the Act in Ontario indicates that such ideal conditions are likely to be the exception and that on the average progress can be made in the reduction of the pest.

The Situation Today in Essex and Kent Compared With That in 1926, the Year Before the Act.

In 1926 there was every reason to believe that without a compulsory clean-up, the corn industry in Essex and Kent was doomed; for in that autumn, fully half of all the corn there was ruined and the other half seriously injured. Some fields had an average of 50 to 60 borers per stalk and many fields had from 10 to 20. This year, after four years of the Corn Borer Act, only about half a dozen plots even of early, sweet corn were heavily enough infested to be ruined. The heaviest infested field corn I saw anywhere was one of dent near Harrow in Essex, which had a stalk infestation of 90%, but even from it a lot of good corn was harvested and the average number of borers per stalk would not be over 5.

In 1926 many corn canning factories were forced to close down, but today they are all running again.

The acreage of corn in 1930 is at least double what it was in 1926 and the farmers instead of planting their corn late to avoid the borers nearly

all planted it this year as early as was their practise before the advent of the borer. In fact so confident are the growers in Essex and Kent that most of them will plant all the corn they desire next year and many of them are asking that we relax to some extent the strictness of the regulations in regard to clean-up.

I am convinced that there is not 1/10th, and probably not 1/20th of the number of borers in either Essex or Kent today that there was in 1926. It is true that the table does not indicate this, but one must not forget that there was a vastly greater acreage in 1926 and that the percentage of borers per stalk rises much more quickly than does the percentage of stalks infested. But gratifying as have been the results in Essex and Kent, it is unquestionable that the borer is still a great menace there and that with the return to early planting of large acreages of corn and with seasons more favorable to the borer than this, nothing but a good clean-up each year will prevent the insect from increasing and again threatening the corn industry.

Desirable Lines of Research

I think it wise that the work on biological control should be encouraged, as ultimately parasites are likely to play a considerable part, but I feel that the most pressing need is still the one that I have often mentioned of improved machinery to make simpler, less costly and easier, the destruction of corn remnants. There is nothing to be gained, however, under Ontario conditions in devising any costly machine, no matter how good, for farmers will not buy it. It is inexpensive devices such as the low-cutting corn binder attachment, corn stalk shavers, new styles of plows or attachments to enable plows to cover stubble and refuse more thoroughly, that are needed. In this connection great credit is due to the engineers of the United States Department of Agriculture for the excellent work they have done. We have been testing their low-cut attachment on a Massey-Harris binder in several counties this fall. In some fields it worked well, in others it clogged and was not satisfactory. We are told, however, that the clogging was probably caused by the Massey-Harris Company having set the stationary knife at too small an angle. This will be altered next year and the attachment re-tested. The International Harvester Company has at last decided to make the stationary knives for their corn binders too, so that there will be every opportunity next year to test the low-cutting attachments widely over the Province and find just what we may expect from them. If they work well it seems to me that any farmer equipped with such an attachment can comply with the law with no extra work whatever unless possibly in a year when corn is badly broken down.

The improvements on plows are well worthy of our study and I think that we have not given them the attention they deserved.

The stalk shavers are probably not well adapted for use in any of our counties except Essex, Kent and the lower part of Lambton, but in these three counties they would be a great help in cleaning up corn fields that had stood uncut over winter. The latest stalk shaver is one having three shavers attached to an ordinary corn cultivator and capable of cutting three rows of corn at a time, level with the ground.

The engineers have also made great improvements in rakes and have now a side-delivery rake which seems to me to be much superior to anything previously on the market. This rake could, I think, be used to great advantage in Essex and would supplement the stalk shaver. The rake is adapted for hay of course as well as for corn remnants.

As to the search for resistant, or semi-resistant, varieties of corn, I am not so hopeful of success as I formerly was. Such a variety must, of course, be a good yielder and well adapted to our climate and short season and to secure this seems to me would require many years' work. What I now believe we need for Essex and Kent is a variety that has a sturdy stalk, is a good yielder and has a comparatively short maturing season. Such varieties or strains exist in Ontario or elsewhere, but they need to be brought forward and their use strongly advocated. With a variety like this, I should like to have Essex and Kent plant half their corn as early as they used to plant it years ago, namely about May 21st and the other half ten days later,—May 31st; because if we have a couple of successive years very favorable to the increase of the borer this would insure, to a very large extent, the farmer from losing as heavily as if all were planted early and at the same time he would run little risk of injury by frost.

Conclusion

In conclusion I might call your attention to the fact that though there are fewer borers, so far as I can judge, per infested stalk this year than usual, more of them, owing to the very dry season, are wintering within five inches of the ground. This means more will be left in the stubble, hence the difficulty of securing the reduction that might be expected next year will be increased. One would almost think that the borer is determined to put every possible obstacle in our way.

PRELIMINARY OBSERVATIONS ON THE WINTER MORTALITY OF THE LARVAE OF THE EUROPEAN CORN BORER IN ONTARIO AND QUEBEC

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During the past three years, studies have been conducted at the Chatham laboratory to determine the winter mortality of the larvae of the European corn borer, *Pyrausta nubilalis* Hubn., throughout its range in Ontario and Quebec. The object of the studies was to determine the normal winter mortality for the various sections infested and whether or not there was an increase in mortality in a south to north direction. By 1927 the borer had spread over the entire corn growing region of Ontario and had reached the town of New Liskeard in Northern Ontario, some three hundred miles north of the first infestations found in Ontario. The question arose as to whether or not the mortality would increase to such an extent that no artificial means would be needed to keep the borer under control in such northern latitudes.

The staff of the Chatham laboratory was assisted in this work by a large number of the officers of the Entomological Branch, including Mr. L. S. McLaine, Chief of the Division of Foreign Pests Suppression and Mr. L. L. Reed of the same division, Mr. H. G. Crawford, Chief of the Division of Field Crop and Garden Insects and the following members of the various laboratories: Messrs. W. A. Ross and W. G. Garlick, Vineland; Messrs. Thomas Rankin and A. G. Dustan, Ottawa; Messrs. A. B. Baird and C. W. Smith, Belleville; Messrs. C. W. Petch and G. H. Hammond, Hemmingford, Quebec; Mr. R. W. Thompson, of the Ontario Agricultural College also assisted in the work.

The experiments were conducted in the following manner. Heavily infested corn stalks were secured in the vicinity of Chatham, Ontario, and transported to their various destinations throughout the regions to be studied. The larvae within the stalks were placed in three situations at each study point; (a) six inches below soil surface, (b) on soil surface and (c) above snowline. Each lot of stalks was covered with fine wire cloth cages made especially for the purpose. These were used to prevent the escape of larvae. The cages over the stalks below ground surface and on the ground surface consisted simply of a wooden frame over which the wire cloth was stretched. These cages were fitted with galvanized iron sides which were pushed into the ground about six inches to prohibit possible lateral migrations by the larvae. The cage placed above the snowline was simply a wooden lath framework covered with wire cloth.

Each autumn these infested stalks were transported to their destinations and put into the cages. This was done late in November or early in December. The cages with their larvae were left undisturbed until the following spring when they were examined in late April or early May. At this time one half of the stalks from each cage were taken out and the dead and living larvae per stalk recorded. The number of larvae counted varied considerably, but it was hardly ever below one hundred and sometimes as high as 250. The remainder of the stalks were left for a later examination in our studies having to do with the difference in the seasonal development of the corn borer throughout its range. Temperature and precipitation and other available meteorological records for each station were obtained so far as was possible from the Meteorological Service of Canada. Soil type and other factors such as slope, elevation, etc., were recorded by ourselves.

The results of these studies for the more important stations are shown below. In the tables the stations are arranged in order of their latitude, Harrow being the most southern station.

Table 1.—Larval Mortality in Per Cent. Larvae in Stalks on Ground Surface 1927-1930

Station	Winter 1927-28	Winter 1928-29	Winter 1929-30
Harrow	11.63	0.00	1.00
Chatham	7.40	0.00	2.20
Vineland	——	1.40	0.62
Stratford	2.43	2.53	1.47
Guelph	1.18	0.00	0.00
Belleville	——	2.10	9.24
Collins Bay	——	1.31	1.16
Peterboro	——	3.35	11.4
Lindsay	——	1.21	8.62
Orillia	3.10	1.12	1.66
Hemmingford, Que.	——	6.45	15.0
St. Martins de Laval, Que.	——	0.88	1.6
Farnham, Que.	——	7.07	19.5
Ottawa	14.28	x1.17	0.0
Gore Bay	4.85	0.00	5.71
North Bay	3.93	3.6	3.84
Sudbury	6.96	2.3	6.02
Sault Ste. Marie	——	1.7	1.98

x—Migration occurred and figure of no value.

The results indicate that no very high mortality occurred anywhere in Ontario or Quebec at the points where experimental stalks were placed. The average mortality for all points at which readings are given was as follows: 1927-29, 5.2 per cent.; 1928-29, 2 per cent.; 1929-30, 5 per cent.

These mortalities are very close to the average annual mortality found in larvae in stalks in natural positions in the counties of Elgin, Kent and Essex, in southern Ontario. Spencer (1923) gives the mortality for the winter of 1920 at Port Stanley, in Elgin County, as 3 per cent. and for the

winter of 1921 as between 4 and 5 per cent. The mortality for the past few years at Chatham, in Kent County, has averaged around 6 per cent. These mortalities also agree very closely with those found by Caffrey (1927) in New England. He states that the average annual mortality for a five year period is 6.6 per cent.

Our results indicate that no increase in mortality takes place in larvae within stalks lying on the surface of the soil in the more northern portions of Ontario.

Table II.—Larval Mortality in Per Cent. Larvae in Stalks Below Ground Surface 1927-1930

Station	Winter 1927-28	Winter 1928-29	Winter 1929-30
Harrow	29.88	4.0	4.05
Chatham	7.03	0.6	19.08
Vineland	——	——	23.2
Stratford	36.27	33.33	11.6
Guelph	30.60	8.8	12.0
Belleville	——	†64.28	7.82
Collins Bay	——	2.94	2.51
Peterboro	——	2.22	24.6
Lindsay	——	15.5	3.81
Orillia	27.02	4.51	12.0
Hemmingford, Que.	——	*36.29	28.2
St. Martin de Laval	——	84.40	96.4
Farnham, Que.	——	19.00	48.5
Ottawa	28.57	†28.80	9.22
Gore Bay	94.28	7.60	13.4
North Bay	26.47	0.00	1.4
Sudbury	88.18	0.00	5.88
Sault Ste. Marie	——	1.9	13.9

†—Migration occurred and larvae not recovered, therefore, this figure is of no value.

*—In one or two cases doubtful if larvae were really dead.

From the table it would appear as if larval mortality in stalks below ground did not show any marked mortality in any particular region. It is true some very high mortalities are shown, but they are exceptional and not uniform from year to year.

In general, the mortality below ground is greater than that found in larvae in stalks on the surface of the soil. The average mortality for the stations indicated for the various years are as follows: 1927-28, 40.9 per cent.; 1928-29, 14.6 per cent.; 1929-30, 18.7 per cent.

Table III.—Larval Mortality in Per Cent. Larvae in Stalks Above Snowline 1927-1930

Station	Winter 1927-28	Winter 1928-29	Winter 1929-30
Harrow	4.16	1.20	0.00
Chatham	2.13	0.00	4.28
Vineland	——	2.24	1.57
Stratford	0.98	6.25	0.86
Guelph	6.67	7.00	0.84
Belleville	——	2.27	8.39
Collins Bay	——	7.84	9.23
Peterboro	——	0.00	0.00
Lindsay	——	2.90	2.19
Orillia	6.60	4.08	1.66
Hemmingford, Que.	——	0.00	93.80
St. Martin de Laval	——	8.77	66.60
Farnham, Que.	——	2.80	99.10
Ottawa	0.00	21.42	58.70
Gore Bay	27.38	20.40	42.00
North Bay	100.00	100.00	100.00
Sudbury	100.00	100.00	100.00
Sault Ste Marie	——	25.90	100.00

The average mortality for all points is as follows: 1927-28, 27.5 per cent.; 1928-29, 17.3 per cent.; 1929-30, 27.1 per cent. These average mortalities are high because at certain points in Northern Ontario and Quebec nearly all or all of the larvae were killed in certain years. The points south of North Bay in Ontario do not show a high mortality and an average of these would give about the same mortality as is shown for larvae in stalks on the surface of the soil in the same regions.

The striking fact shown by the table is that all larvae were killed at North Bay, Sudbury and Sault Ste. Marie, in the three years, with the exception of Sault Ste. Marie in 1928-29. Other stations in the northern region studied but not recorded in the table, also show complete mortality for the winter of 1928-29 in which they were studied. All larvae at Desbarats, twenty-five miles from Sault Ste. Marie, were killed as were all the larvae above the snowline at New Liskeard, the most northern of any station studied.

An attempt is being made at the laboratory and in the field to determine and evaluate the factor or factors causing winter mortality and a detailed discussion of these will be reserved for another time. The factors which might cause mortality are low temperature, excessive moisture, a combination of temperature and moisture acting together, alternate freezing and thawing, dehydration through excessive evaporation in the presence of wind and the lack of moisture and the biotic factors such as parasitism, disease, and because of these, lowered vitality.

It is known that parasitism has played no part in killing the larvae under consideration as no parasites were observed either in the autumn or spring dissections.

It can be seen that these factors will not play the same role under the three situations in which the larvae were left during the winter. There would be more moisture available to the larvae below ground than would be the case for larvae on the soil surface and above the snowline. Low temperatures would be modified for those larvae under the cover of snow while those placed above the snowline would be exposed to the lowest temperatures experienced by the station. The lowest temperatures for some of the stations in degrees Fahrenheit were as follows: Winter 1927-28, Harrow 5, Chatham 1, Guelph 20, Orillia 25, Farnham 27, Ottawa 25, Gore Bay 32, North Bay 32, Sudbury 45, New Liskeard 52. During 1928-29, Harrow 12, Chatham 7, Vineland 0, Stratford 9, Guelph 22, Belleville 17, Peterboro 14, Lindsay 15, Orillia 17, Hemingford 9, Farnham 21, Ottawa 26, Gore Bay 26, North Bay 32, Sudbury 35, Sault Ste Marie 28.

SUMMMARY

Through the studies reported in this paper, it has been shown that the winter mortality of the European corn borer is annually about six per cent in larvae in corn stalks lying on the surface of the soil. This is the same amount of mortality found normally in the southern portion of Ontario and in New Engand for larvae in stalks in natural positions in fields.

The mortality of larvae buried in stalks six inches under the soil surface was considerably greater than the mortality for larvae in stalks on the surface of the soil throughout Ontario and Quebec. Mortality in buried stalks was uniform throughout the area. This mortality was also greater than that in stalks above snowline for the greater portion of Ontario.

The mortality of larvae in stalks above snowline is about the same as that of larvae in stalks on the ground surface for the southern and middle

regions of Ontario. In Northern Ontario at such parts as North Bay, Sudbury, New Liskeard, Desbarats and Sault Ste. Marie, all the larvae above the snowline were killed except at Sault Ste. Marie in the season 1928-29. The highest minimum temperature at a point in which all larvae were killed was -32 degrees Fahrenheit. The lowest minimum temperature was -52 degrees. One other point, Gore Bay, in Manitoulin island, had a minimum temperature of -32 degrees and only 27.38 per cent. of the larvae were killed. This station is, however, surrounded by water while the others are on the shores of lake Superior or inland. Sault Ste. Marie in 1928-29 had a minimum temperature of -28 degrees and only 25.90 per cent. of larvae were killed.

Studies are being continued by the laboratory to determine the factor or factors responsible for causing larval mortality and its fluctuations in different situations and regions.

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FURTHER NOTES ON THE MORTALITY AND FEEDING HABITS OF NEWLY-HATCHED ORIENTAL PEACH MOTH LARVAE

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In a paper[1] presented last year, the writer gave some preliminary notes on the mortality and feeding habits of newly hatched Oriental Peach Moth larvae. During the past summer, similar, but more complete observations were made which seem to show, that, as indicated by the first season's results, host resitance is the primary factor bringing about this mortality.

The method was the same as that used in 1929, and briefly, was as follows: batches of five eggs each were obtained in the laboratory on peach leaves and allowed to incubate naturally. When the eggs were almost ready to hatch, the piece of leaf was pinned to the under side of a leaf on a peach shoot containing no "wild" eggs or previous injury. The shoot was banded with tangle-foot about one foot from its tip, to prevent any larvae from being lost. (It should be noted here that all these experiments were conducted on growing trees under natural orchard conditions.) In from two to five days after all the eggs had hatched, the twigs were removed to the laboratory and given a very careful examination under a binocular, noting the number of hatched eggs, the number of living or dead larvae, and all types of injury. Two series of experiments were run simultaneously, one on Yellow St. John trees and the other on Late Elbertas. During the latter part of the season two tests were made on late maturing varieties, viz., seedling peaches and Lemon Frees. The experiment was conducted as a series of tests, run at approximately ten day intervals during the time fruit

was present on the trees. Accurate records were kept of the days of hatching and the prevailing weather conditions.

Results: Twelve tests, using a total of 521 eggs, were run on the Elberta peaches during the period, May 22 to August 30. Ten tests, using 425 eggs were run on Yellow St. Johns during the period May 22 to August 21. One test was made on seedling peaches on August 30, and one on Lemon Frees on September 10. Ninety-seven of the 946 placed eggs failed to hatch, giving an egg mortality of 10.3 per cent. From the remaining 849 eggs, 312 larvae survived, thus making the mortality of the young larvae 63 per cent. The mortality of the young larvae on the Elbertas was 64.9 per cent., and on the St. Johns 61.1 per cent. The minimum mortalities on the two varieties were as follows: Elbertas, 30.5 per cent., and St. Johns, 37.5 per cent. The maximum mortalities were: Elbertas, 91.1 per cent. and St. Johns, 84.4 per cent. The detailed data for the tests on the two varieties are given in the following tables. It will be noted that no eggs were available for test No. 5, on the St. Johns.

Table No. I.—Elbertas

Test	Date	No. of eggs placed	No. of eggs hatched	Mortality of eggs	Surviving larvae	Mortality of larvae
1	May 22	35	24	31.4%	13	45.6%
2	May 29	45	36	20.0	17	52.7
3	June 8	50	49	.5	34	30.5
4	June 18	50	48	1.0	20	56.5
5	July 4	26	25	3.8	5	80.0
6	July 10	50	49	.5	12	75.5
7	July 19	40	38	5.0	7	81.3
8	July 26	40	37	7.5	7	81.0
9	Aug. 5	50	45	10.0	4	91.1
10	Aug. 16	50	38	24.0	7	81.6
11	Aug. 21	45	45	0.0	14	68.8
12	Aug. 30	40	39	2.5	26	33.3
	Season	521	473	9.2	166	64.9

Table No. 2.—St. John

Test	Date	No. of eggs placed	No. of eggs hatched	Mortality of eggs	Surviving larvae	Mortality of larvae
1	May 22	30	19	36.6%	6	68.5%
2	May 29	30	17	43.3	6	64.7
3	June 8	40	40	0.0	25	37.5
4	June 18	45	41	8.8	15	63.4
5	No eggs	.....	.....	.....	.....	.....
6	July 10	45	44	2.2	11	75.5
7	July 19	45	45	0.0	7	84.4
8	July 26	40	38	5.0	8	78.3
9	Aug. 5	50	47	6.0	24	48.0
10	Aug. 16	50	35	30.0*	18	48.6
11	Aug. 21	50	50	0.0	26	48.0
	Season	425	376	11.7	146	61.1
Average for both varieties		946	849	10.3	312	63.0

* Ten of the eggs which failed to hatch were parasitized by *Trichogramma* sp.

The mortality on the seedling peaches was 69.2 per cent., and on the Lemon Free 90.9 per cent., as shown in table No. 3.

Table No. 3—Seedling and Lemon Free

Variety	Date	No. of eggs	Mortality of eggs	Surviving larvae	Mortality of larvae
Seedling	Aug. 30	40	2.5%	12	69.2%
Lemon Free	Sept. 10	45	2.2	4	90.9

Discussion of Results: The most striking thing noticeable in the above tables is, that on both varieties of peaches, there is a definite trend in the mortality throughout the season, viz., a comparatively low mortality in the earlier part of the season, a high mortality during mid-summer, and a low mortality again as the fruit starts to ripen. This is shown by the following grouping of the results for the various tests.

Variety	Early	Mid Season	Late
Elberta	Tests 1-4 46.4%	Tests 5-10 83.4%	Tests 11-12 51.0%
St. John	Tests 1-4 58.5%	Tests 5-8 79.4%	Tests 10-11 48.5%

There are two possible sets of external factors (excluding parasites and predators) which might affect this mortality, viz., weather conditions and host resistance.

The writer believes the observations to show quite conclusively, that, under the prevailing conditions during the past two seasons, host resistance was the factor almost wholly responsible for this seasonal trend of mortality, although weather conditions such as temperature and humidity almost certainly must act in conjunction with host resistance thus modifying the influence of the latter.

The most obvious indication that host resistance is the most effective factor, is that the mortality, in the latter part of the season, drops off earlier on the St. John than on the Elberta. The St. Johns mature from two to three weeks earlier than the Elbertas, so this decreasing mortality can be explained only on the basis of host resistance, as the tests on the two varieties were run simultaneously. Similarly the mortality on Elbertas and seedling peaches can be compared for test No. 12 of August 30, when the larvae on the Elbertas had a mortality of 33.3 per cent., and on the seedling peaches 69.2 per cent. At this time the Elbertas were starting to ripen, while the seedling peaches were still green and hard.

Still more significant indications of the importance of host resistance are, in the view of the writer, furnished by a study of the feeding habits of the newly hatched larvae throughout the season. The young larvae attack the tips of the young growing twigs in the early part of the season, but when these start to harden, they transfer their feeding to the fruit. The time of twig hardening varies with the age of the tree and the growing conditions, so this period of twig feeding will also vary in different seasons and in different orchards. However, the fruit during the period following twig hardening, does not seem to be in a favourable condition to receive the attacks of the young larvae. Prior to this period, the fruit makes appreciable growth, then for a period of almost two months little growth takes place. During this latter period the young larvae seem unable or unwilling to attack the flesh of the fruit, but confine their attacks almost entirely to the woody stem of the fruit itself. About three weeks before the fruit is ready to pick, appreciable growth again starts, and continues until maturity. From the beginning of this last period the larvae can attack the fruit with increasing ease, and do so, thus lowering their mortality.

To support the above theory of varying host resistance, careful data were kept of the types of injury caused throughout the season, an analysis of which data is given in tables 4 and 5. For the purpose of comparison the types of injury are given as the percentage of the total injury for each test. Growth measurements of the Elberta fruit are also given, in table 6, to show the arrested growth period during mid-summer. It should be noted

here that owing to the very dry season, the growth just prior to ripening was considerably less than in the previous year.

Table No. 4.—Elberta

Test	Mortality	Per cent of total injury per test		
		Twig	Flesh of fruit	Woody stem of fruit
1	45.8%	66.6	8.3	25.
2	52.7	56.2	0	43.8
3	30.2	59.3	0	40.7
4	56.5	21.7	8.8	69.5
5	80.0	14.2	0	85.8
6	75.5	0	0	100.0
7	81.3	0	12.5	87.5
8	81.0	0	28.5*	71.5
9	91.1	0	0	100.0
10	81.6	25.0	25.	50.0
11	68.8	3.7	92.3	3.7
12	33.3	0	91.3	8.7

*—Larvae entered through a wound.

Table No. 5—St. John

Test	Mortality	Per cent of total injury per test		
		Twig	Flesh of fruit	Woody stem of fruit
1	68.5%	100	0	0
2	64.7	50	16.6	33.3
3	37.5	60	4.0	36.0
4	63.4	13.3	13.3	73.3
5	No eggs	.....	.....	.....
6	75.5	0	0	100
7	84.4	0	0	100
8	78.3	10.0	20.0	70.0
9	48.9	0	64.0	36.0
10	48.6	0	80.0	20.0
11	48.0	0	96.2	3.8

Table No. 6.—Diameter of Elberta Peaches

Date	Diameter in Inches
May 22	.25
May 27	.29
June 5	.46
June 13	.70
June 20	.89
June 27	1.22
July 4	1.28
July 11	1.31
July 22	1.31
July 30	1.35
Aug. 9	1.38
Aug. 15	1.43
Aug. 28	1.63
Sept. 4	1.75
Sept 10	1.79
Sept. 15	1.87

The significant point to be noted from tables 4 and 5, is that the mortality is inversely proportional to the percentage of injury to the woody stems of the fruit. The comparatively low percentage of woody stem injury in the early part of the season is counterbalanced by a high percentage of twig injury, accompanied by a low mortality, while that of the latter part of the season is counterbalanced by a high percentage of injury to the flesh of the fruit, again with a comparatively low mortality. During mid-summer, with a high percentage of woody stem injury and little flesh or twig

injury, we find a high larval mortality. It should also be noted that the decrease in woody stem injury started earlier in the season on the St. Johns than on the later maturing Elbertas. Another observation of interest is that the young larvae will enter the flesh of the fruit quite readily, even in mid-summer, through wounds or injury holes left by other insects. This was the case in test No. 8, on the Elbertas, when all the flesh injury was made through wounds.

In concluding this phase of the discussion the writer would like to point out first, that during the mid-summer high mortality period, larvae have been observed wandering over the surface of the fruit for as long as 15 hours but never starting a feeding-hole, although occasionally rasping the surface with their mandibles; and second, that wounds, or injury holes made by partially grown larvae during this period, soon fill and exude sticky gum masses. It is possible that the avoidance of the fruit proper at this time is an instinct of the young larvae to which the gum might render successful feeding difficult if not impossible. It has been observed however that partially grown larvae can successfully establish themselves in the hard fruit during mid-summer. Finally, larvae entering the fruit during the latter part of the season, just prior to ripening, make far more progress in feeding than those entering in mid-summer, the former going directly to the pit and working in the flesh next to it.

The effects of weather conditions: An examination of the weather data for the days of the tests gives very little, if any, indication that weather conditions play an important part in directly affecting the mortality. Table No. 7 gives the mean temperature and the approximate relative humidity during each test. (As the hygrograph used to obtain the humidity figures was not accurate, these data on relative humidity are at best only relative to each other.)

Table No. 7.

Test No.	Mean Temperature	Mean R.H.
1	71.2	61
2	49	76
3	51	69
4	68	87
5	62	61
6	70	61
7	85	53
8	82	60
9	78	51
10	66	55
11	65	56
12	76	63

It will be noticed that during the period of high mortality on the Elbertas, the temperature was comparatively high during some of the tests, but that this did not prevent the mortality from dropping off in the St. Johns when the host resistance lessened. Also during the final test on the Elbertas with the lowest mortality for the season, a fairly high temperature prevailed. However it is quite probable that high temperatures along with low relative himidities may have a secondary detrimental effect on the young larvae especially when they stay outside the host for several hours during the periods of higher host resistance. In view of the fact that the eggs are usually laid within one foot of a suitable feeding point and that the young larvae can soon be within the moist tissues when the host is favourable, it is not likely that temperature and himidity would be as important factors as they appear to be for some other insects, e.g., the European Corn Borers,[2] which latter often have to wander considerable distances over the surface of the plant to find a suitable feeding point.

Comparison of the mortality in 1929 *and* 1930: A comparison of the mortality on Elberta peaches for the past two seasons is given in the following table:

	1929	1930
Number of eggs placed	400	521
Mortality of eggs	9.2%	9.2%
Mortality of newly hatched larvae for all tests	74.2%	64.9%
Mortality of newly hatched larvae from period, June 18 to end of tests	74.2%	72.1%

In 1929 the experiment was not started until June 15, while in 1930 it was started on May 22, hence line four in the above table gives the most accurate comparison for the two seasons. It is of interest to note that the egg mortality on the Elbertas was exactly the same for the two years. The summer of 1930 was much warmer and drier than that of 1929, and the fact that 1930 had a slightly lower mortality than 1929 gives added evidence that weather conditions do not influence the mortality to any great extent. References:

[1]G. G. Dustan, 1929, Preliminary Notes on the Mortality and Feeding Habits of Newly Hatched Oriental Peach Moth Larvae. Rept. Ont. Ent. Soc. pp. 108.

[2]Unpublished data by Geo. Fitch, Michigan State College Corn Borer Experiment Station, 1930.

THE BIOLOGICAL CONTROL FACTORS AFFECTING THE ABUNDANCE OF THE ORIENTAL PEACH MOTH (*Laspeyresia Molesta* BUSCK) IN ONTARIO DURING 1930

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The biological control investigations and experiments conducted with the predators and parasites of the Oriental Peach Moth (*Laspeyresia molesta* Busck) during 1930 is a continuation of the program outlined and begun in the spring of 1928 (1) (2) and expanded during each sucessive year. The studies conducted on the native parasites have been extended to include all the peach growing districts of the Province in the hope that not only would the extent of native parasitism be determined, but promising species might be discovered which would offer material for artificial propagation. Improvement in laboratory technique and increased knowledge about the field habits of *Trichogramma minutum* Riley made it possible to undertake a much enlarged program for the colonization of this parasite during the present year, and some 10,000,000 *Trichogramma* were used in the work. From material collected in Southern New Jersey, 8,864 adults of *Macrocentrus ancylivora* Rohwer were colonized in our areas of heaviest Oriental Peach Moth damage. This number was increased by 2,191 parasites obtained by laboratory breeding and field collections in Ontario. As a result of arrangements made by the Dominion Entomologist with the Imperial Institute of Entomology investigations with a new parasite were undertaken with the arrival in Ontario of shipments of Oriental Peach Moth material, from the French and Italian Rivieras, containing *Pristomerus vulnerator* Panz. These collections were made under the direction of Dr. W. R. Thompson of the Farnham House Laboratory in England.

The production of *Trichogramma* was carried out by Mr. George Wishart, who also looked after its preparation for liberation. The hearty co-operation of Mr. W. A. Ross and Professor L. Caesar is also gratefully acknowledged.

Each project will be considered separately in the following discussions:

Native Parasites—

Trichogramma minutum Riley is the only egg parasite thus far found attacking the eggs of the Oriental Peach Moth in Ontario. Its seasonal history has been very irregular and this year it played little part in reducing the numbers of the pest. The abundance of this parasite depends on the presence of host eggs, and, in general, there seems to be a concentration of *Trichogramma* where suitable insect eggs are abundant. During 1929, when Oriental Peach Moth eggs were plentiful in the peach orchards, *Trichogramma* adults were commonly observed on the foliage, but during the present season, when eggs were scarce, the parasite was seldom seen. Field observations indicate a tendency of the parasite to remain and search for additional eggs where an oviposition has been completed, and the production of a migratory restlessness, when eggs are not found, which leads the insect to travel considerable distances.

The regular peach and quince tree examinations failed to show the presence of *Trichogramma* until July 16 when it was found to have parasitized about five per cent. of the Oriental Peach Moth eggs on quince at Niagara-on-the-Lake. Counts made at other points in Niagara township on the same day failed to show the presence of the parasite. By July 30 the parasitism on quince had reached 39 per cent. at the above point ,which is the highest recorded amount of parsitism by the native species for the year. During the rest of the season Oriental Peach Moth eggs were very scarce on quince and the percentage parasitized by *Trichogramma* was greatly diminished. The last egg examination on quince was made on September 1, and no parasitized eggs were found. The parasite was not found in Oriental Peach Moth eggs on peach foliage until August 18 when a 3.4 per cent. egg parasitism was discovered at Virgil. Toward the end of the third generation of the moth and just before the late Elbertas were picked, the following percentages of parasitism were found: Niagara-on-the-Lake 6, Virgil 13.3, and Queenston 27. The last point was less than one half mile from large artificial colonizations and may have been influenced by wind drifts and migrations.

Larval collections were made from each generation of the Oriental Peach Moth, primarily for recovery of *Macrocentrus ancylivora* but served also for the determination of the abundance and distribution of the native parasitic insects attacking the pest. The infested twigs, when cut off, were stripped of their leaves and forwarded to the Belleville Laboratory where the larvae were allowed to finish their feeding and were then segregated into individual vials. They were reared in an incubator operated at a temperature of 80 degrees F. This temperature speeded up development and made it possible for parasites to be returned to the field for recolonization in the shortest possible time.

The first generation collections were begun as soon in the spring as injury appeared in the orchards. These collections consisted of three series. The first two were reared at St. Davids and the moths used in breeding experiments. The material of the third series was sent to Belleville and handled as described above. No species is recorded as a parasite

of the Oriental Peach Moth unless it was individually reared from that host.

SERIES 1—This material consisted of twigs gathered in the vicinity of St. Davids and yielded 473 emergents with 10 native parasites, consisting of 4 species.

SERIES 2—These collections were made from early peach drops at St. Davids and gave 1,342 emergents, of which 70 were native parasites consisting of 9 species.

SERIES 3—This series of collections came from all parts of the Province where peaches are grown and gave 2,231 emergents of which 79 were parasites, representing 7 species.

The native species secured from the first generation were grouped as follows; the percentage given indicating only the relationship to other species of parasites:

Dioctes obliteratus Cress.	33.3 per cent.
Cremastus minor Cush.	21.0
Glypta rufiscutellaris Cress.	15.1
Calliephialtes grapholithae Cress.	6.3
Macrocentrus sp. (black head and abdomen)	3.6
Apanteles sp.	3.6
Ascogaster carpocapsae Vier.	2.6
Meteororus sp.	1.3
Glypta sp.	1.3
Microbracon sp.	.5
Lixophaga plumbea Ald.	.5
Unidentified	2.0

The total percentage of larvae from the above mentioned sources destroyed by native parasites in the first generation was 3.9. It will be noticed that the larvae secured from the small infested drops were more heavily attacked than those from twigs. Undoubtedly a considerable number of the larvae taken in the fruit had migrated there from twigs where they had been previously parasitized, but a significant feature of the drop collections was that two new forms taken were from this source alone. These two, a species of the *Macrocentrus* genus and probably new, and *Calliephialtes grapholithae* Cress. are admirably fitted to reach the larvae while feeding within the fruit, since both are sturdy insects with long ovipositors. When their numbers are removed from the computation of percentages the parasitism of the three series of collections runs much the same. It is hoped that the attractions of these species to the Peach Moth will be increased, as pasasites attacking the larvae while feeding within the fruit would be a valuable addition to the parasitic fauna.

The second generation collections, which consisted of infested twigs alone, showed a considerable increase in larval destruction. Out of 2,245 emergents from collections from all parts of Ontario, 259 native parasites were secured, which were grouped as follows; the percentage again referring to the interrelationship of parasite species:

Glypta rufiscutellaris Cress.	76.4 per cent.
Cremastus minor Cush.	10.0
Dioctes obliteratus Cress.	10.0
Ascogaster carpsocapsae	.7
Glypta sp.	.7
Epiurus sp.	.7
Nemorilla maculosa Mg.	.4
Unindentified	1.1

Glypta, which played little part as a control factor in 1929, again assumed its place as the past important native form attacking the Peach Moth in Ontario. These collections showed a parasitism by all species of 11.5 per cent., this being the greatest amount of parasitism recorded in any year since the introduction of the pest.

Because of the extreme dryness of the weather during the time the third generation larvae were feeding, their attacks were confined mainly to fruit. Several small collections of twigs were made which yielded 257 emergents, of which only 5 were parasites grouped in importance as follows:

Glypta rufiscutellaris Cress.	40 per cent.
Dioctes obliteratus Cress.	40
Cremastus minor Cush.	20

The extremely low parasitism of 2 per cent. on the last generation may be partially explained in that the collections came from points where *Macrocentrus ancylivora* Rohwer was plentiful. In competition for host material with other larvae, the *Macrocentrus* larvae appear very successful. A comparative study of the amount of parasitism produced by the native parasites and *Macrocentrus* consistently shows few native forms where *Macrocentrus* is abundant.

Colonization of *Trichogramma minutum* Riley

The first small colonizations of this species were made by Mr. C. W. Smith in the spring of 1928 with stock bred from material kindly furnished by experimenters in the southern United States. The early experiments were with small numbers, and while they indicated a certain amount of establishment and egg destruction, they also demonstrated the necessity of using large numbers of parasites if control of a commercial nature was to be secured. In the following year some 750,000 *Trichogramma* reared in the laboratory from the same stock were colonized in 8 orchards. The egg parasitism in these orchards, amounting to over 70 per cent. in one case, seemed to justify the continuance and expansion of the work in the present season. Consequently, some 10,000,000 parasites were placed in an area of about 250 acres in the St. Davids, Queenston, and Niagara-on-the-Lake districts.

Material used in the colonization of the present season was bred from two strains of the parasite; the one being the progeny of the original importations from the United States and the other from a strain indigenous to the Niagara Peninsula. It was thought that the native variety might be more adaptable to our climatic conditions, and also, from an experimental standpoint, it would produce more generations during the summer since its life cycle was considerably shorter, thus producing a more rapid multiplication of the parasite in the orchards. The imported strain was still used to act as a check and to allow for a comparison with the work done in the previous years.

The liberations were made chiefly at two periods during the summer, viz., just before the peak of the egg lay of the second and third generations. The liberations were timed so the parasites would appear in the orchards about two days before the greatest number of eggs would be on the foliage. The material was prepared for liberation at the laboratory, using waxed paper cones as in 1929 (2). Each cone contained 10,000 parasitized host eggs with the ages of the parasites so arranged that they emerged in four lots two days apart. Just previous to the colonization date, which was deter-

mined by moth and egg counts in the orchards, the cones were transported to the orchards and placed on trees previously marked. By having the parasites of different ages, emergence was spread over several days and consequently an overlapping of *Trichogramma* cycles was secured in the orchards. Also the presence of the parasite was assured during the time when the eggs were most abundant on the trees.

The peculiar field conditions of the past season made it particularly difficult for the parasite to become established and multiply because there was a relatively small increase in the number of moth eggs available in the successive generations. This condition may have been partially due to the dry weather during the oviposition period, but in general was caused by the increase in larval parasitism and the great abundance of predators. The latter not only destroyed great numbers of healthy Peach Moth eggs, but also many of those parasitized by *Trichogramma*.

On July 18 the first colonizations were made in orchards in the St. Davids and Queenston districts, the total area covered being approximately 200 acres. The parasites were distributed in numbers varying between 20,000 and 60,000 per acre, with one cone to a colonization tree. Tree examinations prior to the releases showed very few eggs on the foliage and of those present 75 to 80 per cent. were shells remaining from the first and early second generation ovipositions. The absence of storms during the summer tended to leave these old shells upon the foliage and their presence caused considerable difficulty in interpreting the results obtained. Where first generation shells were marked, over 50 per cent. of them were still on the foliage at the end of the season and the presence of these shells tended to give a greatly depreciated impression of the parasite's usefulness.

Tree examinations were made beginning eight days after the first parasites emerged from the cones. In general, the liberation trees showed the highest amount of egg destruction with a gradual decrease in the trees farther away, but since the interest is in the nature of orchard control rather than in individual tree records the following figures refer to the averages for the orchards. No unhatched eggs were considered in the figures since to do so would have necessitated rearing all unhatched eggs until they either turned black or hatched.

Orchard	per acre	per cent. parasitism
	Blond Strain	
A.	20,000	9.0
B.	20,000	7.4
C.	20,000	9.0
D.	40,000	16.0
E.	50,000	4.7
F.	60,000	3.3
	Dark Strain	
G.	20,000	29.0
H.	20,000	43.8
I.	40,000	23.3

It will be observed that the amount of parasites liberated per acre is not the only factor which determines the amount of parasitism secured. The abundance of host eggs appears to have a much more important influence on the ultimate result. The type of the foliage and the exposure of the orchard to wind currents also seem to influence the activity of the parasite. The results obtained from the liberations of the imported strain showed a much larger amount of egg destruction, but unfortunately we have not sufficient data to show what caused the difference.

The small number of eggs appearing in the orchards made it appear advisable to increase the number of *Trichogramma* liberated per acre to

see if this would correspondingly increase the amount of egg parasitism. Consequently in the third generation two new orchards were chosen besides the regular acreage covered in the former liberation, and parasites were liberated in these at the rate of 100,000 and 1,000,000 per acre respectively. The following figures were obtained from the counts made on this generation.

Orchard	Blond Strain per acre	per cent. parasitism
K.	20,000	37.0
D.	40,000	43.0
J.	40,000	41.0
E.	50,000	44.0
L.	100,000	61.7
M.	1,000,000	63.1
	Dark Strain	
G.	40,000	29.0

Check Orchards	Per Cent. Parasitism
N.	6.0
O.	13.3

Orchards L. and M. received colonizations during the third generation, orchard G. received only a second generation liberation, while all the rest obtained the same number of parasites on each generation.

The third generation examinations were made just previous to picking and, therefore, at a time when protection to the fruit was most desirable. Fruit examinations were made in four of the orchards which showed the following results.

Orchard	per cent. injury		
D.	9.0	Check (1 mile west)	20.0
L.	14.7	Check	26.8
M.	6.6	Check	11.6
G.	26.8		

In orchard D. a 75 per cent. reduction was recorded over 1929, while in the other three the reduction was 50 per cent. or more when compared to the figures of the previous year. In orchards L. and M. the check plots were influenced by the migration of *Trichogramma* into them, which reduced the infestation to some extent.

It is safe to assume that where *Trichogramma* was colonized in large numbers that it was an important factor in reducing the injury from the activity of the moth. This was particularly noticeable when the egg parasitism in orchards some miles distance from the experimental orchards were examined. It seems safe to assume that as our knowledge of the biology of the insect increases we shall be able to breed it in far greater numbers, at lower cost, and use the material to much greater advantage in the field.

Colonization Studies with *Macrocentrus ancylivora* Rohwer

The first colonization of *Macrocentrus ancylivora* Rohwer was made in the spring of 1929 (3) when 2,350 individuals of the species were secured from collections made in southern New Jersey. These were liberated at two points in Niagara township where the Oriental Peach Moth infestation was most severe. From these original colonizations the parasite rapidly increased in numbers and spread over a considerable area. In its first season some 421 recoveries were made and at one of the points a parasitism of 57 per cent. was secured on the third generation of the pest.

In continuing the work this spring, the writer, accompanied by Mr. R. W. Thompson of the Ontario Entomological Service, spent three weeks

collecting parasitized host larvae in New Jersey. The material secured during the trip was handled precisely the same as in 1929 except that some of the infested twigs were mailed to the Belleville Laboratory. The material which was mailed suffered a much higher mortality and yielded fewer parasites than that which was transported directly from Moorestown to Belleville by automobile.

Before any liberations of the parasites from New Jersey were made, collections of twigs infested with Oriental Peach Moth were made, in the areas where establishment had been secured in the previous season, to determine if the parasite had successfully survived the winter. These collections yielded 53 recoveries which represented the progeny of overwintering parasites. The greatest amount of parasitism, amounting to 22 per cent. was obtained in a young bearing orchard. While recoveries were not secured over such a large area as in the fall of 1929, the distribution was very satisfactory and showed the hardiness of the insect in its new habitat.

As *Macrocentrus* adults emerged from the New Jersey collections they were placed in shipping cages and forwarded, mostly by automobile, to the orchards. It proved desirable to ship the parasites soon after emergence and when so handled the mortality sustained during transportation was less than half of one per cent. The material yielded 9,418 *Macrocentrus*, of which 5,951 emerged from Oriental Peach Moth larvae and 2,467 emerged from Strawberry Leaf Roller material. Some 351 parasites were used in experimental breeding work and the rest were colonized between June 18th and July 1st as follows:

Two points at St. Davids	4,511
One point at Virgil	1,656
Two points at Niagara-on-the-Lake	622
One point at Queenston	246
One point at Fonthill	247
One point between St. Davids and Virgil	1,153
One point at Cedar Springs	394
Total	8,829

A short time after the colonization of the parasites, collections of first generation infested twigs were taken at all the liberation points and at as many dispersal points as possible. Each collection consisted of 100 twigs, which were shipped to Belleville and handled as were the collections for native forms. The two points at St. Davids showed a parasitism of 69 and 70 per cent. respectively, and that between St. Davids and Virgil a parasitism of 76.5 per cent. The lowest parasitism at any of the liberation points was in one orchard at Niagara-on-the-Lake where 20 per cent. was secured. The collections made after the liberation of the New Jersey material yielded 224 parasites, making a total for the first generation collections of 277 recoveries.

As soon as second generation larvae appeared in the orchards the collections were duplicated. The following figures do not include the entire collections for the period, but give a fair idea of the establishment of the parasite.

	Orchards	Per Cent. Parasitism
St. Davids	3	85, 60.7 and 80
Virgil	2	51 (1 mile from col. point)
		77
Niagara-on-the-Lake	2	44 and 74.4
Queenston	2	16 and 35
Between St. Davids and Virgil	1	73
Fonthill	1	32
Cedar Springs	1	30

The parasite was definitely shown to be established at all the points where colonizations were made and revealed a considerable dispersal amounting, in some cases, to over two miles. From all the second generation collections a total of 771 recoveries was secured.

During the time the second generation larvae were feeding in the twig growth, further colonizations were made with parasites secured from the collections at the older liberation points and from material secured from the breeding experiments conducted at the Belleville Laboratory. These two sources provided an additional 2,191 *Macrocentrus*, of which 1,360 came from the breeding work. These parasites were used to place colonies at points, such as St. Catharines, Port Weller, Grimsby, Fruitland, Winona, and Leamington, which had hitherto received no material.

Because of the extremely dry weather, very few collections could be made during the third generation of the moth, but wherever it was possible to find larvae in twigs *Macrocentrus* recoveries were secured. A total of 180 recoveries were made from the following points:

	Orchards	Per Cent. Parasitism
St. Davids	2	56 and 25 (2 miles from col. point)
Between St. Davids and Virgil		65.5
Queenston		79
Niagara-on-the-Lake		92

At the time of Elberta picking, infested fruit was opened and the larvae reared for recoveries. These collections gave several *Macrocentrus* recoveries which further demonstrates the possibility of the parasite wintering, not only in larvae maturing in young orchards where twigs are available, but in older bearing orchards where succulent twigs are very scarce.

The history of *Macrocentrus ancylivora* Rohwer since its introduction into Ontario has been of a very promising nature. It quickly availed itself of the abundance of host material and has built up a very substantial parasite population, which effected a considerable larval destruction during the past year. The 1,228 specimens of the parasite recovered from the twig collections represents a very small percentage of the total population present, for in each collection only a very few of the available infested twigs were taken. It can be fairly estimated that close to 70 per cent. of the Oriental Peach Moth larvae feeding in twigs in the vicinity of St. Davids were destroyed by the parasite.

Other Biological Control Factors Influencing Reduction

Soon after the appearance of the second Oriental Peach Moth generation eggs, the larvae of a lace-wing. (*Chrysopa oculata* Say), became extremely numerous on the foliage. These voracious little larvae began to feed upon the eggs and even attacked larvae when they became exposed. Normally the species feeds upon aphids, but in their absence during the past season became a general feeder on all sorts of insect eggs and larvae. Examination of the eggs sucked by Chrysopid larvae showed that it was possible to distinguish between eggs which had normally hatched and those which had been sucked. Using this distinguishing factor as a basis, counts were made to determine the extent of its effect in reducing the numbers of the moth. In the second generation 50 to 60 per cent. of the eggs were sucked by the predator, and while it somewhat decreased in numbers toward the end of the summer, between 20 per cent. (Queenston) and 32 per cent. (St. Davids) of the third generation eggs were destroyed in a similar manner.

SUMMARY

There has been a considerable reduction in the infestation of the Oriental Peach Moth which was particularly noticeable in the area of oldest infestation and where, in the past, the damage from the pest has been heaviest. This decrease has been chiefly due to the abundance of parasites and predators which destroyed great numbers of the Oriental Peach Moth eggs and larvae.

One of the interesting features of the infestation for the entire district, during the past season, was the fact that there were relatively few more third generation eggs than there were second generations eggs, that is, the insect did not increase nearly as rapidly as in former years and was held practically stationary after the second generation. This condition was particularly noticeable in the immediate vicinity of St. Davids where, in some orchards, there was a 75 per cent. reduction in fruit injury as compared with 1929. Such a condition is what we might normally expect when we consider the influence of the various natural and biological control factors affecting reduction.

(1) Smith, C. W.—Parasitism of the Oriental Peach Moth in Ontario with Special Reference to Biological Control Experiments with *Trichogramma minutum* Riley.—Ann. Rep. Ont. Ent. Soc.—1928.

(2) Steenburgh, W. E.—Notes on the Natural and Introduced Parasites of the Oriental Peach Moth in Ontario—Ann. Rep. Ont. Ent. Soc.—1929.

(3) Steenburgh, W. E.—A Season's work on the Colonization In Ontario of *Macrocentrus ancylivora* Rohwer, a Parasite of the Oriental Peach Moth. Can. Ent. April, 1930.

A BRIEF SURVEY OF THE ORGANIZATION AND PROJECTS OF THE BELLEVILLE PARASITE LABORATORY

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The Dominion Parasite Laboratory was established at Belleville, Ontario, by the Entomological Branch of the Dominion Department of Agriculture for the purpose of consolidating its work on the biological control of insect pests, and forming a study centre for the increasingly large and varied problems of this nature being undertaken each year. It is now quite generally conceded that the operation of biological control is a very distinct phase of economic entomology requiring special equipment, special knowledge and special methods of handling, and is essentially a type of work in which centralization is most advantageous. The basic value of this principle was recognized by the Imperial Institute of Entomology in the establishment of the Farnham House Laboratory in 1927 to serve as a study centre and clearing house for biological control work throughout the British Empire. Our laboratory will form a link in the chain of Empire organization. The problems in each country will, however, be very different and in practice we must work out our own salvation.

Biological control work has formed an important part of the Entomological Branch program for more than twenty years, beginning with

the introduction of Larch Sawfly parasites by Hewitt in 1909. The development of this method of control was very spasmodic for many years, due partly to the length of time usually required to produce an effective or even noticeable percentage of control by biological agencies, but chiefly perhaps to the remarkable successes achieved in the use of chemical agencies for controlling certain pests. With the passing of years, however, the results of earlier parasite introductions began to bear fruit and likewise it has proven difficult to achieve satisfactory results in the chemical control of all pests, so we now find entomologists in all parts of the world looking for a solution of their problems in a combination of both methods. We, who are primarily interested in biological control, do not anticipate that it will ever replace chemical or mechanical control agencies but the two are unmistakably linked together.

Just here, I would like to point out the necessity for a thorough study of the ultimate result of applications of certain dusts and sprays on account of their lethal or deterrent effects upon parasites normally attacking the pests concerned. As an instance, we have found in experiments with *Trichogramma* that this species would not parasitize Oriental Peach Moth eggs on trees sprayed with oils or covered with certain dust mixtures, whereas the Peach Moth adults appeared to be attracted to certain of these plots. I mention it as indicating one of the many things we have to keep in mind in carrying on this type of work.

Another point, which, perhaps, is not well understood, is the necessity for a thorough knowledge of the habits and life history of the host insect. This was clearly illustrated in connection with the Wheat Stem Sawfly work during the past summer. It was found that liberations of the parasite made following the peak of egg laying of the host were unproductive, and this is apparently explained by the fact that only one larva survives in each stalk and the larva hatching first usually destroys all eggs deposited later in the same stalk. Knowing this, future liberations will be made earlier in the season. Many parasite introductions made by hit and miss methods have proven successful but a large percentage have not and we must look for the explanation in a study of parasite and host, and their relation to the particular environment.

Those entomologists who have endeavoured to rear rare specimens of larvae through to the adult stage for determination, or to rear through 100 adults from a like number of eggs will realize some of the difficulties encountered in mass production of parasites. One of our major problems is the development of technique and apparatus for breeding, storing and transporting insects. In our breeding work the old idea of providing natural conditions is, in most cases, discarded, since insect mortality in nature is ordinarily very high. We aim to provide optimum conditions for 100 per cent. survival. This also is very important in handling material collected for parasite recovery, especially when parasitism is low. Although certain basic principles apply throughout, each species handled presents sufficient new problems to keep the work intensely interesting. Our work is also unique in that we must, in the case of some species at least, be able to produce millions of individuals on a commercial economic basis, and this involves, not only the development of methods and equipment, but the use of the most advantageous type of labour in production.

As the projects develop, a great deal of taxonomic study is involved, particularly in the handling of imported material and in conducting recovery studies. We are greatly handicapped at present by a lack of specialists who can determine parasite specimens reared and we hope that taxonomists

will concentrate more on these most important economic groups for a few years at least.

Biological control work is thus, while a distinct phase of economic entomology, essentially dependent upon the co-operation of workers in all other branches of entomology as well as many of the other sciences for its successful development. We must also develop to the fullest extent co-operation with all other organizations interested in the problems in hand. It is our aim at Belleville to confine our activities to such projects as can be carefully handled by the staff and equipment available, enlarging our program as the occasion demands when funds are available for the requisite additions of men and equipment.

Practical operations are being conducted with the following pests in the regions indicated:—

European Corn Borer (*Pyrausta nubilalis* Hbn.) Ontario and Quebec.

Oriental Peach Moth (*Laspeyresia molesta* Busck.) Ontario.

Larch Sawfly (*Lygaeonematus erichsoni* Hartig.) Manitoba and all Eastern Canada.

Wheat Stem Sawfly (*Cephus cinctus* Nort.) Saskatchewan.

Lecanium Scale (*Eulecanium coryli*) British Columbia.

Satin Moth (*Stilpnotia salicis* L.) British Columbia and Nova Scotia.

European Earwig (*Forficula auricularia* L.) British Columbia.

Woolly Aphis (*Eriosoma lanigerum Hausm.*) British Columbia.

European Pine Shoot Moth (*Rhyacionia buoliana* Schiff.) Ontario.

Greenhouse White Fly (*Trialeurodes vaporariorum* Westw.) Ontario.

In the case of all of the above insects, except the European Earwig, for which parasites have been introduced and colonized, recoveries of parasites have been made, indicating that they are becoming established, but in most cases it will be several years before the practical value of the introduction will be apparent. It should be borne in mind that with the majority of parasites the first cost is the only cost, and in computing the value of the work this should be spread over a period of years.

The laboratory property at Belleville was acquired by the Department in the fall of 1929. It is located at the eastern entrance to the city on the transprovincial highway, and was originally a three storey solid brick house with small brick barn adjoining. These have been completely renovated and modified to suit our requirements. The laboratory proper comprises a full size basement, divided into three large rooms, eight rooms on the ground floor, eight rooms on the second floor and the third floor with three rooms and two tower rooms.

The four front rooms on the ground floor are occupied as offices and the remaining space is given over to general laboratory work rooms and storage. An electric refrigeration room in the basement, 6′ x 6′ x 7′, provides storage space for a large amount of material, and a smaller box capable of maintaining very low temperatures is used for various experiments. An electric superheating chamber, 5′ x 7′ x 6′, is used for fumigation of incubators and material as desired; and a three compartment greenhouse immediately adjoining the back of the laboratory will provide facilities for winter work on insects requiring green plants for food of host insects. Foreign insect material is handled in large screen cages in tightly

screened rooms provided for this purpose and a number of home-made incubation chambers have been built to suit the requirements of the different species studies.

The grounds will provide space for much experimental work and permit of the extension of facilities required from time to time to cover special problems.

THE BLUEBERRY MAGGOT SITUATION IN CANADA A PRELIMINARY REPORT

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Entomological Branch, Ottawa

During the past summer (1930) a report was received by the Department to the effect that fresh blueberries exported from Canada to the United States were being delayed and in certain cases refused entry by the United States authorities on account of maggots. Subsequent investigation showed that all shipments of blueberries entering the United States were being tested by officials of the Food, Drug and Insecticide Administration, United States Department of Agriculture, for the presence of the apple maggot, and that in certain cases this pest had been found.

The apple maggot (*Rhagoletis pomonella* Walsh), has a variety of hosts including crataegus, crab apples, pears, plums, cherries, huckleberries, blueberries, cranberries, apples, and a closely related species attacks snowberries. According to Porter,[1] the first report of this pest in Canada was in 1887 when it was reported as attacking haws in Ontario, Fletcher[2] reports it for the first time in 1896 as attacking apples in an orchard at Adolphustown, Ontario and Brittain and Good[3] report its presence on apples in Nova Scotia in 1913. The first report of this insect attacking blueberries was made by Wood[4], in 1914, who stated that it had been bred from this fruit in Maine the previous year, although he also stated that the apple maggot had been reared from huckleberries in Connecticut in 1905 and in New Jersey in 1910. So far as can be learnt the literature does not reveal this insect as ever having been bred from blueberries in Canada. Brittain and Good state in their bulletin on the apple maggot, that "It has not, however, been found affecting these plants (huckleberries and blueberries) in Nova Scotia, though a careful search in some of our extensive blueberry barrens has been made. Furthermore we have not been able to find any one who remembers having seen 'wormy' blueberries in the province." Although the apple maggot is present in various localities in eastern Canada, its discovery this season on blueberries came as an unpleasant surprise to entomologists and the industry generally.

Owing to the fact that the report was not received until the latter part of August, it was impossible to carry on field observations to any extent in Canada, but the writer did have an opportunity to visit Maine and learn something of what had been done in that state. Since the discovery of the apple maggot in blueberries in 1913, the intensity in the degree of infestation and the spread of this insect into the blueberry sections of the state has increased to a very alarming extent. There are now about seven townships in which the blueberries are so heavily infested with maggots that they can not be picked and sold as fresh fruit. An entomological laboratory has been established at Cherryfield since 1924, and effective means of con-

trolling the pest have been developed by means of dusting with calcium arsenate. Canning berries which do not show too high a percentage of maggot infestation can also be safely treated by the so-called "Maggot washer". Furthermore, the state has an inspection law, which requires that all blueberries shipped out of the state must be tested for maggots.

At the present time the blueberry industry in Canada is for the most part in an unorganized condition, the blueberries are gathered by settlers and others in remote districts, and sold as fresh fruit, whereas in Maine it is apparently a fairly well organized industry, and is handled by the canners whose plants are located in a comparatively small area of the state. Furthermore, the control measures which are so successful for canning berries, do not appear to be as suitable for the fresh or chilled fruit side of the trade. The Canadian problem, therefore, will be a difficult one to handle and will undoubtedly tax the resources of the entomologists into whose care it is entrusted, for as has been said it is one that we know but little about at the present time.

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THE WHITE GRUB SITUATION IN EASTERN CANADA

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During recent years, white grubs have caused very serious losses in eastern Canada, to farm and garden crops, as well as to coniferous seedlings and young apple stocks in nursery rows. It would be difficult to determine the total loss to agriculture but we may safely assume from a knowledge of conditions for the past five years that visible and invisible losses would amount to many thousands of dollars over southern and central Quebec, eastern Ontario and certain parts of the Gatineau and upper Ottawa valleys.

Such being the case, white grubs continue to constitute a class of insects which is of great economic importance and worthy of the most careful study. It is particularly desired to present certain facts relative to common white grub life cycles in eastern Canada, inasmuch as they are of unusual interest and will have a very decided bearing on the timing of local control recommendations.

It was formerly thought that the common white grub species, *Phyllophaga anxia Lec.*, had a contemporary life cycle through its range in eastern Ontario and over the principal agricultural sections of Quebec. Recent findings, however, show that the species has three well-defined life cycle zones within a radius of 50 miles, each separated by possible physiographic barriers and each characterized by a more or less distinctive biological setting. For instance, third year grubs were the most common stage

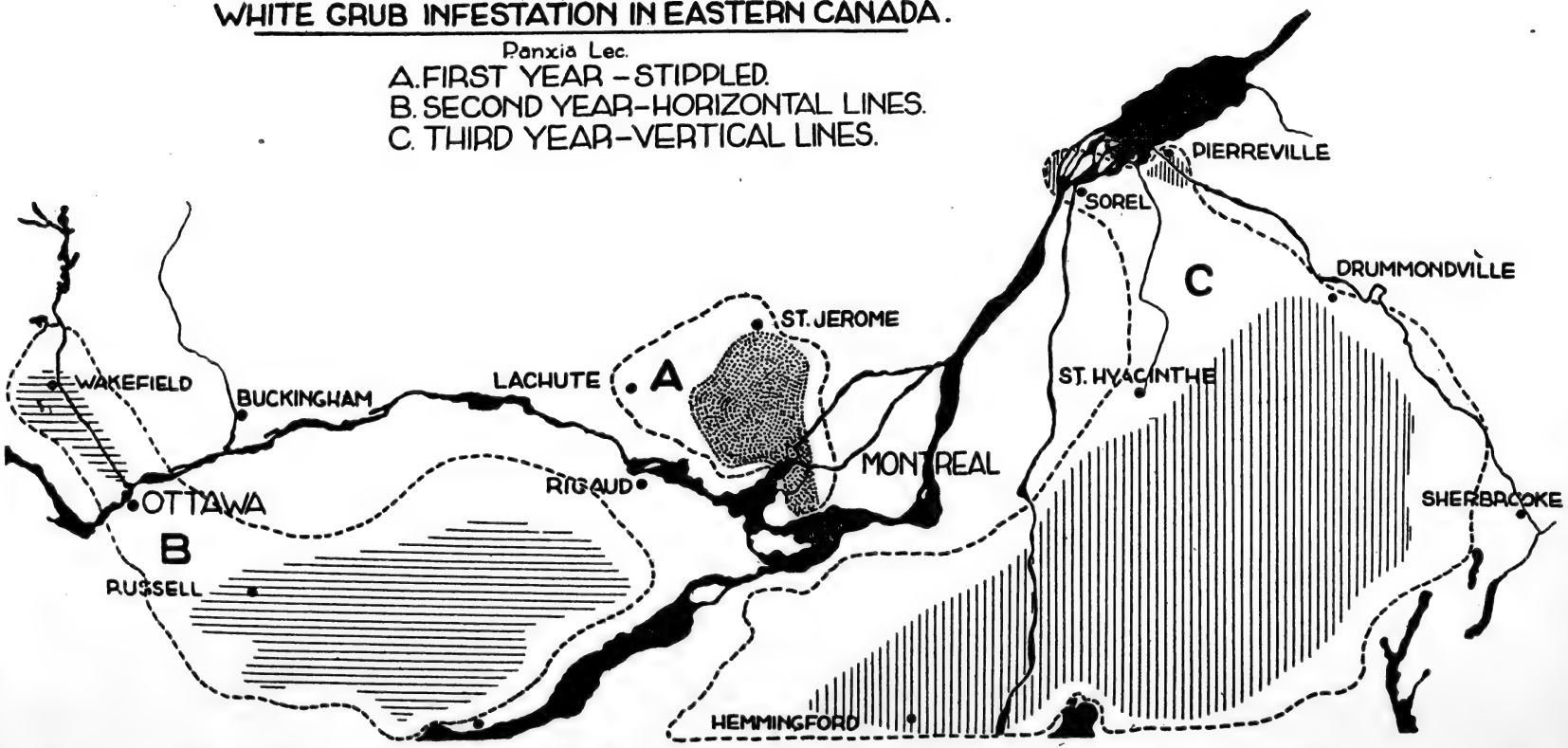

Figure 1.—Distribution of white grub infestations in Eastern Canada in 1930 indicating phase of life-history present in different areas; (A) first year grubs; (B) second year grubs and (C) third year grubs.

over southern Quebec during 1930, first year grubs immediately to the northwest of Montreal and second year grubs in Glengarry and Stormont counties of eastern Ontario.

In other words, each year of the three year life cycle was represented in one or other of the geographical sections under discussion and it was possible to observe the fluctuations in the numbers of white grub natural enemies, both with regard to the stage of development of the grubs and local factors.

The largest life cycle zone is located over south-western and central Quebec, exclusive of Montreal island and is situated south of the St. Lawrence river, except for a severe local outbreak near Berthier. The Oka-St. Jerome zone does not enter Ontario at any point, nor does it extend to the south shore of the St. Lawrence river in Quebec and is the smallest of the three zones under discussion. The eastern Ontario zone covers a fairly large area in extreme easterly section of the province, extending northward across the Ottawa river district into the Gatineau and upper Ottawa valleys. Each zone will, however, be dealt with more fully under separate paragraphs.

The southern and central Quebec zone covers an area of approximately 4,000 square miles, most of which is heavily infested by white grubs. It is bounded on the south-west by the St. Lawrence river, on the south by the International Boundary and on the north-east by the St. Francis river valley, although it is likely that the sparse white grub populations to the north-east belong to this zone also. A great diversity of physical conditions is found over this area and the heavier white grub infestations are found in loam, sand and gravel at comparatively low altitudes. Severe injury from second year grubs occurred during 1929 over the section indicated by vertical lines on the map (fig. 1). June beetle host trees such as American elm, *Ulmus americana* Linn., various species of poplar, ash, hickory, oaks and butternut, occur in ample quantity to supply food for the heavy flights of June beetles occurring over this zone and the large areas of undisturbed sod in pasture and hay land provide every opportunity for the maintenance of a severe infestation.

This zone is well furnished with white grub parasites and predators but they vary greatly in numbers from locality to locality. The two principal insect parasites, *Tiphia inornata* Say and *Microphthalma michiganensis* Tns. have been very effective locally and they are, therefore, of decided value in natural control. The parasitic fungus *Cordyceps* sp. was conspicuous during 1930 and was responsible for a spectacular reduction in white grub larvae in certain fields. Ground beetles, mammalian and bird predators such as the star-nosed mole, the skunk and the crow were also effective in reducing white grub numbers.

Over this entire section the grubs were in the third year during 1930 and pupated during the present summer, developing into the beetles which will form a major flight during the latter part of May and the first three weeks in June, 1931.

The Oka-St. Jerome zone of infestation covers an area of about 425 square miles, of which about two-thirds is heavily infested. The most southerly point of this zone is Beaconsfield and between this point, Oka and St. Jerome the infestation is pronounced. Between these latter points, Lachute, Piedmont and Terrebonne the zone is distinct although the present infestation is light. The heavier infestations are also located at comparatively low altitudes in sand or sandy loam soils. Many field crops were

attacked, the injury to garden or truck crops such as corn, strawberries, vegetable seedlings and potatoes was also serious during 1928, the last year when the destructive second year grubs were prevalent. This area, located within easy reach of the Montreal market, produces a large volume of truck crops and it is well furnished with favorite June beetle host trees.

White grubs will be in the destructive second year stage during 1931 and severe injury to susceptible crops may be looked for in some sections, especially since the two principal insect parasites occurring over southern Quebec, T. *inornata* Say and *M. michiganensis* Tns. are at present not very effective and the parasitic fungus, *Cordyceps* sp., is not found except in rare instances. Insect, bird and mammalian predators which are found south of the river occur in heavily infested fields in this zone and seem to be equally effective in control.

The so-called eastern Ontario zone, reaching from St. Polycarpe in Soulanges county in Quebec to Iroquois and Manotick in Ontario on the west, which is also continuous with the Gatineau and upper Ottawa valley infestations, covers an area of almost 1,000 square miles, 700 square miles of which are at present heavily infested by white grubs. Glengarry and Stormont counties suffered the heaviest losses and muck soil seemed to be preferred by white grubs, although heavy infestations occurred in loam, gravel, sandy loam and other soils exclusive of clay. Severe injury is indicated on the map (fig. 1) by parallel horizontal lines. Injury to potatoes was very general and quite severe. Crops like timothy, corn and fibrous-rooted grasses suffered exceptionally severe injury over this dairy section, although tap-rooted plants like alfalfa and red and alsike clover, located under similar conditions, escaped injury. A 20-acre field of timothy on one farm was so seriously reduced in yield through grub feeding that it was not worth cutting and the owner, in common with many other farmers in this infestation zone, was forced to buy additional fodder for this live stock.

Residents in the districts concerned in this infestation affirm that grub losses were the heaviest in 40 years. A few of the principal insect parasites occurring over southern Quebec were observed but in such small numbers that they could have little effect in reducing white grub concentrations. Predators such as the skunk and the star-nosed mole were not observed and the parasitic fungus *Cordyceps* sp. did not appear in fields under examination. Hence, it seems safe to assume that the lack of natural enemies is associated with the present condition in this zone.

The last flight of beetles occurred during 1929 and the next flight is due during 1932, while during 1933 the grubs will again be in the destructive second year stage and severe injury may be looked for at this time.

The Gatineau and upper Ottawa valley infestation zone is really an extension of the eastern Ontario zone but it is here treated as a separate zone because of its physiographic grouping and because of its occurrence at some distance from the former. It involves an area of about 250 square miles. Grubs were found in moderate numbers between Wakefield and Low and in outbreak numbers at the north-west corner of Phillip lake some distance southward of Masham, extending almost to this latter point. Second year grubs were also found in moderate numbers in sod at Aylmer and Quyon and at intervening points. The presence of large tracts of arable clay in the Gatineau valley would prevent a widespread white grub outbreak although the soil over much of the upper Ottawa valley is ideal for white grub habitation.

The digger wasp *Tiphia* was the only parasite observed in the two areas, although the species *P. anxia* Lec. is the same as that occurring over other zones under discussion.

There are always a number of white grub or June beetle stages which do not belong to the predominating phases in a given locality and while the over-lapping in some individual sites may be considerable, it is on the average, not important in eastern Canada, influencing less than three per cent. of the total population. This over-lapping may be due to retarded development which in turn may be due to stings from the parasite *Tiphia,* followed by unsuccessful parasitism, late hatching, cold soil and individual unthriftiness.

In analyzing the situation as a whole it is rather difficult to arrive at a logical conclusion in respect to how these areas developed three distinct life cycle zones.

All three zones occur within one degree of latitude and from the eastern side of the main Quebec zone to the distant side of the eastern Ontario infestation zone is only about 250 miles; average temperature variations between these zones are not very great; and hence it may be that the physical barriers imposed by the large rivers and the associated broad areas of heavy soil may have an important part in maintaining these distinct life cycle zones. Any full explanation of the causes of the present life-cycle rhythm in these areas awaits further study.

THE SATIN MOTH IN THE MARITIME PROVINCES

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This paper is intended primarily, to record the presence of an additional foreign pest in the Maritime provinces, but before dealing with that matter in detail, it may be of interest to refer to the history of the satin moth on this continent.

The first record in Canada was discovered by an officer of the Entomological Branch in July, 1920, when an outbreak was found on poplar trees at New Westminster, B. C., and about the same time, an outbreak was found in the cities of Malden and Medford near Boston, Mass. In 1922, the satin moth was discovered at Bellingham in the state of Washington on the Pacific coast.

In view of the fact that the adults are strong fliers, it was anticipated that natural spread would occur quite quickly. As this pest is a close relative to the brown-tail and gypsy moths, it was also realized by the various authorities interested in these outbreaks, that every effort should be made to prevent unnecessary distribution.

In each district it was found that the imported poplars were the most favoured host trees and even at the time of the original discovery of the outbreak, rather serious defoliation had occurred, and various species of willows were also found infested. In the New England states and in the state of Washington, scouting operations were carried on each year to determine the spread of the insect, and the movement of poplars and willows to points outside the known infested districts was prohibited by special quarantines. These annual scouting activities have shown that by 1929, the infested area in the state of Washington covered the complete western

section of that state involving all that area west of the Cascade Mountains. In the New England states, the distribution had extended to include the entire area east of the Connecticut River, as far north as Springfield, with additional westward spread in Massachusetts and the south-eastern section of Vermont. In addition, spread occurred northward in New Hampshire to Newport, Plymouth and Glen. In the state of Maine the area included the south-western section of the state, approximately south of a line from Bethel to Belgrade, Skowhegan and Lincoln with the most eastern record at Ellsworth.

Activities in Canada

When it was realized that the satin moth was proving to be a serious pest in British Columbia, due to the fact that the native cottonwoods were also being infested, action was taken to prevent artificial distribution by placing a quarantine on the south-western section of the province, in April 1928. Scouting carried on during the past two years has shown that the satin moth is present between Victoria and Campbell River on Vancouver Island, as well as at Port Alberni on the west coast. On the mainland, the northern distribution extended to Powell River, a distance of eighty miles from Vancouver and as far east as Hope on the C.P.R., and Anderson Lake on the P.G.E. Railway. No further spread was found in 1930, but reports show an increase in many sections with resulting damage to the host trees.

In view of the annual eastward spread in the New England states, it was anticipated that the Maritime provinces would become infested within a limited period. The first official record of the satin moth in the Maritime provinces was reported by Mr. R. P. Gorham of the Entomological Laboratory at Fredericton, who discovered an outbreak at Annapolis Royal, N.S., in June, 1930. As a result of this discovery, scouting was organized to examine portions of Nova Scotia and New Brunswick. Several small, local outbreaks were found in Nova Scotia, between Annapolis and Yarmouth along the coast, and in addition one infestation was located near the border of the Yarmouth-Shelbourne county line.

In New Brunswick, four separate centres of infestation were located. Three small outbreaks were found at St. Andrews, Marysville (near Fredericton) and Sussex, but the most interesting outbreak concerns sections of Kent, Westmoreland and Albert counties, which has most likely resulted from a central infestation in Moncton city. This outbreak may have been present for some years, as it has developed to such an extent that the Moncton city authorities have found it necessary to practice control measures so as to prevent serious damage to the trees and inconvenience to the citizens.

The satin moth is widely distributed throughout Europe and Asia where a number of races are recognized in the different regions where it occurs. Poplar and willow trees are recorded as the most favoured host plants, but oak is also mentioned. Observations on the feeding habits of this insect during the past several years have shown that it has a preference for the imported poplars and in British Columbia the native cottonwoods are also becoming a favoured host. Reports from the New England states received this season, indicate the possibility of this pest turning its attention to our native poplars in the east. Although no special investigations have been carried on in that regard, native poplar stands in some of the areas which have been infested for several years, have suffered defoliation. This would indicate that the satin moth may prove to be an additional pest of importance to some of our forest and shade trees in eastern Canada.

NOTES ON JACK PINE SAWFLIES IN NORTHERN ONTARIO

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During the past two years several reports were received indicating that in many parts of Northern Ontario and Eastern Quebec the jack pine had been attacked by a sawfly. From a survey made in 1929 it appeared that the infestation was probably still on the increase and it was decided to study the habits of this sawfly and its relations to other insects in two different and widely separated localities. During the present season, Mr. M. B. Dunn had charge of a field laboratory at Laniel, Que., and the writer conducted a similar station at Biscotasing, Ont.

At the beginning of the jack pine sawfly investigation in Biscotasing, Ont., it was expected that only one species, probably *Neodiprion banksianae* Roher, would be present in this region. Soon it was learned that not less than three species of sawflies were attacking jack pine of all sizes and ages. As far as is known, all three species belong to the genus *Neodiprion* and the adults are rather difficult to separate. Up to the present, no determination from a specialist could be obtained and, therefore, common names are used in this paper.

A. The Black-Headed Jack Pine Sawfly

The winter is passed in the egg stage on the host tree. The eggs hatch during the latter part of May and the larvae are full-grown by the end of July or beginning of August. The adults appear in the latter part of August and the first half of September. The eggs are laid during September in slits which are cut in rows along the edges of the new needles. The larvae in all the stages have a black head capsule; the body is greenish. In the later stages darker longitudinal stripes appear on the dorsal and the lateral areas. Five larval stages are the rule. This species is apparently the one referred to by Dr. S. A. Graham in his "Principles of Forest Entomology", pp. 161, 162, as *Neodiprion banksianae* Roher. It is rather common but of no special economic importance so far as the present study is concerned.

B. The Brown-Headed Jack Pine Sawfly

This species hibernates as a prepupa in cocoons which are spun in the litter on the ground either beneath the infested trees or at a short distance from them. In the latter part of May, the prepupae transform to the pupal stage and the adults appear during the latter part of June. The eggs are laid in slits which are arranged as in the foregoing species and are laid in the foliage of the preceding season. Hatching takes place during the first half of July. The larvae feed upon the old foliage throughout July, August and the greater part of September, when they become full-grown. The larvae moult five times and always have a brown head capsule. From the third stage onward the larvae are marked with longitudinal stripes which are often interrupted especially in the fifth stage. A dark spot on the 9th segment is always entire. Many of the larvae transform to the prepupae on the trees. Approximately 30 to 40 per cent. of the infestation at Biscotasing is caused by this species.

C. The Twin-Egg Sawfly

The seasonal history is similar to that of the brown-headed jack pine sawfly, except that the adults appear about four weeks later in the season.

The common name, "Twin-egg sawfly", was chosen on account of the peculiar oviposition habits. The eggs are always laid in slits cut in the new foliage. Usually a single egg-slit is made in each of the two needles in the bundle, the slits being always opposite to each other. The larvae emerge about the end of July and are full-grown toward the end of September. The head capsule is brown in all stages, the first four stages showing no darker markings at all. The fifth and sixth stages have somewhat similar markings to the brown-headed jack pine sawfly, but the marking on the 9th segment is always divided. Sixty to seventy per cent. of all the sawflies met with in this study at Biscotasing belonged to this species.

The principal methods followed in this study will now be briefly described. The exact results obtained through them have not been worked over and will not be published before the different points have been checked for a number of years.

Throughout the season, at least two soil samples, each one foot square, were taken from selected localities. The following data were recorded: the number of cocoons per square foot; the emergence of the adults as indicated by the increase of empty cocoons; the hold-over of sawfly prepupae to a second summer; the percentage of parasitized cocoons; the increase of the cocoons in the fall; the winter mortality in the cocoon stage; the preference for certain types of soil or soil cover for pupation, and the fauna of the soil and litter in jack pine stands.

Emergence cages placed under selected trees and examined every day throughout the season gave the emergence of the sawflies as well as of all other insects which spent the winter in or on the ground.

It was found possible to watch the development of selected groups of sawflies from oviposition to hibernation in the fall. The different stages of the larvae were marked with paint. Through daily examination of these rearing samples, a great amount of information was obtained concerning the length of the egg and the larval stages, the mortality and reduction in each stage, the migratory and the feeding habits, the time of dropping from the branches to spin the cocoons, the moulting habits, etc.

Three twig samples were taken daily for each one of the two economic species. A sample included a twig or branch on which a single group of eggs had been laid, showing all the feeding which had been done. It was learned that one female when undisturbed lays only a single group of eggs; each one of these samples, therefore, represented the progeny of one female. Much time was spent in determining the amount of food consumed by the progeny of one female throughout the season. The analysis of one sample is given in the following tables.

TABLE NO. 1

INSECT ANALYSIS

Date—August	Sample Tree No.	Eggs			Scars	Empty pockets	Unhatched Eggs										Larvae						Pre-pupa	Pupa	Remarks
							Parasitized Eggs								Killed by Predators				Larvae								
							Stage of Parasite Present												Stage								
		Orig. No.	Hatched	Not Hatched			Egg		Larva		Pupa		emerged		Hemip. tera	Ants and Wasps	Parasite and Host killed by Hemip.	Fresh eggs	I.	II.	III.	IV.	V.	VI.			
							T*	H*	T	H	T	H	T	H													
29	62	90	69	21	1	3			18						1		2						5	37			

T* and H* Two unknown species of egg parasites.

TABLE NO. 2

TWIG ANALYSIS

Date	Sample Tree No.	Length in mm. — Twig						Length in mm. — Needles					Orig. Number of Needles						Feeding 1930 in Needles						Remarks
		1926	1927	1928	1929	1930	Total	1926	1927	1928	1929	1930	1926	1927	1928	1929	1930	Total	1926	1927	1928	1929	1930	Total	
August 29					39						30					54						14			
					125						33					126						58			
					5						27					6						6			
					72						22					90						90			
					34						22					22						22			
					38	95					22	37				48	162					47			This total represents 535 needles of an average length of 28 m.m.
				135	69	21				39	28	20			140	105	42				101	17	10		
				83	21	38	775			35	21	30			108	44	82	1029			107.	28	2		
	62														248	495	286	1029			208	282	12	502	
															9240	13,324	8.294	30858			7,684	7,058	260	15,002	

Sum in Needles

Sum in Millimeters

Ground sheets fastened to a wooden frame, with the latter on top and covered with tangle foot, were used successfully to check points such as the dropping of the full-grown larvae or prepupae from the branches for hibernation; the determination of the percentage of diseased and dead larvae and the percentage of parasitism in the prepupae.

Throughout the investigation an accurate record was kept of many physical and biotic factors of the environment.

NOTES ON THE OCCURRENCE OF THE PINE BUD MOTH (*Exoteleia dodecella* L.) IN WELLAND COUNTY, ONTARIO

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During the early part of the summer of 1928, while obtaining infestation records and conducting eradication measures in connection with the infestation of the European pine-shoot moth in the nurseries of the Fonthill and Ridgeville districts of Welland county, Ont., we repeatedly came across small, undeveloped, withered and hollow buds containing minute, somewhat flattened, cigar-shaped pupae. These small pupae, dark brown in colour, were almost instantly recognized as being quite distinct from the very much larger, paler, almost yellowish-brown pupae of the European pine-shoot moth. Being quite unable to determine their identity, a number of specimens were collected, some of which were successfully reared in the Plant Inspection Office at Niagara Falls and the adult moths submitted to Ottawa for identification.

On arrival at the Entomological Branch headquarters in Ottawa, the specimens were referred to Dr. J. McDunnough by whom they were identified as *Exoteleia dodecella* L.; the identification being later confirmed by Mr. A. Busck of the United States Bureau of Entomology.

Our discovery and collection of pupal specimens of the pine bud moth constitutes, we believe, the first record of this insect on the North American continent.

Following this discovery and in view of its economic importance, which is well indicated in reports from Germany, it was considered advisable to keep a close watch on the insect during the two succeeding years, 1929 and 1930. This work has been carried on in association with our European pine-shoot moth eradication campaign, which necessitates the close examination of between 35,000 and 40,000 pine trees of various species in the nurseries, parks, cemeteries, and public gardens of the Niagara peninsula.

In complete accord with our preliminary observations in the early summer of 1928, our systematic search for the pine bud moth in the corresponding season of the following year (1929) indicated that this pest was quite prevalent on Scotch pines and not uncommon on mugho pines among the plantations in the larger nurseries of the Fonthill and Ridgeville districts; it was rare in both Scotch and mugho plantations in the parks and cemeteries in the immediate vicinity of the city of Niagara Falls, and was apparently entirely absent from those other parts of the Niagara peninsula where pines are known to be grown in appreciable quantities.

Further search and systematic examination of pine trees during the past summer (1930) has shown us that the pine bud moth is still holding

its own, in both Scotch and Mugho pines, at Ridgeville; but that our effort to eradicate this pest at Fonthill in 1929 had apparently met with marked success for infestation by *Exoteleia dodecella* is now reduced to a very low ebb in that locality. In the immediate vicinity of Niagara Falls, it is still possible to find an occasional pine with one or two buds infested by this potentially dangerous pest but here the pine bud moth can only be considered, at the present time, as a very rare insect. Elsewhere in the Niagara Peninsula, in accord with our findings in 1929, this insect would still appear to be entirely absent.

Wherever the insect has occurred, our observations have indicated that it normally shows a marked preference for the buds of the Scotch pine (*Pinus sylvestris*). The mugho pine (*Pinus montana mughus*) is also rather frequently attacked, and our co-worker, Mr. F. W. Gregory, has given us one record of a pupa collected from an eight year old white pine (*Pinus strobus*). We have no definite record of it attacking any other species of pine, although, from some early notes made in 1928, it would appear that it will very occasionally attack *Pinus austriaca,* especially when the growth is not very strong. A sturdy vigorous growth of Austrian pine with strong well developed buds would appear to be very resistant to the larvae of the European pine shoot moth, probably owing to the immense amount of gum secreted by the buds which, we have noticed, have a tendency to exude great quantities of this sticky substance and drown the larvae of *Evetria buoliana* as soon as they start eating in the early spring. This being the case with *Evetria*, it is only reasonable to suppose that a similar fate would overtake the larvae of the smaller *Exoteleia* directly they attempted to penetrate the buds of such trees.

Owing to the fact that infestations of *Exoteleia* have almost invariably been found on trees somewhat heavily infested by *Evetria* it has, due to a certain similarity of injury, been rather difficult for our field inspectors to make absolutely accurate records of the former species. All recorded specimens have been collected in the pupal state, for at this stage the difference between the two species, as previously indicated, is very marked. The larvae of *Exoteleia* appear to pupate several weeks earlier than the majority of the larger species of bud destroying moth, and possibly owing to the fact that we have been unable to get into the field on this project until toward the end of May or early June, our knowledge of the larval stage of the pine bud moth is very scanty. The few specimens of larva which we have handled appear to be very similar to an immature stage of the caterpillars of the European pine-shoot moth and we have never been absolutely sure that we were not dealing with under-developed larvae of the latter species although, if our observations are correct, we should say that the larvae of *Exoteleia* are generally of a richer darker-brown colour and with the black thoracic shield a little more pronounced than in the immature larvae of *Evetria.* Attempts made in the Plant Inspection Office at Niagara Falls, to bring supposed larvae of *Exoteleia* to the pupal and adult stages, have most unfortunately, been unsuccessful on two separate occasions. A more recent attempt, this autumn, to find larvae or larval borings in the needles of Scotch pines, from the buds of which pupae were collected this spring, was also unsuccessful. Our failure to find needle-boring or hibernating larvae this autumn is probably due in part to natural parasitism but in larger measure to the effectiveness of our eradication work, which entails the cutting off and destruction or collection of all the infested buds discovered during a very careful examination of each individual tree.

Certain hymenopterous parasites, one of which has been identified as a species of *Epiurus,* were found to be not at all uncommon in the Fonthill

and Ridgeville districts in 1928, and at that time appeared to be attacking indiscriminately the larvae and pupae of both the pine bud moth and the European pine-shoot moth. Our observations in 1929 and again this year would indicate that ichneumen parasites were again quite active among the infested trees at Fonthill and Ridgeville and have undoubtedly had some influence on the reduction of both pests in these locations.

We have been unable to make any definite observation on other forms of natural control; but the writer has noticed chickadees, kinglets and yellow warblers active in trees infested with European pine-shoot moth and undoubtedly these and other species of birds have some bearing on the mortality of both *Evetria* and *Exoteleia.*

Although natural control factors and our own vigorous eradication campaign are rapidly reducing the numbers of pine bud throughout the localities in which it was originally discovered, it would appear that it will be very necessary to keep a close watch upon this potentially dangerous insect so long as there are any to be found within the county.

NOTES ON THE RECOVERY OF ONION MAGGOT MATERIAL FROM SOIL SAMPLES BY THE USE OF A CENTRIFUGE

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In connection with the onion maggot studies which are being carried on in the Ottawa district it is necessary at regular intervals to recover from definite soil samples such insect material as eggs, egg shell, first, second and third stage maggots, full and empty puparia. For the larger stages this is a comparatively easy matter but for eggs and small maggots the task is much more difficult. At the commencement of the work an effort was made to recover the material by means of a soil washer but it was soon recognized that this machine was not suitable for the work due, primarily, to the minute size of certain of the stages. During the past two years the method adopted was simply to pick over the samples by hand, but this, although more accurate than the soil washing method, has proved exceedingly laborious and time-consuming and not by any means perfect.

Recognizing that there was no suitable method known for the recovery of the smaller stages of insects from the soil some time has been devoted to a study of this point during the past two seasons. A number of possible methods were tested but little success was met until centrifugalizing of samples was tried. From the outset this method gave distinct promise. It is described here, not because the study is completed and perfect but because it is thought that it might be used and experimented with by entomologists working with other species who are having difficulty in recovering certain stages, such as eggs or young larvae, from the soil.

In brief, the method is to immerse the samples to be tested in a concentrated saline solution and after thorough agitation to centrifuge them for from four to five minutes at a velocity of 800 revolutions per minute. The different stages of the insect float up on the surface of the liquid and can be recovered by throwing the solution on to ¼ millimeter mesh copper screens. At first it was thought necessary to stop the centrifuge half way through the process to again stir up the soil and water but sub-

sequent experiments have shown that this step is not needed for perfect results. A word might be said in regard to the method of procedure used in handling the soil. After the samples are secured the soil is placed in the glass bottles with which each of the metal cups of the centrifuge is equipped. The bottles should be filled about two-thirds full and the concentrated salt solution which has been previously prepared added; sufficient liquid being poured in to fill the glass containers up to the neck. The soil and liquid should then be thoroughly stirred by means of a glass rod or else the materials may be mixed by placing the hand over the top of the bottle while it is tipped up and back several times. It is essential that the contents of each bottle be thoroughly agitated. The glass vessels are now placed in the metal cups of the centrifuge and the machine set in motion. The speed should be gradually worked up to 800 revolutions per minute and held there for a period of from four to five minutes as has been stated previously. Some difficulty was experienced in recovering the first stage maggots from the liquid after centrifugalizing due chiefly to the fact that they were exceedingly small and almost translucent in color. Immersing the samples in certain hardening solutions before treatment, such as picric acid, hot water and corrosive sublimate was tried with good results. A weak solution of corrosive sublimate proved best, this material hardening and whitening the larvae so that they became more easily seen. When corrosive sublimate was used, however, it became necessary to use non-metal screens when recovering the maggots, etc., from the salt solution due to the fact that it is extremely corrosive in character. Very little work has been done by us with this hardening material, since the idea was only acted upon late in the season of 1930, but screens of some dark colored cloth, such as scrim, supported in wooden frames might prove effective in this connection. This point will have to be further investigated.

The type of centrifuge used is not of great importance provided the requisite number of revolutions per minute can be attained, but the size of machine has a very direct bearing on the speed with which the work can be carried out. In our work we were fortunate in having the co-operation of Dr. F. T. Shutt, Dominion Chemist, who allowed us to use a comparatively large centrifuge, in the laboratory of the Division of Chemistry at the Central Experimental Farm, which held four cups with a capacity of about half a pint each. This was admirable for small samples but if large samples were to be examined larger cups and more of them would be necessary.

If any of our entomological workers have used, or make use of this method in the future, the writer would be interested in hearing of their results and in gaining new ideas from their experiences.

It is a pleasure to acknowledge the assistance rendered by Mr. Wm. Dickison during the progress of this study.

NOTES ON CHEMOTROPIC RESPONSES OF CERTAIN INSECTS

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In the course of field work preliminary to a detailed study of the influence of odors on the apple maggot fly, *Rhagoletis pomonella* Walsh., certain substances were found to be attractive in varying degrees to other insects. It is desirable that such data be recorded at this time for they will

not have a place in the work which it is hoped will be published later dealing entirely with the apple maggot fly.

The procedure in this preliminary work was simple. The odorous material to be tested was placed in water contained in a grey graniteware pan which was suspended at a height of about ten feet in an apple tree bearing fruit and known to have been infested with apple maggot the previous year. Pure compounds were tested at a ratio of about 1: 750 in the water. Other materials were used in water at varying concentrations according to their nature. Pans were examined and trapped insects removed twice a week during the flight period of the apple maggot fly which in Nova Scotia may be expected to extend from the first week in July to the last week in August.

Some references have been examined in which a few of the insects concerned, notably the eye-spotted budmoth, *Spilonota ocellana* D. & S., are stated to have been attracted to certain odorous mixtures. The observations below then, will be partially new material, partially corroborative. On account of the fragmentary nature of this paper, no references are quoted, no bibliography appended.

The most interesting or most definite responses to odor are best presented in tabular form.

Attractant Body	Forms Evidently Attracted*	Apparent Degree of Attraction
1. Chemically Pure, Technical Grade or Crude Compounds		
Geraniol C.P. Geranyl acetate C.P. Geranyl butyrate C.P.	*Desmometopa* sp. (Milichidae, Dipt.)	Fair
Eugenol Tech.	*Hylemyia cilicrura* Rond. (Seed Corn Maggot, Dipt.)	Slight
Isoeugenol, Crude Amyl valerianate C.P.	*Anchicera pusilla* Payk. (Silken Fungus Beetle, Cryptophagidae, Coleop.)	Slight
Isoamyl formate C.P.	A winged ant—not yet determined	Decided
Safrol Tech.	*Lygus* sp. (Miridae, Hemip.)	Fair
Ethyl propionate, Tech.	*Campylomma verbasci* Mayer (Miridae, Hemip.)	Fair
Methyl phenyl acetate C.P.	An Ichneumonid of the tribe Porizonini	Very Slight
Ethyl malate, crude	*Rhagoletis pomonella* Walsh., (Apple maggot, Dipt.)	Fair
	Sarcophaga pallineruis Thoms. and *Helicobia halicis* Towns.	Fair
	Fannia canicularis L.	Fair
	Anthomyia Sp. Anthomyiidae Dipt.)	
	Pollenia rudis F.	Fair
	Lucilia sp. (Calliphoridae Dipt.)	
Methyl malate, Crude	*Rhagoletis pomonella* Walsh. (Apple Maggot Dipt.)	Slight
2. Essential Oils		
Oil Rhodium	*Hylemyia cilicrura* Rond. (Seed Corn Maggot, Dipt.)	Decided
	Simaethis pariana Cl. (Apple and Thorn Skeletonizer, Lepid.)	Decided
Oil Aniseed	*Simaethis pariana* Cl.	Decided
Oil Sweet Almonds	*Simaethis pariana* Cl.	Slight

3. Fruit Juices and Fruit Juice Products		
Fermenting Apple Syrup*	*Spilonota ocellana* Shiff. (Eye-spotted budmoth, Lepid)	Fair
Fermenting Apple Cider		
Fresh Apple Vinegar		
Fermenting Cherry Juice	*Pseudotephritis van* Say. (Ortalidae, Dipt.)	
	Rhagoletis pomonella Walsh (Apple maggot, Dipt.)	Slight
	Coleopterus truncatus Rond.	
	Epuraea labilis Er.	Fair
	Glischrochilus fasciatus Oliv. (Nitidulidae, Coleop.)	
4. Pollard Baits		
Pollard Sodium borate (Pollard 8 parts, Sodium borate 1½ parts, water 100 parts.)	Peculiarly attractive to Diptera, particularly Muscids, Anthromyiids, and Trypetids (including apple maggot flies) for about a week or more, later for Noctuid moths including *Catacolas* and for certain social wasps undetermined.	

* Determinations by Division of Systematic Entomology, Entomological Branch, Ottawa.

* Apple syrup diluted with water to about equal proportions quite the most attractive of these substances to all forms. Other materials used undiluted.

It is obvious that these notes can only be regarded as mere suggestions, for the local population of the various insects mentioned have not been estimated. Furthermore, insect species probably vary very greatly in regard to the likelihood of their drowning in the type of bait trap used. Again, it has been determined here and elsewhere that both color and form of bait trap may exercise considerable influence over the movements of some insects, notably certain of the fruit flies.

EXPERIMENTS ON THE CONTROL OF THE GRAY-BANDED LEAF ROLLER, *Eulia mariana* Fern.

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Introduction

The grey-banded leaf roller, *Eulia mariana* Fern., was first noticed to be a serious pest in a few orchards near Berwick, N.S. in 1925. Since that time it has shown a gradual increase and lately has been found to be quite generally distributed throughout the Annapolis Valley, in a number of cases the infestations being severe enough to call for special methods of control. It is confined to orchards which are in sod or those which have wide sod strips.

Notes on Life-history

This insect spends the winter in the pupal state on the ground enclosed within a folded leaf. Where the land is ploughed and most of the leaves turned under, this pest has, of course, no chance to survive, but when the sod system of orchard culture is followed the situation is different. The moths emerge when Gravenstein trees are in the advanced pink stage, usually about the last week in May, and eggs are deposited on the leaves and on the smooth bark of the trees. The young larvae feed, at first, on the under side of the leaves and thoroughly protect themselves with small webs. Feeding continues on the foliage of the trees all through the sum-

mer, the caterpillars in the later stages rolling the leaves in a manner typical of leaf rollers, and also feeding quite freely on the fruit until well into October. The caterpillars then go to the ground and pupate among the fallen leaves.

Method of Control

For several years a great deal of experimental work was carried on with the object of determining the most satisfactory time to affect a control and the most promising materials to be used. The results of these experiments indicated that the best period for the application of sprays was at the time the larvae hatch and begin to feed on the foliage. As a consequence, an experiment was conducted, during 1929, which gave somewhat promising results. The eggs are laid in masses of 50 to 140. On hatching, the larvae spin down on fine webs and are carried, by air currents, to all parts of the tree, where they immediately begin to feed on the under surface of the leaves. As they continue their feeding entirely in this location for a considerable time after hatching, it was considered that to be effective, spray applications would have to be made to the under surface. Accordingly plots were arranged in which an area was treated with one spray of lead arsenate at the rate of one pound to forty gallons; another area with the same material, but making two applications; and still another area in which two applications of nicotine sulphate (40%) was used at the rate of one pint to one hundred gallons. Wettable sulphur was used with each of these poisons. An untreated area was left in the centre of the block for a check.

The eggs of this pest were observed hatching on June 26 to 29, and so the first spray application was made on June 27 and 28. The second application was applied on July 6.

Later, extensive counts of leaves on the trees were made and the insect population determined.

To summarize the results, it was found that the following degree of control had been obtained:

One application of lead arsenate	48.9%
Two applications of lead arsenate	75.3%
Two applications of nicotine sulphate	84.8%

It was obvious from these results that two applications were much better than, and also it would appear as though nicotine was a little more effective than lead arsenate. The degree of control, while not as high as desired, was nevertheless very appreciable, and a great difference was apparent on the amount of scarring of the fruit.

From our present knowledge, therefore, the control of this pest would appear to be the application of two sprays, the first being timed about ten days after the calyx spray, and the second about twelve days later than this. These sprays should be made to the under surface of the leaf, and very thoroughly done. Either lead arsenate or nicotine sulphate may be used in this connection, and for a spray applied in the above manner, it is probable that wettable sulphur would be the best fungicide to combine with the poisons. It was impossible, in our experiment, to obtain more than, probably, 70% or 80% coverage of the under surface of the leaves, due to the overlapping or "shingle effect." The amount of coverage obtainable depends on the apple variety and manner in which the trees have been pruned.

THE ENTOMOLOGICAL RECORD, 1930

W. J. BROWN

Entomological Branch, Dominion Department of Agriculture

The present "Entomological Record" follows the usual plan. The practise of supplying complete distributional lists for a few families has been discontinued for the present. Records received from amateur collectors and those taken from the literature have been incorporated in the general lists which are based largely on material in the National Collection. An asterisk (*) is used in the following lists to indicate species recently described in journals other than the "Canadian Entomologist". Records included in that journal are not repeated here, and the reader is asked to note that during the year extensive lists of the Lepidoptera, Ephemeroptera, Heteroptera, and Coleoptera of the north shore of the Gulf of the St. Lawrence appeared there. The portions of this "Record" relating to Hemiptera, Diptera, and Hymenoptera have been prepared by Mr. G. S. Walley.

The following notices refer to the larger systematic contributions of interest to our readers which were published during the year. Several publications omitted from previous numbers of the "Record" are noted also.

ORTHOPTERA

The Orthoptera of Montana, by Morgan Hebard; Proc. Ac. Nat. Sci. Phila., LXXX, 211-306, 1928.

The Orthoptera of Colorado, by Morgan Hebard; Proc. Ac. Nat. Sci. Phila., LXXXI, 303-425, 1929. These papers are prepared in the same form as "The Orthoptera of South Dakota" which appeared in 1925. Each is an annotated list of the species occurring in the region considered. The notes given refer largely to distribution and to taxonomic characters and are such that the papers will be very valuable to all students of the order. Both papers contain descriptions of new species.

HEMIPTERA

Essay on the Subfamily Stenopodinae of the New World (*Reduviidae*), by H. G. Barber; Ent. Amer., X, 148-238, 1929 and 1930. This paper fills two numbers of Entomologica Americana. It consists of keys to and descriptions of the species. Many tropical species are described as new, and the Nearctic genera and species are considered for purposes of comparison.

A Monographic Study of the North American Species of Euscelis and Allied Genera (*Cicadellidae*), by J. P. Sleesman; Ent. Amer., X, 87-148, 1929. The paper consists of keys to and descriptions of the genera and species. There are ten plates of line drawings illustrating structural characters and a bibliography.

COLEOPTERA

A Manual of the Genera of Beetles of America North of Mexico, by J. Chester Bradley; 360 pp., Daw Illston and Co., Ithaca, N.Y., 1930. This volume is a compilation of keys from the most recent sources. It is intended to replace the out-of-date "Classification of the Coleoptera" by Leconte and Horn. It consists almost entirely of keys to genera and higher groups; little descriptive matter is included. The volume has been prepared very carefully.

The Moneilema of North America and Mexico, I (*Cerambycidae*), by Frank J. Psota, Coleop. Contrib., I, 111-141, 1930. The paper includes descriptions of the species and a key to those of the typical subgenus. Thirty species, including a number that are new, are considered. There are twenty-four plates illustrating the beetles and four illustrating their habitats. The author has examined all types in North American Institutions and intends to consider the Mexican species which are at present unknown in part 2 of his study.

DIPTERA

A Handbook of the Mosquitoes of North America, by Robert Matheson; 274 pp., 24 fig. and 26 pl.; C. C. Thomas, Springfield, Ill., 1930. This is a concise account of the mosquitoes.

Empididae, by A. J. Melander; Genera Insectorum, fasc. 185, 484 pp., 1930. This large work is indispensable to students of the family.

NOTES OF CAPTURES

CORRODENTIA

*Caecilius perplexus Chapman. Banff, Alta.
Jour. N. Y. Ent. Soc., XXXVIII, 326.

TRICHOPTERA

* Limnephilus robertsi Banks. Winnipeg Lake, Man.
* Limnephilus hageni Banks. Ft. Resolution, N.W.T.
* *Limnephilus sackeni* Banks. "Sault de Ste. Marie River".
Psyche, XXXVII, 226 and 227.
* *Arcadopsyche prominens* Banks. Cape Breton, N.S.
* *Rhyacophila fairchildi* Banks. Cape Breton, N.S.
* *Plectrocnemia aureola* Banks. Cape Breton, N.S.
* *Plectrocnemia albipuncta* Banks. Cape Breton, N.S.
Bull. Brook. Ent. Soc., XXV, 129 to 131.

ORTHOPTERA

* *Xanthippus corallipes buckelli* Hebard. Chilcotin District, B.C.
* *Melanoplus oregonensis triangularis* Hebard. Middle Fork of Old Man's River in Livingston Range, Alta.
Proc. Ac. Nat. Sci. Phila., LXXX, 241 and 269.

HEMIPTERA

By G. S. Walley

Gerridae

* *Gerris dissortis* Drake and Harris. Que.: Kazubazua (Brown, Walley). Mascanin (Brown), Natashquan (Brown). Bull. Brook. Ent. Soc., XXV, 145.

Corixidae

* *Arctocorixa omani* Hungerford. B.C.: Chilliwack, Vancouver Isl. (Taylor). Pan-Pac. Ent., VII, 25.
* *Arctocorixa impersonata* Walley. Que.: Fairy Lake (Brown, Walley). Ont.: Merivale, Ottawa (Walley). Bull. Brook. Ent. Soc., XXV, 204.

Scutelleridae

Acantholoma denticulata Stal. Britannia, Ont., (Walley).
Phimodera toripda Wlk. Medicine Hat, Alta. (Pepper).
Vanduzeeina borealis Van. D. Crow's Nest Pass, Alta., (Pepper).

Cydnidae

Galgupha nigra (Dallas). Aweme, Man., (Handford). On *Euphorbia glyptosperma.*

Pentatomidae

Sciocoris microphthalmus Flor. Waterton Lakes, Alta., (Pepper).
Aelia americana Dallas. Rolla, B.C., (Vroom).
Neottiglossa undata (Say). Blairmore, Cypress Hills, Medicine Hat, Alta., (Pepper).
Perillus exaptus (Say). Medicine Hat, Alta., (Pepper).
Rhacognathus americanus Stal. Banff, Alta., (Carr).
Podisus placidus Uhl. Lethbridge, Alta., (Pepper).

Aradidae

Aradus niger Stal. Fredericton, N.B., (Simpson).

Miridae.

Diaphnidia pellucida Uhl. Tupperville, N.S., (Gilliatt).
Diaphnidia capitata Van D. Tupperville, N.S., (Gilliatt).

Membracidae

Platycotis maritimus Van D. Goldstream, B.C., (Anderson).

Cicadellidae

Bythoscopus rufoscutellatus (Bak.). Aweme, Man., (Criddle); Saskatoon, Rudy, Sask., (Fletcher, King); Fairview, Vernon, B.C., (Treherne).
Parabolocratus viridis Uhl. Saskatoon, Sask., (Atkinson); Waterton, Alta., (Seamans).
Mesamia nigridorsum Ball. Aweme, Treesbank, Man., (Criddle, White).
Acinopterus viridis Ball. Dinsmore, Sask., (Atkinson).
Eutettix chenopodii Osb. Covey Hill, Que., (Petch); Aweme, Man., (Criddle); Sask., (King).
Phlepsiius marmor S. & De L. Harris, Sask., (King).
Phelpsius lascivius Ball. Rosetown, Marengo, Sask., (King, Atkinson).
Phelpsius nebulosus Van D. Saskatoon, Sask., (King); Manton, Alta., (King).

Fulgoridae
Scolops hesperius Uhl. Lethbridge, Alta., (Pepper).

Phylloxeridae
Adelges lariciatus (Patch). Fredericton, N.B., (Prebble) (on needles of larch).

COLEOPTERA

The following list includes the records of Mr. F. S. Carr and of the National Collection. Many of the interesting records from British Columbia are due to the careful collecting of Mr. G. Stace Smith. The arrangement of the list is that of Leng's Catalogue of Coleoptera.

Carabidae
209 *Callisthenes moniliatus Lec.* Happy Valley and Pincher, Alta., (Carr).
933 *Cylindrocharis rostrata* Newn. Scotch Lake, N.B., (Moore).
1430 *Triaena pallipes* Kby. Saskatoon, Sask., (King).
1575 *Platynus bembidioides* Kby. Purple Springs, Alta., (Carr).
1591 *Playtnus quadrimacultatus* Horn. Medicine Hat, Alta., (Carr).
1801 *Miscodera artica* Payk. Chilcotin, B.C., (Spencer).
1860 *Brachylobus lithophilus* Say. Wynndel, B.C., (Smith).

Haliplidae
2306 *Haliplus subguttatus* Robts. Ottawa, Ont., (Brown).

Dytiscidae
2398 *Bidessus granarius* Aube. Ottawa, Ont. (Brown).
2408 *Coelambus turbidus* Lec. Copper Mt., B.C., (Smith).
19185 *Coelambus semivittatus* Fall. New Dayton, Alta., (Pepper).
2458 *Hydroporus spurius* Lec. Wakefield, Que., (Brown).
19222 *Hydroporous aequus* Fall. Covey Hill, Que., (Brown).
2577 *Agabus clavatus* Lec. Copper Mt., B.C., (Smith).
19236 *Agabus approximatus* Fall. Copper Mt., B.C., (Smith.
19238 *Agabus ontarionis* Fall. Cypress Hills, Alta., (Carr).

Gyrinidae
2685 *Gyrinus confinus* Lec. Wynndel, B.C., (Smith).
3694 *Gyrinus consobrinus* Lec. Wynndel, B.C., (Smith).
2696 *Gyrinus affinis* Aube. Wynndel, B.C., (Smith).
2703 *Gyrinus pectoralis* Lec. Copper Mt., B.C., (Smith).
2704 *Gyrinus picipes* Aube. Wynndel, B.C., (Smith).
Gyrinus bifarius Fall. Wynndel, B.C., (Smith).

Hydrophilidae
2716 *Ochthebius nitidus* Lec. Wakefield, Que., (Brown).
2717 *Ochthebius cribricollis* Lec. Wakefield, Que., (Brown).
2723 *Ochthebius lineatus* Lec. Winnipeg, Man., (Wallis); Copper Mt., B.C., (Smtih).
2728 *Ochthebius lapidicolus* Van D. Queen Charlotte Islands, B.C., (Keen).
2764 *Hydrochus squamifer* Lec. French Lake, N.B., (Brown).
2789 *Hydrous triangularis* Say. Lethbridge, Alta., (Seamans); Vernon, B.C., (Gillespie).
2818 *Paracymus despectus* Lec. Ottawa, Ont., (Harrington).
2825 *Paracymus digestus* Lec. Knowlton, Que., (Brown).
2826 *Paracymus rufiventris* Horn. Creston, B.C.. (Smith).
2816 *Crenitis moratus* Horn. Copper Mt., B.C., (Smith).
2827 *Crenitis monticola* Horn. Portaupique, N.S., (Frost); Bolton Pass, Que., (Walley).
2836 *Enochrus perplexus* Lec. Covey Hill, Que., (Brown).
2837 *Enochrus cinctus* Say. Covey Hill, Que., (Brown).
Enochrus collinus Brown. Copper Mt., B.C., (Smith).
2850 *Cymbiodyta fimbriata* Melsh. Knowlton, Que., (Brown); Miners Bay, Ont., (Walley).
2851 *Cymbiodyta blanchardi* Horn. Knowlton, Que., (Brown).
19276 *Cymbiodyta minima* Notm. French Lake, N.B., (Brown); Covey Hill, Que., (Brown); Pt. Pelee, Ont., (Milne).
19277 *Cymbiodyta vindicata* Fall. Kazubazua, Que. (Brown).
19278 *Cymbiodyta acuminata* Fall. Aylmer, Que., (Brown); Ottawa, Ont., (Brown); Copper Mt., B.C., (Smith).
2876 *Cercyon praetextatus* Say. Copper Mt., B.C., (Smith).

Silphidae
2935 *Pteroloma forssteroemi* Gyll. Hope Trail, B.C., (Smith); Waterton, Alta., (Carr).
2978 *Colon pusillum* Horn. Fairy Lake, Que., (Brown).

Staphylindiae
3288 *Micropeplus punctatus* Lec. Edmonton, Alta., (Carr).

3290 *Micropeplus costatus* Lec. Edmonton, Alta., (Carr).
3299 *Siagonium punctatum* Lec. Cypress Hills and Edmonton, Alta., (Carr).
3424 *Acidota crenata* Fabr. St Peters, N.S., (Balch).
3437 *Tilea cavicollis* Fauv. Leggan and Waterton, Alta., (Carr).
3462 *Geodromicus strictus* Fauv. Knowlton, Que., (Milne).
3596 *Platystethus americanus* Er. Edmonton and Medicine Hat, Alta., (Carr).
3621 *Bledius turgidus* Csy. Edmonton, Alta., (Carr).
3625 *Bledius fumatus* Lec. Edmonton, Alta., (Carr).
3720 *Stenus ventricosus* Csy. Edmonton, Alta., (Carr).
3858 *Dianous zephyrus* Csy. Lundbreck, Beaver Creek and Waterton, Alta., (Carr).
4008 *Lathrobioma othiodies* Lec. Edmonton, Alta. (Carr).
4015 *Tetartopeus capitosus* Csy. Banff and High River, Alta., (Carr).
4016 *Tetartopeus punctulatus* Lec. Medicine Hat and Cypress Hills, Alta., (Carr).
4045 *Lathrotaxis longiuscula* Grav. Medicine Hat, Alta., (Carr).
4278 *Astenus longiusculus* Mann. Medicine Hat, Alta., (Carr).
4285 *Nudobius cephalus* Say. Edmonton and Lesser Slave Lake, Alta., (Carr).
4296 *Gyrohypnus obsidianus* Melsh. Medicine Hat, Alta., (Carr).
4308 *Gyrohypnus hamatus* Say. Edmonton, Alta., (Carr).
4314 *Gyrohypnus pusillus* Sachse. Edmonton, Alta., (Carr).
4319 *Gyrohypnus gularia* Lec. Medicine Hat, Alta., (Carr).
4326 *Leptacindoes nigritulus* Lec. Medicine Hat, Alta., (Carr).
4364 *Neobisnius paederoides* Lec. Medicine Hat, Piegan and Indian Reserve, Alta., (Carr).
4384 *Philonthus aeneus* Rossi. Castor and Edmonton, Alta., (Carr).
4400 *Philonthus duplicatus* Bnhr. Edmonton and Cypress Hills, Alta., (Carr).
4401 *Philonthus lautus* Csy. Medicine Hat, Alta., (Carr).
4412 *Philonthus umbrinus* Gray. Medicine Hat and Banff, Alta., (Carr).
4419 *Philonthus theveneti* Horn. Medicine Hat, Alta., (Carr).
4421 *Philonthus varians* Payk. Medicine Hat, Alta., (Carr).
4424 *Philonthus discoideus* Grav. Medicine Hat, Pincher and Cypress Hills, Alta., (Carr).
4432 *Philonthus occidentalis* Horn. Medicine Hat and Pincher, Alta., (Carr).
4470 *Philonthus nigritulus* Grav. Edmonton and Medicine Hat, Alta., (Carr).
4480 *Philonthus instabilis* Horn. Medicine Hat, Alta., (Carr).
4497 *Philonthus aurulentus* Horn. Medicine Hat, Cypress Hills and Edmonton, Alta., (Carr).
4579 *Quedius molochinus* Grav. Waterton and Lake Louise, Alta., (Carr).
4586 *Quedius capucinus* Gray. Banff, Alta., (Carr).
4589 *Quedius brunneipennis* Mann. Lake Louise, Alta., (Carr).
4601 *Quedius iricundus* Say. Medicine Hat, Alta., (Carr).
4638 *Oxyporus occipitalis* Fauv. Cypress Hills, Alta., (Carr).
4672 *Tachinus instabilis* Malsl. Banff, Alta., (Carr).
4673 *Tachinus basalis* Er. Banff, Alta., (Carr).
4681 *Tachyporus jocosus* Say. Medicine Hat, Alta., (Carr).
4696 *Conosoma littoreus* L. Pincher, Alta., (Carr).
4723 *Bolitobius cincticollis* Say. Banff, Alta., (Carr).

Sphaeritidae
6529 *Sphaerites glabratus* Fab. Waterton, Alta., (Carr).

Histeridae
6885 *Saprinus fraternus* Lec. Medicine Hat, Alta., (Carr).
6896 *Saprinus patruelis* Lec. Medicine Hat, Alta., (Carr).

Melyridae
7503 *Dolichosoma foveicollis* Kby. Lethbridge, Alta., (Glen).

Cleridae
7616b *Enoclerus laetus coccineus* Schklg. Medicine Hat, Alta., (Carr).

Mordellidae
7821 *Mordella oculata* Say. St. Thomas, Ont.

Rhipiphoridae
7967 *Rhipiphorus fasciatus* Say. Medicine Hat, Alta., (Carr).

Meloidae
8005 *Epicauta sericans* Lec. Medicine Hat, Alta., (Carr).
8006 *Epicauta pruinosa* Lec. Cypress Hills, Alta., (Carr).
8026 *Epicauta oregona* Horn. Medicine Hat, Alta., (Carr).
8172 *Nemognatha lurida* Lec. Medicine Hat, Alta., (Carr).
8174 *Nemognatha lutea* Lec. Medicine Hat, Alta., (Carr).

Pedilidae
8239 *Pedilus oregonus* Fall. Victoria, B.C.
8246 *Pedilus lewisii* Horn. Saskatoon, Sask., (King).

Anthicidae
8342 *Amblyderus pallens* Lec. Aweme, Man., (N. Criddle).

Elateridae
8731 *Ludius vulneratus* Lec. Cape Breton, N.S., (Balch).
8802 *Eanus maculipennis* Lec. Nova Scotia.
Eanus albertanus Brown. Revelstoke, Mt., B.C., (Dennys).
8821 *Hypnoidus exiguus* Rand. Pt. Pelee, Ont., (Walley); Aweme, Man., (N. Criddle); Hatton, Sask., (King).
8826 *Cryptohypnus abbreviatus* Say. Rhein, Sask., (Glen).
8846 *Hypnoidus gentilis* Lec. Edmonton, Alta., (Carr); Agassiz, B.C., (Glendenning).
8849a *Hypnoidus pectoralis futilis* Lec. Nicola Lake, B.C.
8885 *Agriotes mancus* Say. Roche Percee, Sask., (S. Criddle).
8890 *Agriotes ferrugineipennis* Lec. Lethbridge, Alta., (Pepper).
8894 *Agriotes limosus* Lec. Crow's Nest Pass, Alta., (Pepper); Ft. Simpson, McKenzie River, (Crickmay).
9114 *Horistonotus curiatus* Say. Pt. Pelee, Ont., (Walley).

Buprestidae
9377a *Buprestis fasciata langi* Mann. Cypress Hills, Alta., (Carr).
9394 *Anthaxia aeneogaster* Cast. Cypress Hills, Albt., (Carr).

Dryopdiae
* *Lara avara amplipennis* Darlington. Revelstoke, B.C., Pysche, XXXVI, 330.

Helmidae
9619 *Helmis corpulentus* Lec. Blairmore, Alta., (Pepper).
Helmis tardellus Fall. Knowlton, Que., (Milne).
9634 *Limnius fastiditus* Lec. Medicine Hat, Alta., (Pepper).

Dascillidae
9659 *Eurypogon niger* Melsh. Orillia, Ont., (Curran).

Rhysodidae
9947 *Clinidium calcaratum* Lec. Anyox, B.C., (Smith)

Cucujidae
10194 *Oryzaephilus surinamensis* L. Viscount, Sask., (McMillan).

Colydiidae
10558 *Lasconotus borealis* Horn. Fredericton, N.B., (Simpson).
10559 *Lasconotus intricatus* Kraus. Lorna, B.C., (G. Hopping).
10572 *Lasconotus subscostulatus* Fall. Aweme and Onah, Man., (N. Criddle); Merritt, B.C., (R. Hopping).

Lathridiidae
10627 *Lathridius breviclavus* Fall. Knowlton and Kazubazua, Que., (Milne and Brown); Redbank, N.B., (Brown).
10631 *Lathridius liratus* Lec. Treesbank, Man. (White).

Tenebrionidae
12311 *Scaphidema pictum* Horn. Waterton, Alta., (Carr).

Cisidae
12992 *Orthocis punctata* Mell. Biscotasing, Ont., (Schedl).

Scarabaeidae
13108 *Aphodius pinguis* Hald. Medicine Hat, Alta., (Carr).
13200 *Aphodius walshi* Horn. Medicine Hat, Alta., (Carr).

Cerambycidae
15050 *Pogonocherus propinquus* Fall. Merritt, B.C., (Mathers).

Chrysomelidae
15299 *Chlamys cribripennis* Lec. Annapolis Royal, N.S., (Patterson); Fredericton, N.B., (Gorham).
15343 *Pachybrachys coloradensis* Bowd. Medicine Hat, Alta., (Carr).
15627 *Chrysochus auratus* Fab. Medicine Hat, Alta., (Carr).
Calligrapha alni Schffr. Edmonton, Alta., (Carr).
15704 *Gastroidea viridula* De G. Medicine Hat, Alta., (Carr).
15871 *Oedionychis lugens* Lec. Waldeck, Sask., (King).
16068 *Phyllotreta robusta* Lec. Medicine Hat, Alta., (Carr).
16075 *Phyllotreta armoraciae* Koch. Fredericton, N.B., (Gorham).
16089 *Psylliodes punctulata* Melsh. Aweme, Man. (Handford).
16115 *Baliosus californicus* Horn. Medicine Hat, Alta., (Carr).
16117 *Brachycoryna horni* Weise. Medicine Hat, Alta., (Carr).

Curculionidae
16490 *Podapion gallicola* Riley. Biscotasing, Ont., (Schedl).
16840 *Pissodes similis* Hopk. Cape Breton, N.S., (Balch).

17057 *Proctorus decipiens* Lec. Crow's Nest Pass and Lethbridge, Alta., (Pepper).
17076 *Tychius arator* Gyll. Medicine Hat, Alta., (Carr).
17335 *Elleschus ephippiatus* Say. Fish Creek, Sask., (King).
17339 *Orchestes niger* Horn. Aweme, Man., (N. Criddle); Fort a la Corne, Sask., (King).
17345 *Orchestes pallicornis* Say. Nelson, B.C., (Dennys).
17345a *Orchestes pallidior* Leng. Ottawa, Ont.; Aweme, Man., (N. Criddle).
17415 *Lixus musculus* Say. Medicine Hat, Alta., (Carr).
17416 *Lixus parcus* Lec. Medicine Hat, Alta., (Carr).
Lixus blakeae Chitt. Medicine Hat, Alta., (Carr).
17782 *Ceutorhynchus decipiens* Lec. Lundbreck, Alta., (Pepper).
17800 *Ceutorhynchus pauxillus* Dietz. Medicine Hat, Alta., (Pepper).
17801 *Ceutorhynchus convexicollis* Lec. Medicine Hat, Alta., (Pepper).

Scolytidae
18209 *Phthorophloeus picae* Sw. Biscotasing, Ont., (Schedl).
18377 *Cryphalus balsameus* Hopk. Biscotasing, Ont., (Schedl).
18397 *Trypophloeus nitidus* Sw. Biscotasing, Ont., (Schedl).
18422 *Pityophthorus nitidus* Sw. Biscotasing, Ont., (Schedl).
18440 *Pityophthorus pulchellus* Eich. Biscotasing and Ottawa, Ont., (Schedl).
20670 *Pityophthorus briscoei* Blackm. Biscotasing, Ont., (Schedl).
* *Pityophthorus albertensis* Blackman. Banff, Alta.
Bull. N.Y. College of Forest, 1, 50.

DIPTERA

By G. S. Walley

Tipulidae
* *Eriocera alberta* Alexander. Lethbridge, Alta., (Pepper).
Bul. Brookl. Ent. Soc., XXV, 73.

Chironomidae
Ceratopogon (*Pseudoculicoides*) *cinctus* Coq. Saskatoon, Sask., (King).
Probezzia elegans Coq. Ottawa, Ont., (Walley).
Forcipomyia cilipes Coq. Lethbridge, Alta., (Strickland).
Palpomyia illinoensis Mall. Pt. Pelee, Ont., (Walley).
Heteromyia pratti Coq. Pt. Pelee, Ont., (Ide).
Procladius scapularis Loew. Aylmer, Que., (Curran); Pt. Pelee, Ont., (Walley).
Procladius thoracicus Loew. Pt. Pelee, Ont., (Walley).
Procladius turpis Zett. Pt. Pelee, Ont., (Walley).
Procladius caliginosus Joh. Pt. Pelee, Ont., (Walley).
Chironomus needhami Joh. Ottawa, Ont., (Walley).
Cironomus perpulcher Mitchell. Burke's Falls, Ont., (Ide).
Chironomus calopterus Mitchell. Pt. Pelee, Ont., (Walley).
Chironomus basalis Mall. Saskatoon, Sask., (King).
Chironomus devinctus Say. Aylmer, Coteau-du-Lac, Lachine, Laprairie, Que., (Curran, Ide); Pt. Pelee, Ont., (Walley).
Chironomus riparius Meig. Singhampton, Ont., (Ricker).
Chironomus pedellus De Geer. Pt Pelee, Singhampton, Ont., (Walley, Ricker).
Chironomus nigricans Joh. Vaudreiul, Que., (Ide); Pt. Pelee, Ont., (Walley).
Chironomus hyperboreus meridionalis Joh. (det Johannsen). Royal Oak, B.C., (Treherne).
Chironomus pallidus Joh. Ottawa, Ont., (Walley).
Chironomus subaequalis Mall. Pt. Pelee, Ont., (Walley).
Chironomus dorsalis Meig. Pt. Pelee, Ont., (Walley).
Chironomus ontario Walley. Fredericton, N.B.
Thlassomyia obscura Joh. Wakefield, Que., (Walley); Ottawa, Ont., (Curran).
Camptocladius lasiops Mall. Saskatoon, Sask., (King).
Orthocladius sordens Joh. Saskatoon, Sask., (King).
Tanytarsus politus Mall. Pt. Pelee, Ont., (Walley).
Tanytarsus muticus Joh. Beachville, Ont., (Walley).
Tanytarsus tenuis Meig. Orillia, Ont., (Curran).
Tanytarsus gmundensis Egger. Cayuga, Ont., (Walley).
Tanytarsus nigripilus Joh. Horning's Mills, Ont., (Ricker).
Tanytarsus flavicauda Mall. Ottawa, Ont., (Curran, Walley).
Metriocnemus par Joh. Wakefield, Que., (Ide); Horning's Mills, Orillia, Sebright, Ont., (Ricker, Curran).

Ephydridae
* *Hyadina macquarti* Cresson. Skagway, Anchorage, Alaska, (Aldrich)
* *Hydrina nigrescens* Cresson. London Hill Mine, Bear Lake, B.C., (Currie).
Ent. News, XLI, 80.

Dolichopodidae

* *Rhaphium latifacies* Van Duzee. Lake Agnes, Laggan, Alta., (Bryant).

* *Rhaphium longibara* Van Duzee. Banff, Norquay Mt. Alta., (Bryant).

* *Neurigona ornatus* Van Duzee. Edmonton, Alta., (Bryant).
Ent. News, XLI, 53-55.

* *Neurigona nigrimanus* Van Duzee. Banff, Alta., (Bryant).

* *Dolichopus breviciliatus* Van Duzee. Paradise Mt., Laggan, Alta., (Bryant).
Ent. News, XLI, 70-73.

* *Hydrophorus browni* Curran. Bonne Esperance, Harrington Harbor, Que., (Brown).
Jl. N. Y. Ent. Soc., XXXVIII, 74.

Anthomyiidae

* *Pseudolimnophora rotundata* Collin. Tassiusak, West Greenland (Lundbeck).

* *Limnophora sinuata* Collin. Orpiksuit, West Greenland, (Lundbeck).
Hekla Havn, East Greenland, (Deichmann).

* *Limnophora* (*Spilogona*) *latilamina* Collin. Hekla Havn, East Greenland, (Deichmann).

* *Limnophora* (*Spilogona*) *monacantha* Collin. Umanak, West Greenland (Crocker Land Expdn.)
Trans. Ent. Soc. London, LXXVIII, pt. 2, 255-281.

Syrphidae

* *Syrphus pingreensis* Fluke. Seton Lake, Lillooet, Victoria, B.C., (McDunnough, Treherne).

* *Syrphus lebanoensis* Fluke. Keremeos, Seton Lake, Lillooet, B.C., (Garrett, McDunnough).
Ann. Ent. Soc. Amer., XXIII, 133-144.

* *Syrphus* (*Epistrophe*) *flavosignatus* Hull. Capilano Canyon, Vancouver, B.C., (Crew).

* *Syrphus* (*Epistrophe*) *monachus* Hull. Greenland.
Trans. Am. Ent. Soc., LVI, 139-148.

Cnemodon auripleura Curr. (det. Curran). Vernon, B.C., (Venables).

Tachinidae

* *Cyrtophloeba nitida* Curran. Aylmer, Hull, Que., (Curran); Low Bush, Lake Abitibi, Ont., (Bigelow); Aweme, Man., (Vroom).

* *Meriania septentrionalis* Curran. Low Bush, Lake Abitibi, Ont., (Bigelow); Medicine Hat, Alta., (Carr); Creston, Vernon, B.C., (Lallamand, Buckell).
Jl. N. Y. Ent. Soc., XXXVIII, 73-76.

Hymenoptera

By G. S. Walley

Evaniidae

Foenus tarsatorius Say. (det. Viereck). Jordan, Ont., (Ross).

Odontaulacus rufitarsis (Cress). (det. Cushman). Pender Harbor, B.C. (Hopping).

Ichneumonidae

Amblyteles leucaniae (Fitch) (det. Cushman). Norfolk, Ont., (Hall).

Amblyteles pullatus (Cress). (det. Cushman). Norfolk, Ont., (Hall).

Amblyteles suturalis (Cress.). (det. Cushman). Drumheller, Alta., (King).

Amblyteles cestus (Cress.). (det. Cushman). Wigwam Inn, Burrard Inlet, B.C., (Hopping).

Stylocryptus subclavatus (Say). (det. Cushman). Mont Laurier, Que., (Dunn).

Mastrus neodiprioni Vier. (det. Cushman). Ottawa, Ont., (Schedl).

Phaeogenes hariolus (Cress). (det. Cushman). Ottawa, Ont., (Schedl).

Phaeogenes gaspesianus Prov. (det. Cushman). Ottawa, Ont., (Schedl).

Gelis ferruginosus (Strick.). (det. Cushman). Wigwam Inn, Burrard Inlet, B.C., (Hopping).

Cryptus vinctus (Say). (det. Cushman). Norfolk, Ont., (Hall).

Phytodietus annulatus (Prov.). (det. Cushman). Norfolk, Ont., (Hall).

Rhyssa lineolata (Kby.). (det. Cushman). Aylmer, Que.

Rhyssa persuasoria (Linn.). (det. Cushman). Aylmer, Que.

Calliephialtes grapholithiae (Cress.). St. David, Ont., (Steenburgh).

Perithous pleuralis Cress . Waterton, Alta., (Seamans).

Epiurus indagator (Cress). (det. Cushman). Ottawa, Ont., (Schedl).

Itoplectis leavitti Cush. (det. Cushman). Ottawa, Ont., (Schedl).

Itoplectis montana Cush. (det. Cushman). Ottawa, Ont., (Schedl).

Glypta simplicipes Cress. (det. Cushman). Norfolk, Ont., (Hall).

Conoblasta fumiferana Vier. (det. Cushman). Duncan, B.C., (Mathers).

Polysphincta texana Cress. Aylmer, Que., (Graham). Teulon, Aweme, Man., (Hunter, White). Creston, B.C., (Lallamand).

Polysphincta burgessi Cress. Fisher's Glen, Ont., (Walley).
* *Odontomerus punctatus* Cushman, Lorna, B.C., (Hopping). On *Picea engelmanni.*
* *Odontomerus tibialis* Cushman. Aylmer, (Knull), Montreal, Que., Sudbury, Ont.
* *Odontomerus brevicaudus* Cushman. Waterton, Alta., (Seamans). Hedley, B. C., (Garrett).
Proc. U. S. N. M., LXXVII, Art. 3, 1-15.
Odontomerus strangaliae Roh. (det. Cushman). Aylmer, Que., (Curran). Coldstream, Ont., (Wood).
Odontomerus atripes Roh. (det. Cushman). Aylmer, Que., (Hutchings). Ottawa, Ont., (Beaulieu).
Odontomerus dichrous Roh. (det. Cushman). Victoria, B.C., (Anderson).
Odontomerus mellipes Say. (det. Cushman). Niagara Glen, Orillia, Ont., (Walley, Curran).
Odontomerus vicinus Cress. (det. Cushman). Aylmer, Covey Hill, Hemmingford, Lanoraie, Que., Ottawa, Orillia, Sudbury, Ont.
Odontomerus canadensis Prov. (Rohwer). (det Cushman). Aylmer, Covey Hill, Lake Opastika, Que. Sudbury, Ont. Vernon, B.C., (Ward).
Xorides humeralis (Say). Bathurst, N.B., (Knull). Victoria Beach, Man., (Brooks).
Xorides frigidus (Cress). Montreal, Que.
Xorides albopictus Cress. Aylmer, Hull, Que., (Hutchings). Orillia, Ont., (Curran).
Xorides catomus (Davis). Creston, Nicola, B.C., (Lallamand, Buckell).
Xorides stigmapterus (Say). Kentville, N.S., (Gorham). Sudbury, Toronto, Ont.
Deuteroxorides vittifrons Cress. Hemmingford, Que., (Hammond).
Deuteroxorides borealis (Cress.). Nordegg, Alta., (McDunnough).
Excavarus annulipes Cress. Montreal, Que., (Winn).
Holocremnus lophyri Riley (det. Cushman). Mont Laurier, Que., (Dunn).
Syrphoctonus agilis (Cress.). Vernon, B.C., (Venables).
Opheletes glaucopterus (Linn.). Fredericton, N.B., (Gorham).
Therion morio (Fabr.) (det. Cushman). Norfolk, Ont., (Hall).
Paniscus geminatus sayi Cush. (det. Cushman). Norfolk, Ont., (Hall).
Paniscus ocellatus Vier. (det. Cushman). Saskatoon, Sask., (King).
Mesochorus basalis Cress. (det. Cushman). Stanley Park, B.C.
* *Sesioplex canadensis* Cushman. St. Agatha, Que., (Seyrig). Timmins, Ont., (Seyrig). Edmonton, Alta., (Salt).
Proc. U. S. N. M, LXXVI. Art. 25, 8.

Braconidae

Meteorus trachynotus Vier. (det. Cushman). Ottawa, Norfolk, Ont., (Schedl, Hall).
* *Brachistes strigitergum* Cushman. Duncan, B.C., (Mathers).
Proc. U. S. N. M., LXXVI, Art. 25, 15.
Ascogaster carpocapsae Vier. (det. Cushman). Vernon, B.C., (Gillespie).
Apanteles militaris Walsh. Fredericton, N.B., (Gorham).
Spathius tomici Ashm. (det. Gahan). Ottawa, Ont., (Schedl).
Spathius canadensis Ashm. (det. Cushman) Ottawa, Ont., (Schedl).

Cynipidae

* *Cynips fulvicollis canadensis* Kinsey. S. E. Canada.
Ind. Univ. Stud., XVI, 273, 1929.
Andricus seminator Harr. (det. Kinsey). Simcoe, Ont., (Hall).

Pteromalidae

Cheiropachus colon (Linn). (det. Gahan). Ottawa, Ont., (Schedl).
Cheiropachus obscuripes Brues (det. Gahan). Ottawa, Ont., Schedl).

Eurytomidae

Eurytoma crassineura Ashm. (det. Gahan). Ottawa, Ont., (Schedl).

Belytidae

Cinetus canadensis Ashm. (det. Gahan). Ottawa, Ont., (Schedl).

Scelionidae

* *Amitus arcturus* Whittaker. Hollyburn, B.C.

Diapriidae

* *Paratelopsilus canadensis* Whittaker. Chilliwack, B.C. (Whittaker).
* *Diphora nearctica* Whittaker. Hollyburn, B.C. (Whittaker).
* *Acropiesta pulchella* Whittaker. Hollyburn, B.C., (Whittaker).
* *Acropiesta pulchella melanocephala* Whittaker. Hollyburn, B.C., (Whittaker).
* *Acropiesta pulchella rufifrons* Whittaker. Hollyburn, B.C., (Whittaker).
* *Acropiesta pulchella rufa* Whittaker. Hollyburn, B.C., (Whittaker).
Proc. Ent. Soc. Wash., XXXII, 67-76.

* *Monelata nigra* Whittaker. Hollyburn, B.C., (Whittaker).
* *Acanosema sylvana* Whittaker. Hollyburn, B.C., (Whittaker).

Bethylidae
* *Anteon flaviscapus* Whittaker. Hollyburn, Chilliwack, Galiano, B.C., (Whittaker).
* *Anteon hirtifrons* Whittaker. Hollyburn, B.C., (Whittaker).

Serphidae
* *Disogmus torvus* Whittaker. Chilliwack, B.C., (Whittaker).
Proc. Ent. Soc. Wash., XXXII, 67-76

Calliceratidae
* *Calliceras concinna* Whittaker. Hollyburn, B.C., (Whittaker).
* *Calliceras boreale* Whittaker. Hollyburn, B.C., (Whittaker).
Proc. Ent. Soc. Wash., XXXII, 67-76
* *Calliceras pacifica* Whittaker. Chilliwack, B.C., (Whittaker).
Proc. Ent. Soc. Wash, XXXII, 129.
* *Lagynodes xanthus* Whittaker. Hollyburn, B.C., (Whittaker).
* *Trichosteresis vitripennis* Whittaker. Chilliwack, B.C., (Whittaker).
Proc. Ent. Soc. Wash., XXXII, 67-76.
* *Aphanogmus subapterus* Whittaker. Chilliwack, B.C., (Whittaker).
* *Aphanogmus canadensis* Whittaker. Hollyburn, B.C., (Whittaker).
* *Aphanogmus obsoletus* Whittaker. Hollyburn, B.C., (Whittaker).
* *Aphanogmus dorsalis* Whittaker. Hollyburn, B.C., (Whittaker).
* *Conostigmus pulchellus* Whittaker. Hollyburn, B.C., (Whittaker).
Proc. Ent. Soc. Wash., XXXII, 129-135

LEPIDOPTERA

Papilionidae
* *Parnassius golovinus* Holland. Golovin Bay, Alaska.
Ann Carneg. Mus., XIX, 155.

Satyridae
* *Oeneis semplei* Holland. Mouth of Little Cape Jones River, Labr.
* *Oeneis gibsoni* Holland. Orange Creek, Y. T. Kuskokwim Valley, Alaska.
Ann. Carneg. Mus., XX, 50 and 51.
* *Erebia avinoffi* Holland. Kotezebue Sound, Alaska.
* *Erebia steckeri* Holland. Kuskokwim River, Alaska.
Trans. Am. Ent. Soc., LVI, 151 and 153.

Hesperiidae
* *Thanaos avinoffi* Holland. Yukon and Kuskokwim Valleys, Ft. Selkirk, Alaska.
Ann. Carneg. Mus., XIX, 156.

Sphingidae
* *Ceratomia undulosa borealis* Clark. McCreary, Man.
* *Pachysphinx modesta borealis* Clark. McCreary, Man.
* *Calasymbolus excoecata borealis* Clark. McCreary, Man.
* *Calasymbolus myops mccrearyi* Clark. McCreary, Man.
* *Smerinthus cerisyi borealis* Clark. McCreary, Man.
* *Darapsa pholus brodiei* Clark. N.S. no locality. Eglinton, Ont., Husavick and Winnipeg, Man.
* *Sphinx eremitus mccrearyi* Clark, McCreary, Man.
Proc. N. Eng. Zool. Club, XI, 18-22.
* *Cressonia juglandis manitobae* Clark. McCreary, Man.
Proc. N. Eng. Zool. Club, XII, 28.

Noctuidae
Schinia trifascia Hbn. Coldstream, Ont., (Hudson).
Sideridis normani Grt. Lethbridge, Alta.
Brachycosmia digitalis Grt. Coldstream, Ont., (Hudson).
Xylomoea chagnoni B. and McD. Coldstream, Ont., (Hudson)
Papaipema eupatorii Lyman. Fredericton, N.B., (Gorham).
Baileya australis Grt. Coldstream, Ont., (Hudson).
Erebus odora L. Lillooet, B.C., (Phair).
Thysania zenobia Cram. Riceton, Sask.

Pterophoridae
Pterophorus ontario McD. Vineland, Ont., bred from grape. (Ross).

Gelechiidae
Gelechia walsinghami Dietz. Knowlton, Que., (McDunnough).
Tricholtaphe nonstrigella Cham. Knowlton, Que., (Milne).

Eucosmidae
Polychrosis spiraeifoliana Heinr. Knowlton, Que., (McDunnough).

Polychrosis cypripediana Forbes. Kazubazua, Que., (McDunnough). Bred from sumac seeds.
Exartema subnubilum Heinr. Norfolk, Ont., (Hall).
Argyroploce osmundana Fern. Knowlton, Que., (McDunnough).
Eucosma invicta Wlshm. Lethbridge, Alta., (Seamans).

Incurvariidae
Incurvaria russatella Clem. Knowlton, Que., (McDunnough).

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