New York State Museum Bulletin

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The University of the State of New York

New York State Museum

JOHN M. CLARKE, Director

EPHRAIM PORTER FELT, State Entomologist

35th REPORT OF THE STATE ENTOMOLOGIST

1921

ALBANY

THE UNIVERSITY OF THE STATE OF NEW YORK

1923

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Published monthly by The University of the State of New York

Nos. 247, 248 ALBANY, N. Y. ~~May-June, 1921~~ July-August, 19[illegible]

The University of the State of New York

New York State Museum

John M. Clarke, Director

Ephraim Porter Felt, State Entomologist

THIRTY-FIFTH REPORT OF THE STATE ENTOMOLOGIST

1921

Dr John M. Clarke, Director of the State Museum

I have the honor to present herewith my report on the injurious and other insects of the State of New York for the period ending October 31, 1921.

The winter of 1920–21 was one of the mildest and the following spring one of the earliest on record in this part of North America. Last March was one of the warmest in the history of the country, breaking known records for high temperatures at some weather bureau stations in the east. Flies and mosquitoes were out at Nassau and troublesome March 21st, the temperature in the morning being 78° F. The unusually mild weather resulted in an ant, Prenolepis imparis Say, swarming in the open at Nassau March 27th, an extremely early record according to Prof. W. M. Wheeler, who identified the species. The mild winter was unusually favorable for the hibernation of southern insects, such as the corn ear worm. It also affected the development of plant life and as a consequence many trees and shrubs budded extremely early. American elms were in bloom at Nassau on March 27th, and Carolina poplar catkins were falling in considerable numbers April 6th. Apple leaves were about half an inch long and pear buds were greatly extended by April 7th. Early in the spring it was estimated that the season was approximately 4 weeks in advance of the normal. Cool weather in May and June caused slower developments and a gradual approach to the normal, though it

appears that the effects of the unusually early spring were not completely offset, since there was a very small partial second brood of European corn borer in the infested areas of New York and Canada, though nothing of the kind had been noted in earlier seasons.

European corn borer. This insect was first discovered in New York State early in 1919 and careful scouting that year resulted in finding the pest over considerable areas in both eastern and western New York. Conditions were such that the entomologists of the State were unanimous in recommending the adoption of a progressive policy, details of which are given on the following pages.

At the close of 1920 the European corn borer was known to be present in portions of seven counties, namely, Albany, Fulton, Montgomery, Rensselaer, Saratoga, Schenectady and Schoharie in the eastern part of the State and in Cattaraugus, Chautauqua, Niagara and Erie counties in the western part of the State. The past year it was found in Albany, Fulton, Montgomery, Rensselaer, Saratoga, Schenectady, Schoharie and Washington counties in the eastern part of the State; two others, Hamilton and Warren, were included in the quarantined area because of the close commercial relations existing with the infested area. In the western section portions of Cattaraugus, Chautauqua, Niagara and Erie counties were added to the infested area.

Conditions were such in the spring of 1919 that it was very desirable to ascertain at the earliest possible moment the distribution of the European corn borer in the State; consequently bulletins and circulars were widely distributed. The Entomologist prepared a brief circular letter which was sent very generally to schools of the State, Cornell University Extension Bulletin 31, of which an edition of 40,000 was printed, and the Bulletin to the Schools of June 1st, the latter illustrated by four admirably executed colored plates. There were also numerous press notices sent to the papers. The Department of Farms and Markets published Circular 182 and issued a number of quarantine orders.

The situation was further complicated by the finding of an infestation in 1920 which centered approximately upon St Thomas, Ontario, Canada. Large areas of field corn in that section were seriously damaged, some 70 to 90 per cent of the stalks being infested and approximately 50 per cent of the ears. The commercial damage in one of the more thickly infested fields was placed at from 20 to 25 per cent. The somewhat serious conditions of 1920 were followed by more severe and general injury to early planted corn the past season.

The European corn borer is of such general importance and its habits in New York State so different from those in Massachusetts that application was made to the Legislature of 1920 for a special appropriation for the investigation of the status of this insect, and $5000 was made available. The money has been used in a careful field study of the pest to ascertain the rapidity of spread, the amount of injury and the possibilities of control or repressive measures. The work was placed in charge of D. B. Young, who was temporarily detailed from the Entomologist's office. Hall B. Carpenter of Somerville, Mass., was engaged as a special assistant for this work and an intensive study of the Schenectady area was made. The studies sustained earlier opinions and demonstrated a considerable difference in the habits of the corn borer in New York State, and as an outcome, there has been a material modification in quarantine restrictions. The special work of 1920 was continued on a greatly modified basis the past season and among other things demonstrated the utility of thoroughly plowing under infested stubble or corn stalks in the fall.

An outstanding feature in 1921, in addition to the very serious injury in Canada, was the discovery in late summer of a sparse infestation along the southern shore of Lake Erie, extending almost continuously from the New York State line west to Cleveland, with scattering infestations from the latter point to the western extremity of the lake. These infestations presumably originated from moths drifting with the winds across Lake Erie or from infested corn stalks carried by water currents or drifting with the wind.

Early in July 1919, the Entomologist was appointed collaborator of the Bureau of Entomology, United States Department of Agriculture, and specifically authorized to investigate European corn borer control in the states of New York and Massachusetts. This appointment has been continued from year to year and has immensely facilitated studies of the broader aspects of the problem and has enabled the Entomologist to keep in close touch with developments in the various infested areas and furthered closer cooperation between the different federal and state agencies.

The Entomologist has participated in a number of conferences called for the special purpose of considering the situation and agreeing upon the most feasible methods of handling the problem.

Late in the fall of 1920, the federal authorities started extensive clean-up operations in the more badly infested area about Silver

Creek, Chautauqua county, with the understanding that the state authorities would cooperate in an educational campaign to bring about better conditions in the more sparsely infested, outlying sections. A very brief statement of the situation with a series of recommendations, which were indorsed at a conference of federal and state officials at Buffalo that fall, was prepared by the Entomologist and has been widely distributed in the infested areas by the Bureau of Plant Industry as Circular 199, Department of Farms and Markets. The distribution of literature was followed by public meetings and the utilization of all available agencies in promoting a general adoption of modifications in agricultural practice unfavorable to the successful development of the European corn borer. The Entomologist has also prepared a revision of the Cornell Extension Bulletin 31.

Other corn insects. The great interest in the European corn borer in 1919 resulted in many careful and repeated examinations of corn fields throughout the State, and one outcome is the finding and reporting of a number of injurious insects. The lined corn borer, hitherto supposed to be rare in New York State, was rather widely distributed and somewhat injurious in 1919, though it attracted little or no attention the following two seasons. The well-known stalk borer and grass webworms also attracted considerable notice and the past season the corn ear worm was so generally abundant that it caused more injury in the State than the European corn borer. It was reported in greater or less numbers from practically all counties, most of the injury being in the central and western parts of the State, particularly in Madison county. The loss was greatest on sweet corn and in some instances approached a considerable proportion of the crop. Available data indicate a close relation between this outbreak and the unusually mild winter preceding.

Small grain pests. The unusual abundance of the wheat midge, Thecodiplosis mosellana Gehin, in 1918 and the ever-present probability of injury by the Hessian fly, Phytophaga destructor Say, and the wheat joint worms, Isosoma tritici Fitch and I. vaginicolum Doane, has resulted in annual wheat surveys during the past 3 years designed to accumulate data indicating the relative abundance of these insects and the probabilities of damage the following season. These data are summarized in the body of the report.

Army worm caterpillars, Heliophila unipuncta Haw., survived the very severe winter of 1918–19 in a partly grown condi-

tion in Saratoga county, they being repeatedly found in partly rotted cornstalks. Similar conditions were also observed the following winter, which latter was much milder.

A distinctly unusual feature was the submission in 1919 of leather jackets or maggots of the crane fly, Pedecia albivitta Walk., accompanied by the statement that they occurred in large numbers in Schuyler county in an oat field and were presumably causing some injury.

Other field crops. The season of 1919 was marked by a very unusual outbreak of the green clover worm, Plathypena scabra Fabr., upon beans, the greenish white caterpillars feeding generally upon the leaves of both common and lima beans and causing serious to somewhat general injury in various parts of the State. The insect was not observed in appreciable numbers the following two seasons.

Asparagus beetles and root maggots were unusually abundant in the vicinity of Albany in 1920, the latter at least being unduly favored by the cold, wet weather of the spring. Several species of wire worms caused rather severe injury in the environs of Albany.

Codling moth. Field studies of this important insect have been continued in cooperation with the Bureau of Plant Industry, State Department of Farms and Markets, special attention being given to securing exact records of evening temperatures as well as the maxima and minima, and correlating them with the egg-laying habits of the moth. The accuracy of this work has been materially increased by the cooperation of the United States Weather Bureau in loaning thermographs and supervising the setting up of the instruments. The field work has been in direct charge of L. F. Strickland, agent, who was located at Lockport. Details are given in the body of the report.

Shade tree insects. The elm leaf beetle and the white-marked tussock moth have not attracted an unusual amount of attention, though both have been locally abundant.

A recently introduced willow leaf beetle, Plagiodera versicolora Laich., was brought to notice in 1919 and has become somewhat generally and widely distributed in the southern portion of the State, causing rather severe injury locally.

Unusual injury to soft maples by the callous borer, Sesia acerni Clem., was found in the vicinity of Buffalo, the borers occurring in a considerable number of soft maples. In some cases the trees were partly girdled.

The spruce gall aphid, Chermes abietis Linn., continues to attract notice on account of the unsightly galls it produces upon Norway maples. The spruce bud scale, Physokermes piceae Schr., is likewise widely distributed. Evidence obtained the past season indicates that under certain conditions at least this latter insect may be an important factor in killing portions of good-sized trees.

Forest insects. There was an outbreak of the antlered maple caterpillar, Heterocampa guttivitta Walk., in Chautauqua county in 1919 accompanied by defoliation of sugar bushes in areas where the insects were most abundant.

A somewhat extended and serious infestation of the gipsy moth was discovered in New Jersey in July 1920 and was followed shortly by the location of several small, light infestations on Long Island, notably at Brooklyn, Greenpoint, Patchogue, Orient Point, Shelter Island and Southhold. There is also a nearly extinct infestation at Garrison. The season of 1921 was marked by the finding of the gipsy moth in the southwest town of Vermont, which means that through natural spread, the insect has virtually reached the New York State line, and the same is almost true for the northwest corner of Massachusetts. There has also been a marked extension in the southwestern portion of Massachusetts, the insect now occurring in small numbers in the towns of Becket, Otis and Sandisfield, all within about 15 miles of the New York State line. There was in 1920 and also during the past season an effort on the part of interested states, namely New Jersey and New York, and the Federal Government to exterminate the above-mentioned isolated infestations. Extremely gratifying progress has been made. This is particularly evident in New Jersey where the larger and denser infestation permitted a most striking contrast between the three million egg masses found in the infested area in 1920 as compared with less than one hundred disclosed by scouting at the end of the past season. It is possible to prevent the dissemination of this insect. The repressive and quarantine work of the Federal Government in cooperation with the interested states has accomplished much in slowing up or checking what would otherwise have been an extremely rapid spread.

The snow white linden moth, Ennomos subsignarius Hubn., was sufficiently abundant in portions of Otsego county in 1919 to defoliate large areas of woodland. The numerous moths appearing in Albany the latter part of July probably originated

from these areas. The same conditions continued the past season, though the defoliated areas were probably farther west, since the moths swarmed in several cities, notably Rochester and Lockport.

The interesting maple leaf cutter, Paraclemensia acerifoliella Clem., attracted notice in 1919 on account of its unusual abundance in the vicinity of Lake George.

The birch leaf skeletonizer, Bucculatrix canadensisella Fern., has been locally abundant and somewhat injurious to gray birches the past season in the northeastern part of the State, ranging from southern Rensselaer county north to Essex county. The outbreak was less marked than in 1901, though large groups of birches here and there were badly browned.

The white pine weevil, Pissodes strobi Peck, has been abundant and injurious in young plantings of white pine for several years. In some instances the entire planting may be seriously damaged before the trees have attained a height of 5 feet, and in other cases the mischief is very restricted and confined to small areas in rather large plantings.

Miscellaneous. A compilation of the office records of the last 20 years indicates a probable biennial life-cycle for the large, strikingly colored Say's blister beetle, Pomphopoea sayi Lec., since it is numerous approximately every other year, when it attracts attention on account of its feeding in swarms upon the blossoms of various trees, particularly honey locust.

The chrysanthemum midge, Diarthronomyia hypogaea Lw., is evidently becoming somewhat generally distributed in the State through the shipment of infested plants. It is fortunate that investigations of recent years have resulted in the formulation of moderately successful control measures.

Publications. The "Key to American Insect Galls" appeared subsequent to the period covered by the last annual report. It is the only comprehensive tabulation of these interesting deformities in America and since it deals primarily with the more obvious swellings or plant malformations rather than with the minute and highly complex gall makers themselves, it will greatly facilitate the study of the interrelations between plants and insects. Owing to the great demand for this bulletin, the edition was speedily exhausted.

A number of brief popular accounts relating to the more injurious pests have been prepared as heretofore and widely circulated, the European corn borer on account of its paramount importance

receiving special attention. There have also been several contributions to our knowledge of gall midges, including one paper on "Indian and Grass Gall Midges," which appeared as a memoir of the Department of Agriculture, India, and a general discussion of "Adaptations among Insects of Field and Forest," which was published in the August issue of the Scientific Monthly.

Lectures. The Entomologist has delivered a number of lectures or participated in discussions and conferences on insects, mostly economic species, before various agricultural and horticultural gatherings, some of these being held in cooperation with farmers institutes or county farm bureaus and a considerable proportion, owing to conditions prevailing during the past 3 years, have related to the European corn borer and its control.

Cooperative work. The Entomologist has continued to cooperate with the Federal Bureau of Entomology as collaborator in European corn borer work to the mutual advantage of both interested agencies. He has also cooperated with the Insect Pest Survey, United States Department of Agriculture. This work covers the entire United States, and since it relates to all insects of economic importance, it is broader in scope than most undertakings of this character. It places at the disposal of all official reporters early and accurate information respecting recent developments and thus frequently provides warnings of probable outbreaks in addition to disseminating much valuable data.

Collections. A number of desirable additions to the state entomological collections have been made, some of the best material being reared in connection with studies of recent outbreaks or secured as a result of requests for information concerning comparatively unknown forms. Special attention has been paid to the acquisition and preservation of immature stages, since these are very difficult to obtain; this is particularly true of a number of borers similar to the European corn borer and found in corn or in the stems of various plants. The special work upon the European corn borer has resulted in numerous, very desirable additions to the state collections.

Mr Henry Dietrich very generously donated to the Museum 551 specimens of California Coleoptera representing 160 species, 55 of these being new to the state collections.

Mr D. B. Young, assistant entomologist, donated from his personal collections of earlier years a large series of Coleoptera, consisting of over 750 specimens comprising over 400 species previously unrep-

resented in the state collections. This large addition has necessitated the rearrangement of many of the Coleoptera and in addition it has involved the study and identification of numerous obscure species. This work has been prosecuted in addition to the many identifications for correspondents and other routine duties.

Office matters. The correspondence has been along the same general lines; the European corn borer, on account of its potential importance and the unusual developments, occupied a prominent place. The extraordinary outbreak of the corn ear worm during the past season resulted in an unusually large number of inquiries in relation to this insect.

The general routine work has made unusually heavy demands upon the Entomologist and his assistant, the latter being in charge of the office and responsible for correspondence and other matters during the absence of the Entomologist.

There being no provision for the continuance of the special work on the European corn borer, authorized by the Legislature of 1920, it was impossible to continue W. A. Hoffman in the temporary vacancy created in June of that year by the transferral of Mr. Young to special work upon the European corn borer. Mr Hoffman resigned from the staff, effective July 31, 1921 and Mr Young resumed his duties on the regular Museum staff October 1st. Hall B. Carpenter of Somerville, Mass., appointed special assistant in European corn borer work in 1920, resigned May 31, 1921.

Fannie T. Hartman prior to her transferal from this office in midsummer, 1920, was very fully occupied in addition to the usual duties of an assistant by translations of technical literature needed in systematic work, the making of numerous microscopic preparations of small insects and the arrangement and care of pressed specimens of insect work and the extensive accumulations of alcoholic material. The vacancy created by the transferal of Miss Hartman has not been filled owing to the impossibility of securing a qualified assistant at the very nominal compensation available. The loss of an assistant must inevitably circumscribe the work of the office and may result in serious limitations.

Horticultural inspection. The nursery inspection work of the Bureau of Plant Industry, Department of Farms and Markets, has resulted as in former years in a number of specimens representing various stages or recent developments, some in very poor condition, being submitted to this office for identification. The satisfactory identification of specimens originating in various parts of the

world requires an intimate and wide knowledge of the literature and insects in both this and other countries and illustrates in a concrete manner the need in entomological work of both training and experience.

General. The work of the office has been materially aided as in past years by the identification of a number of insects through the courtesy of Dr L. O. Howard, chief of the Bureau of Entomology, United States Department of Agriculture, and his associates. There has been very effective and close cooperation with the State Department of Farms and Markets, particularly the Bureau of Plant Industry, the State College of Agriculture at Cornell University, the State Experiment Station at Geneva, the State Conservation Commission, the State Department of Health, the county farm bureaus and various public welfare organizations. A number of correspondents have donated material and rendered valuable service by transmitting local data respecting various insects and assisting in other ways. It is a pleasure to state that there has been, as in the past, most helpful cooperation on the part of all interested in the work of the office.

Respectfully submitted

EPHRAIM PORTER FELT
State Entomologist

October 31, 1921

INJURIOUS INSECTS

EUROPEAN CORN BORER

Pyrausta nubilalis Hubn.

The widespread occurrence of the European corn borer in the northeastern United States and Southern Canada has raised a series of problems which can not be readily answered, particularly when the diverse behavior of the insect is taken into account. We are primarily concerned with the status of the pest in New York State and yet a clear understanding of the situation can not be obtained without some reference to the behavior of the insect in other parts of the country.

History in America. The borer was discovered in Massachusetts in 1917, and in 1918 caused very serious injury in badly infested fields. The total known infested area at the close of that season was approximately 400 square miles.

The insect was first discovered at Scotia, Schenectady county, January 29, 1919, and subsequent investigations showed that the borer was somewhat generally established over an area of possibly 500 square miles, including portions of Albany, Fulton, Herkimer, Rensselaer, Schenectady and Schoharie counties; and extending from a little east of Troy westward to Fort Hunter, north nearly to Saratoga and south to Esperance.

The federal authorities were notified early of the infestation and rendered material cooperation in identifying the insect and later in determining the limits of the infestation. There was at that time, in spite of well-directed publicity efforts, no reason for thinking an infestation occurred elsewhere than in the eastern part of the State and after due consideration, the official entomologists of the State indorsed a progressive policy which eventuated in a special appropriation of $75,000 to be expended by the Commissioner of Agriculture in an effort to exterminate the insect. Operations were pushed with the greatest possible speed and prior to the middle of May the entire known infested area, some 300 square miles, had been very thoroughly cleared up, the corn stalks and corn stubble having been burned or plowed under. The Entomologist in his capacity as a state official advised in regard to the control work, and during the growing season kept a close watch of developments in the infested area for the purpose of obtaining the fullest possible information

concerning the pest. He also served, effective July 1, 1919, as collaborator in European corn borer control for the Bureau of Entomology, United States Department of Agriculture, and in this capacity was given unusual facilities for making observations not only in this State but in Massachusetts.

An infestation in Erie county was located in September 1919 and the comparatively limited scouting permissible between that time and the coming of cold weather resulted in finding the pest established over an area of some 400 square miles in portions of Cattaraugus, Chautauqua and Erie counties, the insect having been found from a little east of Buffalo south and west to Gowanda and Fredonia.

The marked differences in the behavior of the insect during 1919 in the infested New York areas as compared to those in eastern Massachusetts demonstrated the need of a careful study of the pest in this State, and upon request the Legislature of 1920 appropriated $5000 which was used in a careful study of the field conditions prevailing in the eastern infested area, namely in Schenectady and vicinity. These investigations resulted in securing data of much practical value in determining the most efficacious control measures.

There was in 1920 a material increase in the infested areas of this State, particularly in the western section. This latter was due largely to the fact that the western infestation was discovered so late in the season that it was impossible to scout the infested area thoroughly before cold weather made satisfactory work exceedingly difficult.

One very important development in 1920 was the discovery of the European corn borer in the vicinity of St Thomas, Canada, under climatic and agricultural conditions practically identical with those of our infested areas, a most significant feature being the extended and somewhat severe injury to considerable areas of corn, some 70 to 90 per cent of the stalks being infested and accompanied by a commercial damage placed at approximately 20 per cent.

The past season, 1921, was marked by a moderate extension of the infested areas in New York State, the spread under normal conditions being approximately 6 miles and the discovery in late summer of a sparse infestation along the southern shore of Lake Erie extending almost continuously from the New York State line to the western extremity of the Lake. The very scattering character of the infestation suggests that it may have originated from moths drifting with the winds across the lake or from infested corn stalks being

carried by water currents or the wind. If this be true, it is quite possible that the earlier discovered western New York infestation originated in the same way and may therefore be considerably more recent than the one at St Thomas. This may be the factor which explains the difference between the relatively small injury to corn in the Silver Creek area as compared with the damage under very similar conditions in the vicinity of St Thomas.

There is another important matter which should be kept in mind. During the fall of 1920 and the spring of 1921 an extensive clean-up campaign centering upon Silver Creek and limited to the more badly infested area was conducted by the federal authorities. This work appears to have had little effect upon the general infestation, since conditions the past season were very nearly the same in the cleaned-up area as upon the adjacent Indian reservation where no work of this character was possible. There is no doubt but that the clean-up work destroyed many borers and materially reduced the infestation as compared to what it might have been if there had been nothing of the kind. There is a possibility that the benefits resulting from this clean up may have been masked as it were by a considerable driftage of moths from other infested areas, possibly from Ontario.

There was a large increase the past season in the known infested area in Canada, due mostly to the very limited scouting possible in 1920. There was also a great increase in the badly infested area about St Thomas, which latter now comprises about 100 square miles and shows much more serious and general injury to early planted corn than the preceding year. There are numerous 1-acre to 5-acre lots of early corn in that section which have sustained a commercial loss approximating 70 per cent and in a few instances the damage was so severe that no attempt was made to harvest either corn or fodder, the stalks simply being cut, burned and the refuse turned under. A mitigating feature is found in the fact that even in this badly infested area injury to moderately late or late planted corn, sweet, flint or dent was much less and particularly so in the case of the last named.

There was not serious injury in the infested areas of New York State, although there were a number of fields in western New York where a 50 to 70 per cent stalk infestation could be found. This means appreciable damage in sweet corn, though not serious injury to field corn. There was, however, the same relative variation in the infestation in the New York areas as noted in the Canadian territory

mentioned above, the greater injury occurring in the early planted corn.

The spread of the insect in New York State has been comparatively limited the past season.

The list of infested counties, cities and towns given below indicates the known infested areas, the year of addition to the infested territory, if prior to 1921, being given in parenthesis.

The following is a list for the eastern area:

Albany county. Albany (city, 1919), Berne, Bethlehem, Cohoes (city, 1919), Colonie (1919), Green Island (1920), Guilderland (1919), Knox (1920), New Scotland, Rensselaerville, Watervliet (1920) and Westerlo.

Fulton county. Bleecker,[1] Broadalbin (1920), Caroga, Ephratah, Johnstown (including cities of Johnstown and Gloversville, 1919), Mayfield (1920), Northampton and Perth (1919).

Hamilton county. Benson,[1] Hope,[1] Lake Pleasant[1] and Wells.[1]

Montgomery county. Amsterdam (town and city, 1919), Charleston (1920), Florida (1919), Glen, Mohawk (1919), Palatine and Root.

Rensselaer county. Brunswick (1920), East Greenbush (1920), Hoosick, North Greenbush (1919), Poestenkill (1920), Rensselaer (city, 1920), Schaghticoke (1920) and Troy (city, 1919).

Saratoga county. Ballston (1919), Charlton (1919), Clifton Park (1919), Corinth,[1] Day,[1] Edinburg,[1] Galway (1919), Greenfield, Hadley,[1] Half Moon (1919), Malta (1919), Mechanicsville (city), Milton (1919), Northumberland, Providence,[1] Saratoga Springs (town and city, 1920), Saratoga (1919), Stillwater (1919), Waterford and Wilton.

Schenectady county. Duanesburg (1920), Glenville (1919), Niskayuna (1919), Princetown (1919), Rotterdam (1919) and Schenectady (city, 1919).

Schoharie county. Cobleskill, Esperance (1919), Middleburg (1920), Schoharie (1920) and Wright (1920).

Warren county. Luzerne.[1]

Washington county. Easton, Fort Edward, Greenwich and White Creek.

The western area extends from Niagara south around the east end of Lake Erie and along its shore to the Pennsylvania state line.

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[1] Included in the infested area owing to extreme northern location and the fact that corn is shipped out.

It reaches almost to the southern boundary of the State in Chautauqua county and eastwardly an infested town borders upon Wyoming county.

The following is a list of the infested counties, cities and towns in the western area:

Cattaraugus county. Ashford, Dayton (1919), East Otto, Leon, Otto, Perrysburg, Gowanda (1919) and Persia (1919).

Chautauqua county. Arkwright (1920), Charlotte, Chautauqua, Cherry Creek, Dunkirk (1919), Dunkirk (city, 1920), Ellery, Ellicott, Gerry, Hanover (Silver Creek, 1919), Mina, Pomfret (Fredonia, 1919), Portland (Brocton, 1920), Ripley, Sheridan (1919), Sherman, Stockton, Villenova (1920) and Westfield (1920).

Niagara county. Niagara (1920) including city of Niagara Falls.

Erie county. Amherst (1920), Aurora, Boston, Brant, Angola (1919), Buffalo (city, 1920), Cheektowaga (1919), Clarence, Collins (1919), Concord, East Hamburg (1920), Eden (1919), Elma (1920), Evans (1919), Grand Island (1920), Hamburg (1919), Marilla, North Collins (1919), Tonawanda (1920), Tonawanda (city, 1920) and West Seneca (1920).

The distribution of the European corn borer in America at the close of the past season may be summarized as follows: The infestation in New England includes a strip along practically the entire eastern coast of Massachusetts with a small extension in southeastern New Hampshire and Maine. The Canadian infestation occurs along practically the entire northern shore of Lake Erie, the extreme north and south dimensions being about 40 miles and the infested territory extending to the eastern shore of Lake Huron and with an apparently isolated area on Lake Ontario, some 20 miles east of Toronto. The most seriously infested territory in the vicinity of St Thomas has a north and south extension of about 15 miles and an east and west dimension of 40 miles. There are in addition to the above the New York areas and the sparse infestation along the entire southern shore of Lake Erie, mentioned above. This widespread distribution has led to the abandonment of the attempt to exterminate the insect, even in the case of some isolated infestations, and a corresponding modification in quarantine and control measures.

Observations in New York State. The summer of 1919 showed marked differences in the development of the borer in New York State as compared with Massachusetts. For example, female moths

were rather common June 20th in the latter area and at that time a very large proportion of the developing tassels upon early corn contained from one to five or six or possibly more young larvae, and yet no sign of the insect was observed in the Schenectady area until a female was captured June 30th, and it was not until July 14th that a scattering infestation of young larvae was found in one of the earliest corn fields. The maximum infestation that season hardly exceeded 5 per cent, though it should be remembered that all this area had been thoroughly cleaned up in the spring and the infestation must have therefore been greatly reduced.

A special appropriation of $5000 in 1920 made possible an intensive study of the infestation in the Schenectady area and although repeated examinations were made of various plants in and about many infested corn fields, there was no undoubted evidence to show that the European corn borer breeds in this State in any plant except corn. Partly grown to full-grown borers were found in some weeds and grasses in this State but always in or close to infested corn fields and under conditions which led one to conclude that they were wanderers from the corn rather than that eggs had been laid and the insects developed on these other plants. This infestation has invariably occurred only toward the end of the season and upon such a small scale and under such exceptional conditions that broadly speaking, it may be considered negligible, so far as the distribution of this insect from New York areas in plants other than corn is concerned. The infestation of other plants appears to be determined in considerable measure by the density of the insect population, since investigations the past season in the more badly infested Canadian area with its single generation showed that a considerable number of plants near the infested corn were entered by borers toward the end of the season, though there is no record even under such conditions of development from egg to full-grown larvae upon any plant other than corn.

The borer attacks all varieties of corn and injury is most likely to be serious in the small and medium varieties, mostly because the larger types of corn can maintain a greater number of borers with less likelihood of severe injury. It was also evident in connection with this investigation that the earlier fields of corn were much more likely to be infested than those planted later.

The above should be compared with the well-known food habits of the insect in eastern Massachusetts. There it breeds freely in barnyard grass, beggar-ticks, cocklebur, and probably a few less

common plants in addition to various kinds of corn and the closely related sorghums, etc. Partly grown to full-grown borers have been found in eastern Massachusetts in about 170 different species or varieties of mostly herbaceous plants, including a considerable number commonly grown in gardens, such as dahlias, rhubarb, aster, beans, beets, celery and gladioli. Available evidence indicates that most of the infestation of plants other than corn in eastern Massachusetts is due to the work of the second brood, which develops in that section but under normal conditions apparently does not in the present infested areas in this State.

The stalk infestation in the Schenectady area in 1920 varied from nearly 35 per cent on some river bottom fields near the presumable center of the infestation to a very sparse occurrence of the borer on the outer margin of the infested territory. The fields showing a stalk infestation of 10 per cent or more were limited to an irregular, narrowly triangular area centering approximately upon the Scotia flats and covered some 15 square miles, the greatest extension from the presumable center being 5 miles up the Mohawk river and about 3 miles back from the river. Fields with a stalk infestation of 5 to 10 per cent were to be found in an area of approximately 25 square miles outside of the more heavily infested section mentioned above and extending up the Mohawk river for about 8 miles and back from the river some 5 miles. These infestation records should not be construed as applying to all fields in either area, because, as pointed out below, the degree of infestation depends to a considerable extent upon the time of planting, the nearness of infested material and the direction of prevailing winds.

Three types of injury were noted in New York areas. There is first the damage inflicted upon various portions of the stalk, sometimes very apparent in the breaking of the tassel and usually indicated by borings here and there along the stalk itself. This injury as a rule does not greatly affect the development of the crop, unless it is carried to such an extent as to result in breaking of the lower portion of the stalk either above or below the ear, the latter causing the most damage.

The breaking of corn stalks depends upon several factors, namely, the amount of boring, which is closely related to the degree of infestation and, second, the frequency and violence of wind storms. These latter vary widely from season to season and in different localities. The combined effects of boring and wind storm injury

were strikingly shown in the field belonging to Annie Collins on the Scotia flats. This field had a stalk infestation of nearly 35 per cent and on August 25th there was a noticeable amount of injury due to the breaking over of the corn and on September 3d a careful examination showed that 10.45 per cent of the stalks were broken over. This condition makes harvesting difficult, not to mention the danger of fodder and grain mildewing in damp weather. There was similar breaking in a number of other fields, though not to such a great extent.

The third type of injury is due to the borers entering the ear itself. This may occur at the tip, the borer entering through the husks on the side or by tunneling from the stalk through the stem of the ear into the cob. This latter method of entry is rarely noticeable until considerable damage has been inflicted. Records obtained from several fields showed 5 per cent to 7 per cent of the ears more or less injured by borers.

Repeated examinations in the infested area indicated as a rule comparatively slight damage where the stalk infestation was 10 per cent or less and by no means serious injury when the stalk infestation ran to about 30 per cent and ear injury as high as 7 per cent. It is obvious, furthermore, that there can be a larger percentage of ear infestation in field corn with less relative damage than in the case of sweet corn.

The approximate relation between stalk infestation and ear infestation in a sparsely infested area is indicated by the following tabulation:

Stalk and ear infestation, Schenectady area 1920

Name	*Stalk infestation, per cent*	*Ear infestation, per cent*	
Annie Collins, Flats	34.85	7.3	
Fred Fagel, Mohawk ave.	14.53	11.7, 7.0, 2.9, 7.8 } 7.6	Average of figures
Schairer, Charlton rd.	10.38	5.9	
Brewster	4.4	2.	Mr Brewster first estimated 5 per cent and then raised it to 10 per cent
Vley rd.	4.72	(10?) 5.	
Theuner no. 5, Freeman's bridge	8.8	1.08	
Theuner no. 3	?	2.6	
Theuner no. 4	?	1.2	

The above figures should be compared with the 50 per cent ear infestation in Canadian field corn, 1920, having a 70 per cent to 90 per cent stalk infestation and the practical destruction of early planted sweet corn in the badly infested Canadian area last season, this latter indicating a very general, presumably 100 per cent ear infestation in the worst affected fields.

Conditions affecting infestation. The development of the corn, the nearness of infested material, the direction of the prevailing winds and the stubble infestation all appear to have a material influence upon the amount of infestation.

The influence of the time of planting in the infested area was strikingly shown by two fields of howling mob sweet corn, one planted May 20th and next an infested field of last year, and the other planted July 7th and only 100 feet away across the road. The first had a stalk infestation of 10.52 per cent but in the second only one affected stalk was found. Furthermore, 3 acres were planted with early dawn and golden bantam May 8th and 13th and they had a stalk infestation of 4 per cent while a nearby acre of golden bantam planted June 25th had but three stalks affected, or less than 1 per cent.

Messrs Crawford and Spencer, discussing conditions in the badly infested Canadian area in 1921, state that in general corn sown before May 24th was either practically ruined or suffered severe loss; that sown between May 24th and June 1st was heavily infested but suffered relatively less or but slight, actual loss depending upon the type of corn; while the corn sown after June 1st, although in some cases showing a fairly high percentage of infestation, carried few larvae and suffered practically no loss except in the case of sweet corn.

It should be borne in mind in this connection that the date of planting is only an approximate indication of the condition of the corn at the time the moths fly. A rather striking illustration of this was found in western New York in a large field which was planted on the same date, approximately one-half being in white dent and the other half in evergreen sweet corn. The latter was nearer the presumable source of infestation and yet showed a hill infestation of but 7.5 per cent as compared with the 18.18 per cent of the white dent. The owner stated that the evergreen developed somewhat slower and the probabilities are that the white dent was in a more attractive condition at the time the moths were flying and

consequently they passed over the evergreen in great measure and oviposited mostly in the white dent. It is worthy of note in this connection that depressions in rolling fields, if conditions permit early and vigorous growth, are likely to show a heavier infestation.

The nearness of infested materials has a decided influence upon infestation. The more serious damage occurred almost invariably in fields near known sources of infestation and in a number of cases the infestation began and was decidedly more marked on the side of the field next an earlier infested area or near materials from which moths might have emerged.

The direction of the prevailing winds likewise has an important influence. One of the most striking cases was that of two fields in the Mohawk river bottom, one with a stalk infestation of 19.94 per cent and the other with only 5.46 per cent. The first was in the direct line of prevailing winds from an infested area of the preceding season and the other only about 200 feet north and outside the presumable usual drift of the insects with the wind.

There is nothing to show that certain varieties of corn are particularly immune from attack, though available data indicate that the early and smaller varieties, particularly sweet corn and various flint corns, are more likely to be badly infested. This is presumably because these varieties are usually early and therefore in a more attractive condition at the time the moths are depositing eggs and secondly the smaller varieties of corn are unable to carry an infestation that the larger corn could support without serious injury. This is most apparent in the early fall, because small varieties with their early maturity show the effects of injury at a time when damage is comparatively inconspicuous in the later corn, and unless care is exercised an unfair comparison may result.

There is a connection between the stalk and stubble infestation, since one field with a stalk infestation of 35 per cent showed a stubble infestation of nearly 14 per cent. This stubble was 15 inches high and the proportion is therefore relatively greater than it should have been under normal conditions. In another field, a stalk infestation of about 10 per cent gave a stubble infestation of less than 1 per cent. The above should be compared with the badly infested Canadian area having a stubble infestation of nearly 60 per cent. These figures have a bearing on the expense which can be incurred in the destruction of infested stubble or in taking extra pains to cut it close to the ground.

At least some partly grown to full-grown larvae continue more or less active into November with its freezing temperatures and snow squalls, though it should be noted that in many New York fields, especially of the early corn, there is in September a marked cessation of activities and comparatively few hanging borings. Many holes in corn stalks are closed about this time and this condition increases the difficulty of detecting the borer rather late in the season.

In order to secure data in relation to the possible benefits of plowing under stubble, infested stalks were plowed under just before the ground froze in the fall of 1920. Two areas were selected, one a light, sandy soil and the other a moderately heavy, moist to wet loam. The infested stalks were carefully selected, labeled, laid in the furrows and then covered by plowing to a depth of about 6 or 7 inches. An examination early the following spring and on several subsequent dates resulted in finding no living corn borers in the stalks plowed under in the wet, moderately heavy loam. The earlier examinations of the material in the lighter soil showed little or no mortality just after the ground thawed and a gradual increase in the numbers of dead larvae until about the first of May when none or very few survived. The experiments were necessarily on a small scale and yet they indicate a heavy to complete mortality in buried material in the moderately heavy, wet soil and a presumably high ratio of deaths in lighter soils before conditions had advanced sufficiently so that moths could escape. In a general way, the conclusions based upon our inability to find a notably greater infestation during the summer of 1919 in fields near corn stubble, which had been plowed under the previous fall, to the effect that borers did not winter successfully in any great numbers in such material, were amply justified.

Observations in 1921 confirm the experience of the two preceding seasons to the effect that early corn, other things being equal, was most seriously affected. For example an examination September 14th of corn close to the Thomas Indian School showed that golden bantam had a stalk infestation of from 15 to 20 per cent, while nearby later planted corn of the same variety was almost free from the insect. A large field of yellow dent corn about three-fourths of a mile north of the Indian school showed a 40 per cent stalk infestation, while just across the road from it a very similar field of somewhat later corn had a stalk infestation of only about 2 per cent. Similar variations were also noted in the

immediate vicinity of Silver Creek, the insect being notably more abundant in early fields.

Insect activities commenced considerably earlier than in 1920. The first pupa was found at Scotia May 30, 1921, the first moths at both Scotia and Silver Creek, June 16th, the first egg mass at Scotia June 16th and at Silver Creek June 22d, according to data supplied by Federal observers. Developments at Port Stanley, Ontario, closely paralleled those in New York, the first pupa being found May 30th, the first empty pupal case June 16th and the first egg mass June 25th, according to Mr H. G. Crawford who supplied the data. Fully 20 per cent of the larvae at Scotia were nearly full grown June 28th, the remainder being half grown or smaller and limited mostly to the upper portion of the stalk. A pupa was found by Mr Harmon July 25th and the probabilities then indicated the development of a fair sized second brood, which latter was apparently checked by a period of unusually cold weather, though there was a very small, practically negligible second brood. The same conditions prevailed in the western part of the State and in Canada. With the experience of the past three seasons as a guide, it would presumably require a very unusual combination of favorable climatic conditions to produce in our New York areas a second generation capable of causing appreciable injury.

Observations upon the good habits of the borer were continued and as in previous years very few were found in other plants in the near vicinity of corn. These conditions resulted in the modification of both federal and state quarantine regulations and their limitation to corn, broom corn, all sorghums and sudan grass. This greatly simplifies the enforcement of these regulations and gives practically the same protection as the more sweeping provisions of the earlier quarantine.

Economic importance. The history of the European corn borer in America plainly shows that this insect may cause serious to extremely severe injury under certain conditions. The damage in eastern Massachusetts, owing to the development normally of two generations each season, appears to be more general than in areas where but one brood is produced, though even in that section by no means all the corn is greatly damaged. This may be due to a variety of causes which can not be discussed in this connection.

A somewhat serious injury to early corn in Ontario, Canada, in 1920 and decidedly more general and severe damage in 1921 conclusively establishes the probability of extended losses in that area

under favorable conditions, though it should be noted that the greatest damage is limited to the early planted corn. There is a possibility, if not probability, of approximately equally great injury in at least a portion of the single brooded areas in New York State and on that account it is believed that corn growers might well adopt such modifications in agricultural practice as are likely to give protection against this insect without involving an unreasonable expense.

Description, life history, etc. The signs of infestation, the characteristics of the insect and its life history have been outlined so fully in the Thirty-fourth Report of the State Entomologist for 1918 and the recently issued Cornell Extension Bulletin 31, that it appears unnecessary to repeat the information at this time.

Natural enemies. Although several natural enemies have been noted, the probabilities of successfully controlling the European corn borer by such agencies are not particularly promising for the near future. It will certainly require a few years to introduce and establish effective natural enemies, even if they can be found in other countries.

The minute egg parasite, Trichogramma minutum Riley, so destructive to the borer in Massachusetts areas in 1919, is a common egg parasite of some forty-five different hosts belonging to four orders of insects, among which may be mentioned the currant worm, the monarch butterfly, the fall webworm, the brown-tail moth, the cotton moth, the corn ear worm, the fall army worm, the grapeberry moth, the sugar cane borer or the larger corn stalk borer, the oblique banded leaf borer and the locust leaf miner. These are all common insects, most of them becoming exceedingly abundant at frequent intervals; and this alone would indicate that while Trichogramma is sometimes abundant and beneficial, it is very rarely sufficiently numerous to control for more than a short period one or more of these insects and that, generally speaking, it is an unreliable parasite with habits which would hardly justify the expectation of moderately satisfactory control.

Control measures. It is obvious that national and state agencies can not indefinitely continue to clean up the constantly increasing infested areas and it therefore follows that repressive measures which appear practicable to the farmer must be devised or serious losses may follow. The most promising of these are given below. In this connection it seems advisable to emphasize the fact that special attention should be given to early planted corn, because this

is the most likely to be seriously infested and it appears probable that a very considerable reduction in the numbers of the pest may be secured in single brooded areas at least by concentrating efforts upon the early corn. It should not be assumed that all the recommendations given below are considered advisable for every infested area. It is believed that a recognition of the factors involved and judicious application of the recommendations to local conditions may result most beneficially.

1 Cut corn close to the ground, since many of the borers winter in the stubble.

2 Put as much of the corn into silos as possible because the borers are killed by the fermentation of the ensilage. This also applies to waste from canning factories.

3 Cut or shred corn stalks fed to cattle in order to promote their consumption. In any event keep the uneaten parts, the "orts," out of the manure and provide for the destruction by May 15th of the contained borers in all such materials whether in field, lot or barn, by burning, plowing under or submerging in water for some 40 days, unless the stalks are worked into piles containing considerable horse manure which will heat to such an extent as to destroy the borers.

4 Fall plowing, especially early and thorough, destroys many borers. It is considered advisable to encourage the practice in the infested areas. Heavy rolling prior to plowing has been suggested as a valuable aid, because many borers are killed by crushing the butts and it is then easier to turn the stubble under.

5 Weeds and other plants growing in or near badly infested corn may be invaded by borers in late August or September; consequently clean culture is of service in reducing the number of stems in which the pests may winter. Burning over in late fall or early spring of waste or weedy areas in or adjacent to corn fields, especially badly infested ones, is advised.

6 Corn stalks, cobs and almost any thick part of all herbaceous plants may contain these borers under certain conditions and their shipment or removal from the infested area is dangerous and in many cases a violation of quarantine regulations.

7 Crops particularly likely to carry the borer, such as celery, beets, dahlias etc., should not be grown in the infested areas within 50 feet of corn because the borers, deserting the corn for one reason or another, may crawl 30 feet or more before entering some other plant.

8 Where conditions permit, the probabilities of a general and possibly serious infestation may be considerably reduced by planting small areas of early corn, particularly near previously infested fields or adjacent to sources of infestation, such as scattered corn stalks, for the purpose of attracting the moths. In case a serious infestation results, the borers in these small plantings may be destroyed by feeding the corn, or in some other manner. The main crop, if planted a little later, would largely escape the pest, if one may judge from conditions the last three seasons in the infested areas in both New York State and Ontario, Canada.

CODLING MOTH

Carpocapsa pomonella Linn.

Experimental work with this insect has been continued in the orchard of Mr G. W. Mead of Barker, the applications and classification of the fruit being supervised by Mr L. F. Strickland of the Department of Farms and Markets. A general description of the orchard and the location of the plots has been given in the Report for 1917, pages 18 and 19, and need not be repeated.

The first application, the regular calyx spray, was made June 2, 1919 and consisted of lime sulphur, 1 to 40, and lead arsenate, 5 pounds to 100 gallons. The amount used was 225 gallons, the pressure 225 pounds, and an excellent distribution was secured. Plots 2 and 3 were sprayed again June 3d using the same formula, and 150 gallons of spray were applied at a pressure of 225 pounds. Plot 3 was sprayed for the third time, July 31st, about 70 gallons of spray being applied.

The first treatment in 1920 was given June 2d, the second June 24th and, owing to the very light set of fruit, there was no third application to plot 3. The formula was the same as in 1919.

The data for the individual plots have been summarized and are tabulated with that of earlier years.

Comparative codling moth results, Barker orchard, 1917–20

Wormy fruit

PLOTS	TOTAL FRUIT	TOTAL	END	DEEP OR SIDE	AUGUST	SHALLOW	PER CENT WORMY SHOWING SHALLOWS
1							
1917	7 392	1 400	50	305	264	859	61.35
	%	18.93	.69	4.12	3.57	11.62	
1918	5 111	368	0	80	7	281	76.36
	%	7.20	.....	1.56	.13	5.49	
1919	9 021	3 076	2	902	163	2 009	65.31
	%	34.09	.02	9.91	1.80	22.15	
1920	12 047	1 106	0	1 154	5	947	85.62
	%	9.17	0	12.7	.04	7.86	
Average	.....	.....	.....	.....	.....	.....	72.16
2							
1917	8 687	1 405	15	194	80	1 153	82.06
	%	16.17	.17	2.23	.92	13.27	
1918	6 419	596	1	42	3	550	92.28
	%	9.30	0	.65	0	8.56	
1919	17 094	3 748	0	427	89	3 232	86.23
	%	21.92	0	2.49	.52	18.90	
1920	7 341	1 103	0	113	7	983	89.11
	%	15.02	0	1.54	.01	13.52	
Average	.....	.....	.....	.....	.....	.....	87.42
3							
1917	11 015	1 150	24	149	14	1 027	89.30
	%	10.44	.22	1.35	.13	9.32	
1918	9 248	656	0	54	1	631	96.19
	%	7.09	0	.58	0	6.84	
1919	15 029	3 112	0	191	26	2 895	93.02
	%	20.70	0	1.27	.17	19.26	
Average	.....	.....	.....	.....	.....	.....	92.83
Checks							
1917	1 739	725	148	254	141	332	45.79
	%	41.69	8.51	14.60	8.11	19.10	
1918	9 365	922	63	117	3	739	80.15
	%	9.84	.67	1.24	.03	7.89	
1919	12 586	3 348	79	813	302	2 118	63.20
	%	26.60	.62	6.45	2.39	16.82	
1920	4 890	821	22	298	30	471	56.15
	%	16.78	0.4	6.1	0.6	9.6	
Average	.....	.....	.....	.....	.....	.....	61.22

A comparative study of the data obtained in the Barker orchard for the years 1917 to 1920 inclusive clearly indicates the value of the first or calyx spray and less benefit accruing from the second and third applications respectively, at least so far as the codling moth is concerned. The average of the total wormy fruit for this period, obtained by adding the percentage of each year and dividing by the number of years [1] is 17.35, 15.60, 12.74 for plots 1, 2 and 3 respectively while for the check trees it is 23.72 per cent.

[1] This method of obtaining the average percentage more nearly equalizes the results for different seasons and is considered preferable by the author in view of the very great difference in the yields.

A similar comparison of the average percentage of fruit injured by the second brood and indicated in the tabulation by the word August is as follows: 1.63, .36, and .10 per cent respectively for plots 1, 2 and 3 and 2.78 for the check trees.

There is decidedly less difference between the various plots in relation to the characteristic injury by recently hatched larvae designated in the table as shallow. It is as follows: 11.78, 13.56 and 12.41 respectively for plots 1, 2 and 3 and but 13.33 for the check trees. This would indicate, as do other data, that the ordinary spraying of the season has very little or no effect in preventing this characteristic though minor type of injury.

Oviposition and temperature. There is a close relation between insect activities and temperature, and this appears to be particularly marked in egg-laying by the codling moth. Conditions in western New York are such that low temperatures may result in a prolonged period of egg-laying, some 40 days, a condition which greatly increases the difficulty of securing maximum results with the few poison applications.

Mr Strickland has been greatly interested in this problem, and through his cooperation we are able to present some interesting data concerning a number of orchards from approximately the middle of June to the last of July.

The average duration of the egg stage is 6 or 7 days, though it may be considerably prolonged by cool weather. Normally the egg is reddish 2 or 3 days after it has been laid and the black head of the young larvae may be seen through the shell 1 or 2 days prior to hatching. The figures under "entrance" indicate the number of larvae which have entered the apple and those in the column under "shells," the number of eggs which have hatched. A scrutiny of each line therefore gives a good idea of the number and condition of the eggs. The tiny, glistening, semitransparent or whitish speck-like eggs have a diameter of a little less than the head of a pin. They occur upon the leaves and are most easily seen upon the smooth surface of the fruit. The temperature records were checked by the operation of a thermograph loaned by the United States Weather Bureau. One was set up on the farm of Mr A. F. Dale located a mile south of Lockport and the other on that of Mr G. W. Mead of Barker. These gentlemen cooperated by making temperature records at 8 and 9 o'clock and also recorded the maximum and minimum temperatures, the amount of rain, its approximate duration and the direction of the wind between those hours.

Oviposition records were secured in the orchards of the following: F. C. Strong, Lockport, I. G. Palmer, Olcott, G. W. Mead, Barker, F. M. Bradley, Barker, Frank Dietrick, Wilson, L. Nicholl, Lewiston, A. F. Dale, Lockport, G. E. Manning, Ransomville, W. A. Saxton, Wilson, Glen Miller, Appleton, W. Folger, Olcott, H. L. Schultz, Ransomville, L. S. Silberburg, Youngstown, F. D. Weaver, Lockport, R. Wisterman, Lockport, W. T. Hall, Lockport, B. Randolph, Middleport, R. E. Heard, Lockport, I. G. Powell, Olcott.

The close connection between evening temperatures and egg-laying has been graphically shown in the chart prepared by Mr Strickland.

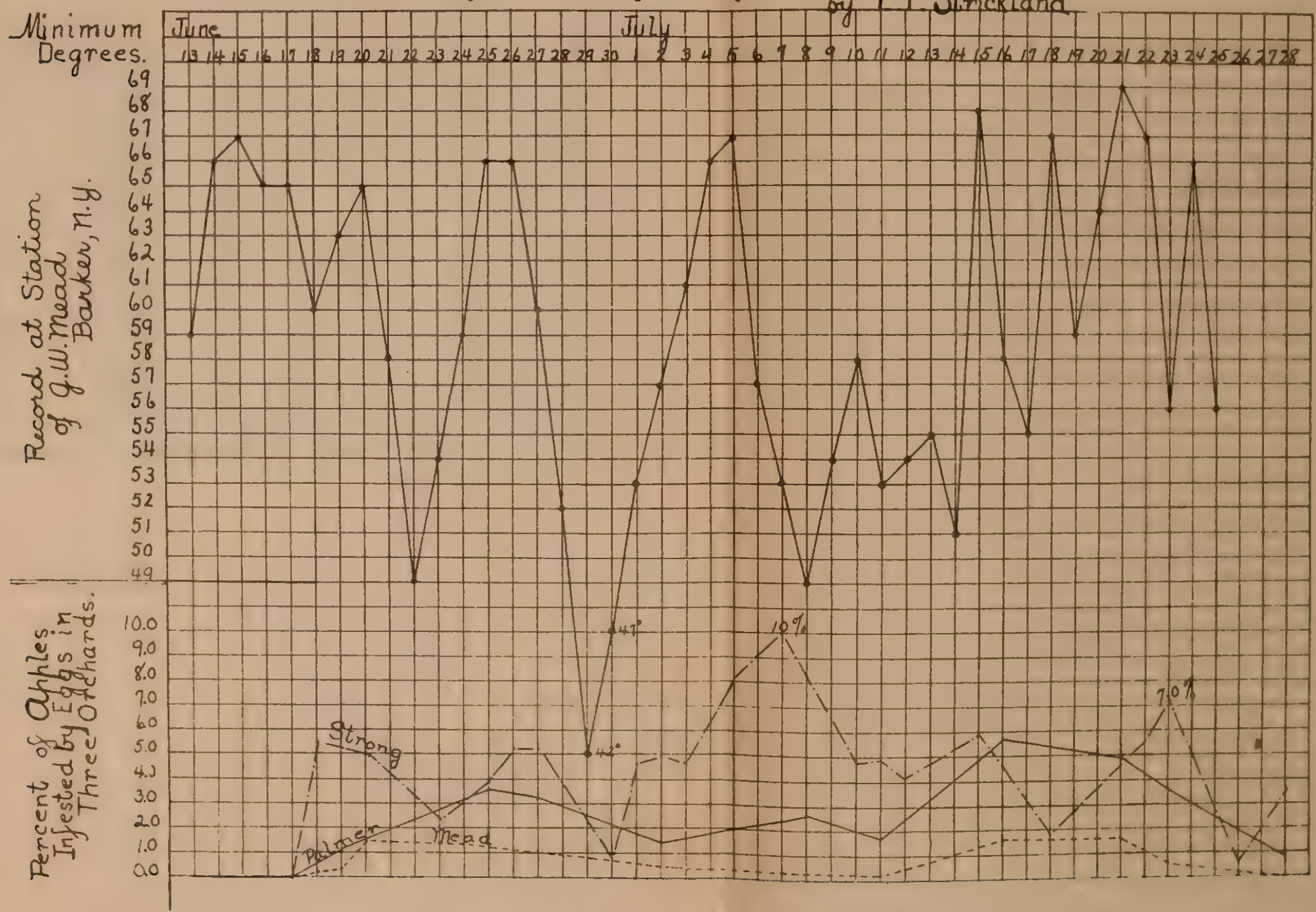
Codling Moth Egg Records, 1919

By L. F. Strickland

PLACE	DATE	NO. OF APPLES EXAMINED	PER CENT OF APPLES INFESTED	EGGS				ENTRANCES	SHELLS
				White	Milk	Red	Black		
Strong's	6/18/19	523	5.52	11	13	1	3	5	4
Strong's	6/20/19	358	5.03	6	6	4	2	6	2
Strong's	6/23/19	641	2.49	6	5	1	4	19	23
Strong's	6/25/19	471	4.03	9	8	0	2	32	12
Strong's	6/26/19	500	5.20	14	10	0	2	31	32
Strong's	6/27/19	650	5.23	22	7	0	5	35	34
Strong's	6/30/19	310	0.96	0	1	0	2	9	8
Strong's	7/ 1/19	730	4.79	20	10	3	2	51	67
Strong's	7/ 2/19	554	5.05	16	7	1	4	40	51
Strong's	7/ 3/19	564	4.78	15	8	2	2	43	42
Strong's	7/ 5/19	122	8.19	9	0	0	1	10	23
Strong's	7/ 7/19	260	10.0	21	1	1	3	22	35
Strong's	7/10/19	513	4.87	14	6	2	3	75	72
Strong's	7/11/19	264	4.92	9	1	0	3	39	42
Strong's	7/12/19	118	4.23	2	0	0	3	9	10
Strong's	7/15/19	504	5.95	12	3	0	15	86	81
Strong's	7/18/19	597	1.97	2	4	3	1	69	52
Strong's	7/22/19	500	5.60	10	11	2	5	134	74
Strong's	7/23/19	501	7.39	10	17	4	6	127	118
Strong's	7/26/19	312	0.05	0	1	1	0	89	45
Strong's	7/28/19	302	3.63	0	6	4	1	96	53
Mead's	6/18/19	812	.36	2	1	0	0	0	1
Mead's	6/19/19	622	0.48	2	0	0	0	0	1
Mead's	6/20/19	627	1.59	5	5	0	0	0	2
Mead's	6/24/19	669	1.33	5	2	0	1	9	9
Mead's	7/ 2/19	384	0.52	1	1	0	0	2	1
Mead's	7/11/19	473	0.21	1	0	0	0	15	22
Mead's	7/16/19	581	1.72	0	7	2	1	24	18
Mead's	7/21/19	117	1.70	1	0	0	1	16	3
Mead's	7/23/19	545	0.73	0	3	1	0	42	33
Palmer's	6/19/19	880	1.13	2	5	1	1	1	2
Palmer's	6/25/19	880	3.75	18	11	2	2	9	17
Palmer's	6/27/19	531	3.20	6	8	0	0	8	4
Palmer's	7/ 2/19	273	1.56	3	0	0	1	4	16
Palmer's	7/ 8/19	531	2.82	3	8	1	3	20	38
Palmer's	7/11/19	636	1.88	10	1	0	1	13	43
Palmer's	7/16/19	526	5.87	7	18	3	3	22	37
Palmer's	7/21/19	122	4.91	1	3	1	1	14	4
Palmer's	7/23/19	552	3.60	4	11	1	4	31	42
Palmer's	7/28/19	313	0.95	0	1	0	2	19	19

Curves Showing Effect of Temperature on Codling Moth Oviposition in 1919 in Niagara County, New York.

by I. F. Strickland



Codling moth, egg records, 1919

By L. F. Strickland

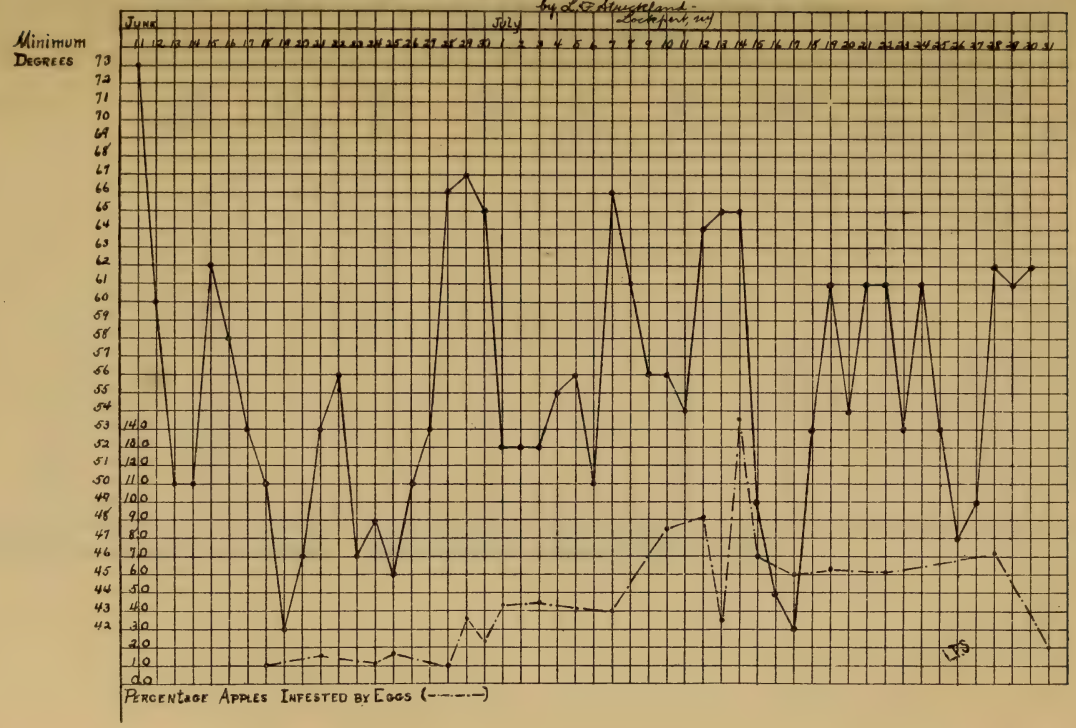
PLACE	DATE	NO. OF APPLES EXAMINED	PER CENT OF APPLES INFESTED	EGGS				ENTRANCES	SHELLS
				White	Milk	Red	Black		
Powell's	6/19/19	719	0.27	1	1	0	0	1	1
Powell's	6/24/19	588	0.34	0	1	0	1	2	12
Powell's	6/26/19	896	0.89	4	4	0	0	10	20
Powell's	7/ 1/19	561	0.89	0	3	0	2	4	20
Powell's	7/ 8/19	500	0.40	1	1	0	0	6	10
Powell's	7/16/19	507	1.16	0	4	2	0	10	21
Powell's	7/22/19	516	0.77	1	1	1	1	36	19
Powell's	7/28/19	317	0	0	0	0	0	20	17
Bradley's	6/24/19	584	0.68	0	0	3	1	11	10
Dietrick's	6/19/19	393	3.81	6	8	0	1	3	3
Nicholl's	6/19/19	457	1.53	4	2	0	1	2	1
Dale's	6/23/19	756	3.83	13	12	1	3	11	19
Dr Manning	7/24/19	355	0.82	0	3	0	0	30	29
W. A. Saxton	7/24/19	344	2.32	3	2	2	1	22	34
Glen Miller	7/24/19	355	1.12	2	1	1	0	11	11
Folger's	7/24/19	375	0.53	0	1	1	0	6	18
F. Dietrick	7/24/19	383	2.34	3	5	0	1	50	46
H. L. Shultz	7/24/19	528	0.95	0	4	0	1	23	32
L. S. Silberburg	7/24/19	372	0.53	2	0	0	0	14	17
F. D. Weaver	7/25/19	356	0.27	1	0	0	0	22	10
R. Wisterman	7/25/19	319	0.31	0	0	1	0	20	22
A. F. Dale	7/25/19	317	0.63	1	1	0	0	72	64
W. T. Hall	7/25/19	318	0.31	1	0	0	0	20	38
B. Randolph	7/25/19	453	0.88	0	3	0	1	28	23
Heard	7/25/19	302	1.32	0	4	0	0	64	33

Thermograph records

DATE	DALE FARM			MEAD FARM, BARKER, N. Y.		
	9 p. m.	Maximum	Minimum	9 p. m.	Maximum	Minimum
1919						
June 14	78	92	65	73	90	66
15	77	89	65	73	88	67
16	73	86	65	71	81	65
17	75	86	65	72	83	65
18	76	90	59	71	85	60
19	74	90	66	73	88	63
20	66	78	66	65	75	65
21	70	87	55	68	82	58
22	64	76	48	64	75	49
23	70	84	50	71	82	54
24	78	93	57	70	90	59
25	66	78	66	68	75	66
26	68	78	66	70	80	66
27	60	69	59	61	71	60
28	59	64	46	55	65	52
29	58	73	41	57	67	42
30	68	83	47	66	80	47
July 1	71	88	53	71	84	53
2	74	93	54	73	91	57
3	72	91	59	77	94	61
4	77	93	64	80	94	66
5	*	93	*	68	90	67
6	*	71	*	58	69	58
7	*	74	*	60	72	53
8	61	76	49	59	70	49
9	74	86	53	76	85	54
10	58	78	57	58	80	58
11	61	74	52	64	76	53
12	63	73	64	62	74	54
13	66	81	55	64	76	55
14	74	88	55	73	82	51
15	68	84	71	68	85	68
16	65	75	57	67	77	58
17	73	88	53	70	85	55
18	74	90	55	72	86	68
19	75	90	60	74	85	59
20	76	90	60	74	85	64
21	68	80	68	69	82	69
22	70	81	66	71	81	67
23	71	85	54	71	83	56
24	70	87	63	69	85	66
25	66	83	55	68	80	56

* Air bubble in column of alcohol. This was removed at 9.30 p. m., July 7th.

Temperature and Oviposition Curves in Relation to Codling Moth in 1920.



Codling moth records; oviposition and parasitism in 1920

Orchard of F. C. Strong, Lockport

DATE 1920	NO. APPLES EXAMINED	NO. EGGS HYALINE	NO. EGGS MILK	NO. EGGS RED	NO. EGGS BLACK	TOTAL NO. EGGS	PER CENT OVIPOSITION	NO. EGGS PARASITIZED	PER CENT PARASITISM	NO. APPLES ENTERED	PER CENT ENTERED
June 18	500	0	4	1	0	5	1.0	0	0.0	0	0.0
June 21	590	1	4	4	1	10	1.6	0	0.0	0	0.0
June 24	542	0	2	4	1	7	1.2	0	0.0	0	0.0
June 25	463	0	6	1	1	8	1.7	0	0.0	3	0.6
June 28	568	0	4	1	1	6	1.0	0	0.0	6	1.0
June 29	574	0	16	3	2	21	3.6	0	0.0	2	0.3
June 30	1,000	3	8	9	4	24	2.4	0	0.0	10	1.0
July 1	522	3	10	6	3	22	4.2	0	0.0	4	0.7
July 3	134	1	1	0	4	6	4.4	0	0.0	9	6.7
July 7	500	9	1	5	5	20	4.0	0	0.0	10	2.0
July 10	276	8	6	9	1	24	8.6	0	0.0	6	2.1
July 12	502	24	17	3	2	46	9.1	6	13.04	20	3.9
July 13	275	6	3	1	0	10	3.6	—	10.	12	4.3
July 14	75	0	6	4	1	11	14.6	2	18.1	6	8.0
July 15	811	11	25	8	13	57	7.02	—	—	21	2.5
July 17	540	6	17	9	1	33	6.11	1	3.3	19	3.5
July 19	500	12	8	4	8	32	6.4	3	9.3	48	9.6
July 22	505	11	14	5	0	32	6.3	9	21.8	47	9.3
July 29	250	13	3	1	1	18	7.2	9	50.00	17	6.8
July 31	100	1	1	0	0	2	2.0	1	1.0	9	9.0

NOTE.— The parasites were *Trichogramma minutum*. Data on parasitism in other orchards not included.

Meteorological records for 1920

Thermometer readings verified and supplemented by thermograph records (By L. F. Strickland, Lockport, N. Y.) Location G. W. Mead, Barker, N. Y.

DATE	ACTUAL TEMPERATURE 8 P. M.	MAXIMUM TEMPERATURE	MINIMUM TEMPERATURE	RAINFALL INCHES	DIRECTION OF WIND	DURATION OF RAINFALL MISCELLANEOUS
June 11	73	83	73	.....	Slight N.W.	
June 12	72	75	60	.....	N. W.	
June 13	Missed	Missed	50*	.....	.....	
June 14	74	86	50	.....	Light, W.	Read at 8.30 p. m.
June 15	70	85	62	0.7	Light, W.	
June 16	59	70	58	0.25	Light, S. E.	
June 17	57	62	53	0.1	Light, N. E.	
June 18	58	64	50	.....	Light, N. E.	
June 19	71	72	42	.....	Light. N. W.	
June 20	69	77	46	.....	East.	
June 21	62	70	53	.....	N. W.	
June 22	59	68	56	.....	N. W.	
June 23	63	71	46	.....	N. W.	Read at 8.05 p. m.
June 24	71	75	48	Trace	Light, S. E.	
June 25	72	79	45	.....	W.	Read at 8.05 p. m.
June 26	72	82	50	.....	W.	Read 8.40 p. m.
June 27	76	86	53	.....	S.	Read 8.10 p. m.
June 28	81	91	66	.....	N. W.	
June 29	70	88	67	0.1	N. W.	Duration 30 min.
June 30	75	83	65	.....	N. W.	
July 1	66	75	52	.....	Light S. E.	
July 2	72	80	52	0.7	W.	Duration 45 min.
July 3	Missed	Missed	52*	0.1	.....	
July 4	62	83	55	.....	W.	
July 5	68	76	56	.....	W.	
July 6	70	80	50	.....	Light, E.	
July 7	71	80	66	.....	E.	
July 8	64	78	61	.....	W.	
July 9	Missed	Missed	56*	0.54	N.	
July 10	77	81	56	.....	W.	
July 11	72	79	54	.....	W.	
July 12	74	77	64	0.07	W.	Duration 30 min.
July 13	71	89	65	0.25	W.	Duration 30 min.
July 14	72	80	65	0.06	W.	Duration 1½ hrs.
July 15	63	79	49	.....	W.	
July 16	Missed	Missed	44*	.....	.....	
July 17	70	76	42	.....	E.	
July 18	65	70	53	.....	W.	
July 19	65	74	61	0.16	W.	Duration 55 min.
July 20	71	81	54	.....	W.	
July 21	71	83	61	0.11	Light, W.	Duration 35 min.
July 22	68	73	61	.....	Light, W.	
July 23	68	74	53	0.18	W.	Duration 45 min.
July 24	63	71	61	0.45	E.	Duration 2½ hrs.
July 25	61	67	53	.....	W.	
July 26	66	70	47	.....	W.	
July 27	Missed	Missed	49*	.....	W.	
July 28	73	82	63	.....	W.	
July 29	75	85	62	.....	W.	Read at 8.45 p. m.
July 30	74	87	63	0.3	W.	Duration 1¾ hours.

Meterological Records for 1920

Note: Instruments set and records made on daylight saving time. The United States Weather Bureau cooperated by the loan of instruments and by correcting the readings. Minimum temperatures of June 13, July 3, 9, 16 and 27 taken from the thermograph records are marked with an asterisk (*).

CORN EAR WORM

Chloridea obsoleta Fabr.

The corn ear worm was exceptionally injurious and unusually widely distributed over the State in 1921, its general occurrence being almost unprecedented and accompanied by great injury in Madison county, considerable to serious damage in Orleans, Cayuga, Livingston and Allegany counties and appreciable injury in Chautauqua, Chemung, Monroe, Orange, Wyoming and Yates counties. One Wyoming county correspondent reported one to six or eight larvae in nearly every ear of a small field of corn. The central and western parts of the State suffered most as was the case in 1919.

It is quite possible that the general interest in the European corn borer, both last season and in 1919, resulted in corn being watched more closely than in earlier years and consequently the numerous reports the past few seasons as compared with those of earlier years may give an erroneous impression respecting the relative abundance of the insect. The pest was received in 1921 by various official entomologists from almost every county in the State. Prof. C. R. Crosby states that golden bantam corn seemed to be especially favored by the insect and he records one case where 1½ acres of wax beans were so badly infested as to render the crop unmarketable.

The widespread injuries noted above were by no means confined to New York State. Similar conditions, we are informed by various correspondents, occurred in Massachusetts, Rhode Island, Pennsylvania and Ohio and Prof. W. A. Ross of the Entomological Laboratory, Vineland, Ontario, stated that the ear worm was so remarkably abundant and injurious that in some parts of southwestern Ontario the canning factories had to close because the corn was so badly infested that practically none of it was fit for canning purposes. For the first time in Canada, so far as he was aware, greenhouse tomatoes were attacked in southern Ontario, most of the injury occurring in early October.

There was an approach to the general prevalence of ear worm in 1921 two years earlier. This, like the outbreak of the past season, followed a mild winter. It was then received at Cornell University according to data supplied by Prof. C. R. Crosby, from seventeen localities representing eleven counties. The records of

this office show that the insect was particularly abundant that year in Chautauqua, Erie, Livingston and Yates counties.

Earlier New York records. An examination of the reports of this office covering a period of over 40 years discloses a record of injury in the central part of the State in 1881, another in 1890, relates to injury at Albany and in Westchester county. A third states that in 1902 this insect was unusually abundant on corn at Mount Vernon and in one instance infested ears were shipped to Albany. It was again destructive to corn in Ontario county in 1908, in 1909 it was reported as injurious from Shelter Island and in 1914 from several Hudson valley localities.

The above records of earlier injury would hardly justify the belief that this insect is markedly injurious from year to year in the southern, warmer parts of the State.

Life-history and habits. The corn ear worm is a well-known southern pest. It is the boll worm and the tobacco bud worm of the south. It is also known as the tomato fruit worm. There are four and possibly five generations in the south, the larvae or pupae hibernating underground.

Our finding, June 29th, of partly grown corn ear worms in a Gowanda field appears to be the earliest record of the insect in the State for 1921. The infestation was scattering and some of the larvae were about half grown. It would appear entirely possible for two generations to develop later in the season and a very sparse infestation thus early might easily account for the serious and widespread injury experienced toward the end of the season.

Comparatively little is known concerning the habits of this insect in the northern states except that it is usually present every autumn in small numbers, and in New York State it is generally limited to the warmer portions, Long Island and the central or southwestern part of the State. There is a general impression that the insect can not winter successfully, at least in large numbers, in the cooler portions of our corn-growing area and this is supported by the fact that outbreaks such as that of last year are very exceptional; moreover both this one and that in 1919 followed exceptionally mild winters, which latter presumably afforded unusually favorable conditions for successful hibernation. The occurrence of the corn ear worm in New York State as outlined above appears to agree substantially with known conditions in Massachusetts, Connecticut, Ohio and presumably Pennsylvania. The presumed inability of the corn ear worm successfully to withstand our northern winters

is of considerable practical importance, since it means, if this be the case, that infestations must originate in most cases from migrating moths and the usual appearance of the pest in corn during September and October also tends to support current opinion respecting the habits of this insect.

There is no question but what the corn ear worm winters successfully a little south of New York State. Dr T. J. Headlee, state entomologist of New Jersey, informs the writer that the corn ear worm unquestionably winters in their soils. On the other hand, Dr W. R. Walton states that the winter mortality of this insect, even so far south as central Virginia, is normally very heavy. Doctor Walton thinks it safe to assume that the northern limit of hibernation is normally somewhere in the neighborhood of 42° north latitude. The above general statements agree very closely with known conditions regarding the corn ear worm so far as New York State is concerned.

The eggs of moths flying in midsummer or later are frequently deposited upon corn silk and the young caterpillars enter the tips of the ears and feed very largely upon the developing grain, though in cases of unusually severe infestation there may be damage to the stalk and the tassel very similar to that caused by the European corn borer. Ordinarily this latter does not occur. Partly grown to full-grown caterpillars spoil ears for domestic purposes and if the infestation is general, may seriously damage crops of field corn.

Characteristics of the insect and its work. The full-grown caterpillars are about 1½ inches long and vary greatly in color from a light green through a rosy color and brown to almost black. They may be either striped, spotted or perfectly plain. Ordinarily, they present rather bright, strongly contrasting colors. They are easily distinguished from the European corn borer by the larger size, the minute black tubercles or warts on the body of the caterpillars, the frequently strongly marked coloration and the usual limitation of feeding to the surface of the ear. Ordinarily, the corn ear worm is not a borer.

Control measures. With the above limitations in mind, and they appear to apply strictly to this species, we are forced to the conclusion that ordinarily remedial measures for the control of corn ear worm are impractical in the New York corn-growing areas, because serious damage is so uncommon. Furthermore the abundance of the insect one season, if it is unable to withstand our severe winters, and such appears to be the case, means little or nothing

so far as probable injury another season is concerned. These reasons lead us to doubt the advisability of recommending systematic fall plowing or other methods designed to bring about the destruction of the caterpillars so numerous in infested corn fields in the fall, because there is such a slight probability of their wintering successfully.

There may be some sections of the State where this pest is sufficiently abundant from year to year to warrant systematic repressive measures; in such cases, fall plowing for the destruction of the hibernating insects may well be generally followed.

In other areas, it is suggested that careful watch be kept for the few early appearing caterpillars and if they occur in midsummer, the last of June or early in July, there is at least a fair probability of some to very material injury developing later. Under such conditions in areas where sweet corn is largely grown or even in more highly prized garden plots, injury may be greatly decreased by dusting the silk of the developing ears with a mixture of 50 per cent powdered arsenate of lead and 50 per cent of finely ground sulphur. The first treatment should be given soon after the silk appears and this followed by one or two others before the corn is ready to pick.

RASPBERRY BEETLE OR RASPBERRY BYTURUS

Byturus unicolor Say.

Small, light brown raspberry beetles were extremely abundant May 13, 1921 in several raspberry plantings belonging to C. J. Hepworth, Milton. An examination on that date in company with J. B. Palmer of the state spray service resulted in finding one to four or five beetles in many of the opened blossoms. It was estimated that presumably half of the commercial value of the crop had been destroyed by the insects feeding in the developing buds. Instinct seems to compel them to bore into buds and to force their way between the folds of developing leaves or into partly expanded flowers. This habit makes satisfactory poisoning very difficult, if not impossible.

Mr Palmer stated that growers in that section were advised to spray immediately after he found the first beetles and in one plot there had been four applications of arsenate of lead, using 3 pounds of paste to 50 gallons of water. The beetles were still somewhat numerous at the time of examination, although the condition of the bushes indicated thorough and effective spraying. There was a

perceptible difference between the area treated in this manner and unsprayed bushes, though the control could not be considered satisfactory from a commercial standpoint. Another plot was examined which had been sprayed at least twice with arsenate of lead and then received a thorough application of strong kerosene emulsion; even in this case, though the latter treatment was recent, there were a number of living beetles.

A nearby grower had sprayed two days earlier with arsenate of lead, 3 pounds to 50 gallons and black leaf 40, using 1 quart to 50 gallons of spray. Even this application, excessive in its nicotine content, resulted in no satisfactory evidence of many beetles having been killed, though some had presumably succumbed. This is not surprising in view of the fact that many of the insects had the anterior three-fourths of the body buried in buds or squeezed between petals of opening flowers, while some were within the latter and sheltered to all practical purposes from any application which could be made.

An examination, May 24th, of the raspberry patch on the farm of C. J. Hepworth showed only five to seven beetles to a hill in the area sprayed four times with poison. The insects were mostly in the opening blossoms. Mr Palmer stated that they were much more abundant three days earlier in two other fields belonging to Mr Hepworth. The pests were less numerous, there being but two to four to a hill. Perfection was the variety most seriously affected and as the patch is a very early one for that section, it is possible that the beetles were unusually abundant at the time of the early bloom and as a consequence the damage was much more serious than if the field had been later. This theory was supported by finding a field of the same variety on a higher elevation and somewhat grassy so that the development was a week later and although seven to ten beetles were found to a hill and two to four or even five in the unfolding leaves, practically none was attacking or boring into the blossom buds. Not many of the blossoms had opened and there was very little injury to the fruit. The owner, Mr Kniffen, seemed to think later pickings were more profitable than earlier ones, probably because his field was somewhat later. On the other hand, in the case of the very early field of Mr Hepworth's, the greatest profit came from the earlier pickings. It would seem from the above that the relative earliness of the field may be an important factor in determining the amount of injury.

A series of cage experiments were started in the office for the purpose of determining the susceptibility of the beetles to poison.

These were not begun until after the insects had been in the field for 2 weeks, and as a consequence the tests were not entirely satisfactory. Each cage consisted of a Mason jar containing a small bottle in which was placed a raspberry shoot which had been previously sprayed with poison, and then ten beetles were added. The poisoned shoots were replaced with fresh ones every other day and a check cage was also maintained. Arsenate of lead was one of the poisons used and in 24 to 48 hours the first dead beetles were found, most, if not all, succumbing at the end of 6 days. In the check cage one beetle died 3 days after the experiment was started. Six escaped at this time and the remaining three were found dead at the end of a 6-day period. Fortunately, there was in addition a stock jar containing a large number of the insects and here there were relatively few deaths.

Although these experiments were started late in the development of the insect, it is evident that the beetles can be destroyed by spraying with poison, though great care should be taken to drive the spray into the crevices of the unfolding leaves. It is probable that two or three applications at 3-day intervals, at the time the beetles are most abundant would give the greatest protection and make possible the production of a fair crop even in the badly infested raspberry patch.

In correspondence with Professor Gossard of Ohio it developed that spraying with a poison had not been entirely satisfactory and that in the case of badly infested fields, supplementary applications of kerosene emulsion have been advised.

It is evident that the raspberry beetle is a somewhat local insect and the serious injuries mentioned above appear to have been confined to a relatively small proportion of the raspberries in that well-known, small fruit section of the Hudson valley. The insect has been troublesome in earlier years. There is a record[1] of injury in that section for 1917 and also for 1911.[2] In both of these cases serious injury appears to have been restricted to a small section and the same is evidently true of earlier reports which need not be cited in this connection.

Comparatively little is known regarding the factors favoring the multiplication of this raspberry beetle and in view of the fact that it occasionally causes serious damage, there should be a careful investigation of the pest for the purpose of working out more satisfactory control measures.

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[1] 1918, N. Y. State Mus. Bul. 202, p. 49–50.
[2] 1912, N. Y. State, Mus. Bul. 155, p. 102–3.

WHEAT MIDGE

Thecodiplosis mosellana Gehin.

Wheat midge, "red maggot" or "red weevil" has been unusually abundant in recent years. It was studied in 1918 and a detailed account of the insect will be found in the report for that year. The studies begun then have been continued on account of the importance of the crop. Additional data have been secured through the cooperation of Prof. C. R. Crosby of Cornell University, the latter working in conjunction with the late W. R. McConnell of the United States Bureau of Entomology, later with P. R. Meyers, and with the aid of L. F. Strickland of the Department of Farms and Markets. Infested heads were secured from widely separated areas in the State and the results are summarized in tabulations given below. The prevalence of the wheat midge during the last few years appears to be the first general abundance noted since the insect was extremely destructive to the New York crop in the years 1854 to 1856, a loss of two-thirds of the crop being the estimate for 1856.

Early injuries by wheat midge summarized in the 34th Report of the State Entomologist, page 41, vary so greatly from present-day conditions, that a few statements obtained in 1921 by Prof. C. R. Crosby from some of the older farmers in Yates county are deemed worthy of record. Isaac Crosby of Penn Yan writing under date of November 2d to his son stated that in 1853–54 Yates county was quite a winter wheat-growing section and about that time the "weevil fly" and the "red larvae" worked in the wheat heads, causing much shriveled grain and for a time wheat raising was not very profitable and they took to raising barley. S. S. Mariner under date of November 10th stated that about 1854 or 1855 the "weevil" caused so much damage that they had to stop raising wheat until they learned that the Mediterranean wheat could resist the weevil. J. D. Meeks under date of November 11th stated that about 1854 or 1855 the loss on his wheat amounted to 25 per cent, while others claimed a 50 per cent loss. W. D. Beaumont under date of November 14th stated that wheat midge injury as he recalled it occurred about from 1852–55, 1854 being the worst on account of the great drought. That year farmers sowed rye and very many lived on rye bread and continued to until the weevil disappeared. These brief accounts by eye witnesses confirm the earlier statements by Fitch.

F. R. Perry of Genesee county, special field assistant of the department of entomology, Cornell University, reported July 19, 1919 that wheat midge was found extensively in winter wheat and also a small amount in spring wheat. These conditions also obtained in at least parts of Niagara and Erie counties and to a less-marked degree for rye in the eastern portion of the State. Many fields in western New York had from 80 to 99 per cent of the heads infested and the sunken grain varied from an average of about 4 to as high as nearly 33 per cent, the latter being unusual. In one case 86 maggots were found in a head of rye and as each maggot usually means a shrunken or blasted grain, such an infestation if at all general is decidedly serious. A close analysis of 143 samples, many collected by Prof. C. R. Crosby, from all parts of the important wheat areas in western New York showed that in 1919 there were nearly one-tenth as many maggots as grains of wheat and that 11 per cent of the total yield was composed of shrunken, comparatively worthless kernels. There was no evidence of general prevalence of either wheat scab or loose smut, consequently such reduction in the crop as noted above must have been due largely to wheat midge.

A general summary of wheat midge conditions in the important wheat areas of New York State is given below.

Wheat Midge Record, 1919

Totals for counties and grand totals

COUNTY	NUMBER		SHORT					MEDIUM					LONG				
	Localities	Farms	No. o heads	Spikelets	Kernels	Poor	Maggots	No. of heads	Spikelets	Kernels	Poor	Maggots	No. of heads	Spikelets	Kernels	Poor	Maggots
Cattaraugus	1	1	....	.....	.....	....	..	5	62	110	14	7	....	.....	.....	....	.....
Cayuga	6	6	6	58	72	29	17	26	313	603	52	25	6	85	199	21	17
Erie	1	2	3	32	53	4	....	8	103	188	8	5	3	48	90	5	.....
Genesee	12	25	70	713	1 068	199	160	67	849	1 436	170	99	73	1 042	1 790	168	141
Livingston	14	19	35	388	524	75	54	70	851	1 521	107	81	30	427	804	60	32
Monroe	11	13	31	286	381	153	154	44	534	890	165	151	30	437	708	183	158
Niagara	9	10	20	190	232	52	43	35	413	696	153	120	6	85	68	38	7
Onondaga	6	7	9	87	149	16	17	29	352	652	67	54	9	146	325	24	19
Ontario	5	5	6	49	68	24	16	21	264	521	39	25	6	88	145	49	28
Orleans	5	7	15	147	218	53	31	25	304	478	129	98	15	213	388	74	58
Oswego	6	6	12	117	212	25	14	22	272	551	35	29	12	207	361	61	56
Putnam	1	1	3	27	34	20	16	3	39	74	15	12	3	46	99	17	12
Schoharie	1	1	3	22	19	15	18	3	38	55	14	20	3	39	79	9	4
Schuyler	2	2	5	56	81	9	2	5	58	104	8	4	6	94	191	17	9
Tompkins	3	4	9	90	172	2	2	14	168	313	16	5	9	144	288	2	1
Wayne	12	16	29	331	428	128	105	59	721	1 189	218	176	28	429	750	169	151
Wyoming	5	8	12	129	243	8	11	44	394	790	41	27	12	202	432	11	13
Yates	8	11	24	238	396	39	19	38	444	838	60	30	23	363	711	32	12
Totals	108	140	298	2 960	4 350	851	679	518	6 179	11 009	1 311	968	274	4 095	7 428	940	718

The wheat heads prior to examination were classed as short, medium and long and an examination of the above data shows an estimated loss in the crop of 26 per cent in the short heads, 11 per cent in the medium heads and 9 per cent in the long heads. These figures are obtained by doubling the number of spikelets to get the maximum number of kernels or grain and making no allowance for reduction by other causes. The estimated reduction for short heads was 1570 and the poor kernels numbered 851. For medium heads the estimated reduction was 1369 and the number of poor kernels was 1311. For the long heads, the estimated reduction was 762 and the poor kernels amounted to 940. It will be noted that the estimated reduction for the short heads is just about twice the number of poor kernels, that the figures coincide almost exactly in the medium heads, while in the long heads, there is a perceptible excess of poor kernels.

This condition is probably explainable by the relative vigor of the plants. Those producing short heads suffered more severely from the attack and a larger proportion blasted before they could develop to any extent. In other words, a considerable part of the crop from the short heads was an almost total loss. The medium heads possessed a fair degree of vitality and as a consequence, the poor kernels almost exactly equalled the estimated loss in the crop. The long heads were on the most vigorous plants producing two and occasionally three grains to the spikelet, consequently the estimated number of poor kernels of wheat is exceeded by the actual number. The last group, in other words, produced a large crop as a result of unusual vigor and in spite of midge injury, although the actual reduction due to injury by the maggot may have been as great or nearly as great as in the case of plants producing short or medium heads.

The following summary gives a somewhat clearer idea of the distribution and the abundance of the wheat midge in various sections of the State:

Summary of estimated yield, yield and approximate losses, 1919

County	*Estimated yield kernels*	*Yield kernels*	*Per cent Reduction*
Cattaraugus	124	110	11
Cayuga	912	874	10
Erie	366	331	9
Genesee	5 208	4 294	17
Livingston	3 332	2 849	14
Monroe	2 514	1 979	21
Niagara	1 376	996	27
Onondaga	1 170	1 126	3
Ontario	802	734	8
Orleans	1 328	1 084	3
Oswego	1 192	1 124	5

Summary of estimated yield, yield and approximate losses, 1919 (*concld*)

County	Estimated yield kernels	Yield kernels	Per cent Reduction
Putnam	224	207	7
Schoharie	198	153	22
Schuyler	416	376	9
Tompkins	804	773	3
Wayne	2 962	2 367	20
Wyoming	1 450	1 465	.....
Yates	2 090	1 945	6
Totals	26 468	22 787	13

The above summary, if the samples be representative, indicates a considerably higher percentage of infestation in Genesee, Monroe, Niagara and Wayne counties in the western part of the State and Schoharie county in the eastern part, with Cattaraugus, Cayuga and Erie county grain fields nearly as badly infested. The Schoharie county record is based upon samples taken from but one field and is therefore not necessarily representative, and the same is true of Cattaraugus and to a less extent of Erie county. This latter, judging from conditions in 1918 and the data secured earlier last season by Mr Strickland, would indicate an infestation in the northern portion at least approximating closely that obtaining in Niagara county.

The preceding data do not represent conditions fairly because the collecting of the wheat samples was a little late to obtain the maximum number of maggots and, furthermore, as a period of several months elapsed between the gathering of the material and the examination of the heads for wheat midge, there was an additional opportunity for maggots to escape. The intimate relation between reduction in the crop and the number of maggots is more clearly brought out in a few samples collected in late June and early July before there was any considerable desertion of the wheat heads by the maggots.

Wheat midge in Erie and Niagara counties, 1919

Data compiled by L. F. Strickland; 10 heads from each field

Variety	Owner	Grains	Maggots	Shrunken grains	Date
Iron clad	F. J. Farley	282	69	19	June 20
Iron clad	A. J. Smith	230	63	21	June 20
Klondyke	B. Smith	202	161	0	June 18
Klondyke	B. Smith	313	177	0	June 18
Klondyke	F. Goesebe	317	260	110	June 23
Klondyke	R. Browmiller	353	69	24	June 23
Number six	D. H. Ortt	266	72	35	July 1
Number six	Mr. Tyler	278	6	0	June 25
Number six	H. Kelkenburg	312	32	31	June 30
Red wave	J. W. Riddle	329	106	43	June 23
White chaff	J. Gunty	295	79	29	June 23
White chaff	Mr. Trippenses	297	2	0	June 25
White chaff	H. Baker	285	6	4	July 1
White chaff	Near Kelkenburg	254	4	1	July 1
Unknown	A. F. Dale	292	187	58	June 23
Totals		4 305	1 293	375	

The heads were examined fresh from the field and it will be noted at the outset that the number of maggots is nearly 30 per cent of the total number of grains of wheat. This is quite different from the approximately 10 per cent of maggots found in the heads collected by Professor Crosby and his associates so late that probably a considerable number of the maggots had an opportunity to escape and others doubtless left the heads between the time of collecting and the several months elapsing before the examinations were completed.

It will further be noted that among the klondyke samples the number of maggots was approximately 36 per cent of the total grains of wheat; in the red wave 24 per cent; in the iron clad 20 per cent; in the number six 11 per cent; whereas in the white chaff it is a little less than 8 per cent. Too much importance should not be attached to these averages though it was very evident in 1918 at least that the softer wheats, such as the klondyke, were much more likely to be badly infested than was the case with the relatively much harder white chaff.

Investigations, examinations and analyses of samples collected from representative areas throughout the State showed that the infestation of 1920 was markedly less than that for 1919, as the latter in turn was a reduction from that of the preceding year. Repeated examinations of rye fields in Albany, Columbia, Rensselaer, Saratoga and Schenectady counties in particular indicate practical freedom in 1920 from wheat midge, although in Schenectady county occasional heads were found containing ten or more maggots and in one case thirty-four yellowish larvae were found in one. This last was so exceptional that it can hardly be considered as significant. One field of rye near Lockport, Niagara county, was examined June 24, 1920 and eight to ten maggots were found in a number of heads. This, however, appeared to be unusual for that section.

Field examinations of wheat in Niagara county, June 24, 1920, resulted in finding in an unusually advanced field some 7 miles northeast of Lockport with a rather general infestation, ten small larvae occurring in one spikelet, eight in another and twenty-five in another. In another field, some 7 miles south of Lockport and in Erie county, thirty-one maggots were found in one head. The infestation appeared to be general around Clarence, Erie county, two to ten small maggots occurring in individual heads. Oviposition was with little question in progress June 24th, and

practically all the maggots were smaller than those found north of Lockport, a number having hatched within a few days. The indications at that time were particularly favorable for a somewhat general and possibly severe infestation of wheat in that section, though examinations in the same area July 20th showed a comparatively light infestation quite different from what was indicated nearly a month before.

A summary of the conditions obtaining in 1920 is given in the following tabulation:

Wheat midge prevalence in 1920

Counties	Summary by Counties Number		Spikelets	Maggots	Grains	Grains poor
	Localities	Farms				
Cattaraugus	1	1	66	4	129	6
Cortland	1	1	60	0	133	2
Cayuga	3	3	176	8	367	12
Chautauqua	9	9	510	12	1 063	32
Erie	8	9	571	50	1 184	58
Genesee	15	30	1 879	396	3 583	389
Greene	1	1	68	1	157	2
Livingston	9	12	776	209	1 533	184
Monroe	13	19	1 213	371	2 234	370
Niagara	5	8	507	75	1 056	94
Onondaga	7	10	649	18	1 372	30
Ontario	13	35	2 302	253	4 705	222
Orleans	9	31	1 991	462	3 858	530
Seneca	5	10	605	62	1 217	67
Tompkins	2	3	174	4	365	4
Wayne	15	19	1 149	218	2 229	210

The above shows a relative general infestation in Genesee, Livingston, Monroe, Ontario and Orleans counties and on referring to data of earlier years, it will be noted that these are the counties frequently showing a heavier infestation than other wheat-growing sections. This is also true of Hessian fly and joint worms.

There appears to be no adequate explanation for this difference, unless it be that wheat is more generally grown and consequently the delicate midges have less difficulty in finding suitable grain from season to season. The data in the above table as well as that for preceding years show a strikingly close correlation between the number of maggots and the number of poor grains of wheat.

Available information indicates that the time of sowing, method of cultivation and contiguity of infested fields appear to have little influence upon the wheat midge, and while there is some range in varietal infestation, even this latter is not great. The harder, stiffer, bearded wheats seem to be relatively immune. It is noteworthy that a comparatively large yield is obtained from well-prepared, vigorous fields, apparently largely due to the fact that the grain

in such fields can meet the demands of the midges and in addition produce a crop rather than that the plants actually outgrow the work of the pest.

It therefore follows that rotation of crops is not likely to have a material effect upon infestation by wheat midge, at least in restricted localities. It is plainly indicated that the preparation of the soil to promote a vigorous growth is of importance in the production of a fairly good crop in spite of midge infestation. Furthermore, injury by this insect is most likely to be severe when climatic conditions favor the grain remaining soft and developing slowly at heading or ripening time.

Wheat Midge in Rye

There is little information available respecting the work of this pest in rye, though European records indicate that this insect apparently shows a greater preference for rye than wheat and that it breeds also in quack grass. It was brought to notice in 1918 because of the excessive local abundance of the maggots and examinations made of badly infested fields indicated that a considerable percentage of the crop had been destroyed by the pest. The limited time available before the ripening of the rye in 1918 prevented more than a very general survey of conditions.

The small grain situation was given more attention in 1919 and a number of samples of rye heads were obtained from five of the more important rye-growing counties. The tabulation given below summarizes these data and indicates a more general and serious infestation than had hitherto been associated with rye in this country, since we have commonly considered the wheat midge as preeminently an enemy of wheat.

Summary by counties, 1919

County	*Number*		*Heads*	*Spikelets*	*Maggots*	*Grains*	*Grains poor*
	Localities	*Farms*					
Albany	2	2	14	470	18	571	38
Columbia	6	8	64	2 046	338	1 736	385
Rensselaer	3	3	10	299	373	261	53
Saratoga	1	1	6	178	99	116	80
Schenectady	2	3	21	750	155	671	228
Totals	.....	.....	115	3 743	983	3 355	784

HESSIAN FLY

Phytophaga destructor Say

The Hessian fly is usually found in small numbers in most grain fields and occasionally it becomes exceedingly abundant and may then destroy a large portion to nearly the entire crop over extended areas. It depends more than many other species upon favorable climatic conditions at the time the grain is developing and to a less extent in all probability upon the relative abundance of natural checks, especially parasites. Those desirous of detailed information in regard to this insect are referred to the author's report for 1901, State Museum Bulletin 53, pages 705–30.

The above conditions make it very desirable to keep watch upon this and associated insects. A Hessian fly survey was started in 1917 in a small way by Prof. C. R. Crosby of Cornell University and the late W. R. McConnell of the United States Bureau of Entomology. The latter has been succeeded in this work by P. R. Meyers of the federal Hessian fly laboratory, Carlisle, Pa. These workers have kindly placed the data at our disposal.

The information already secured has been of material benefit in making possible a somewhat accurate forecast of probabilities and as this information accumulates from year to year, the normal variations under New York State conditions can be interpreted more successfully.

The following brief tabulation summarizes conditions as they existed in 1917:

Percentage of wheat straws infested with Hessian fly puparia, 1917

County	*Locality*	*Per cent stubble infested*
Erie	Clarence	4
Monroe	West Henrietta	4
	West Henrietta, south	4
Niagara	Lockport, 8 mi. S	2
	Lockport, 2 mi. S	2
	Lockport, 3 mi. S	2
Orleans	Albion, north of	6
	Carlton	2
	Waterport	8
Tompkins	Ithaca Exp. Sta	4

An idea of the amount of work involved, the number of localities visited and fields examined is given by the following tabulation which summarizes very briefly the Hessian fly conditions for 1918.

Percentage of wheat straws infested with Hessian fly puparia for 1918

County	No. localities	No. fields examined	Per cent infestation: Maximum	Minimum	Average
Alleghany	1	1	2.86	.....	1.67
Cattaraugus	1	2	4	.....	.86
Cayuga	6	11	4	2.17	1.05
Chautauqua	2	6	8	4	1.47
Columbia	1	4	2.86	.....	.42
Cortland	1	2	4	.....	.84
Dutchess	1	11	3.33	.....	.17
Erie	2	3	8	2.86	1.73
Genesee	2	3	3.23	.....	1.19
Livingston	1	3	6.45	1.1	1.19
Madison	1	3	4	2.63	1.06
Montgomery	1	5	2.17	.....	.28
Monroe	6	14	8	2.33	1.78
Nassau	.....	5	.....	.....	.....
Niagara	3	5	4	2.7	1.67
Oneida	2	2	6.06	2.94	2.57
Onondaga	3	4	12	2.86	3.73
Orleans	8	18	36	2.86	5.91
Rensselaer	.....	2	.....	.....	.....
Schuyler	.....	2	5.71	4	2.59
Seneca	5	5	6.67	3.23	2.56
Steuben	1	6	5.71	2.78	1.1
Suffolk	4	23	4	1.52	.3
Tompkins	6	8	4	2.86	1.28
Wayne	5	11	8	2.22	2.07
Westchester	1	1	3.13	.....	1.75
Wyoming	2	3	4	3.33	1.82
Yates	2	2	3.33	.....	1.81

It will be seen by comparing the above data with those obtained in 1919, that there was a material increase in the abundance of this insect, particularly in Genesee, Livingston and Monroe counties.

Percentage of wheat straws infested with Hessian fly puparia, 1919

County	No. localities	No. fields examined	Infestation: Max. No.	Min. No.	Average per cent
Cayuga	8	8	18	1	9.39
Cortland	2	5	6	1	4.39
Erie	3	8	4	1	3.87
Genesee	15	28	58	1	15.77
Jefferson	1	1	2	.....	4.00
Livingston	11	19	44	1	5.91
Monroe	13	20	50	1	12.24
Niagara	10	10	16	1	7.48
Onondaga	6	8	18	1	7.83
Ontario	5	7	3	1	3.43
Orleans	6	8	14	1	5.79
Oswego	3	6	3	2	2.
Schuyler	1	3	1	.....	.67
Tompkins	2	4	2	1	4.50
Wayne	11	16	32	1	10.38
Wyoming	4	10	6	1	2.98
Yates	8	13	4	1	3.26

Supplementary data were also obtained from a number of the less important grain-producing counties and these are given below.

Hessian fly in wheat and barley; supplementary data, 1919

County	No. fields examined	No. straws examined	Average per cent infestation	Grain
Frank'in	7	175	.31	Spring wheat and barley
Jefferson	6	375	22.5	Spring wheat and barley
Ontario	1	50	6	Winter wheat
Orleans	1	50	12	Barley
Tompkins	1	25	12	Winter wheat
St Lawrence	7	400	1.2	Spring wheat and barley

The figures of 1920 given below show a very material increase in the percentage infestation in all of the more important wheat-producing counties.

Percentage of wheat straws infested with Hessian fly puparia, 1920

County	No. Localities	Average per per cent	Number of infestations: 0 to 9 per cent	10 to 19 per cent	20 to 29 per cent	over 29 per cen
Albany	12	6.12	11	1	.....	1
Cayuga	3	6.67	2	1	.....	.....
Chautauqua	12	4.48	11	.....	.....	1
Clinton	1	2.60	1	.....	.....	.....
Columbia	2	10.72	.....	2	.....	.....
Dutchess	7	16.33	3	3	1	1
Erie	7	14.79	3	3	.....	2
Genesee	15	29.82	7	1	9	13
Livingston	8	16.37	4	3	2	2
Monroe	15	19.69	4	10	7	4
Niagara	9	46.63	.....	.....	3	11
Onondaga	8	24.85	2	5	2	1
Ontario	13	10.11	13	11	2	.....
Orange	1	10.67	.....	1	.....	.....
Orleans	9	37.62	2	5	5	15
Rensselaer	3	12.98	2	3	.....	1
Seneca	5	8.97	5	3	.....	.....
Tompkins	1	7.46	2	.....	.....	.....
Wayne	15	19.25	3	4	6	2

The average percentage of infestation for the State based on 246 samples is 16.11 -4/19.

The data secured in 1921 summarized below show a marked reduction in the numbers of this insect and a correspondingly small probability of serious injury the coming season.

Percentage of wheat straws infested with Hessian fly puparia 1921

County	No. Localities	Average per cent	Number of infestations: 0 to 9 per cent	10 to 19 per cent	20 to 29 per cent	Over 29 per cent
Cayuga	5	6.93	5	.....	.....	.....
Columbia	4	9.97	3	1	1	.....
Erie	7	8.23	5	2	.....	.....
Genesee	7	7.61	6	2	1	.....
Livingston	17	4.29	23	4	.....	.....
Monroe	8	2.84	8	.....	.....	.....
Niagara	7	12.38	4	5	.....	.....
Ontario	11	4.1	13	1	.....	.....
Orleans	3	10.67	2	.....	1	.....
Seneca	6	2.66	7	.....	.....	.....
Tompkins	3	12.44	2	.....	1	.....
Ulster	4	6.40	3	1	.....	.....
Wayne	11	9.36	7	3	1	.....
Wyoming	9	4.94	10	3	.....	.....

A comparison of the average percentages of infestation for the counties of such data as are available from 1917 to 1921 goes far to show that there has been a progressive increase in the numbers of the pest from 1917 to 1920. Apparently this has been followed by a material decrease in 1921, as shown by the following tabulation:

Comparison of average percentages of infestation by Hessian fly

County	*1917*	*1918*	*1919*	*1920*	*1921*
Albany	.....	.....	.....	6.12	.....
Cayuga	.....	1.05	9.39	6.67	6.93
Chautauqua	.....	1.47	.....	4.48	.....
Clinton	.....	.....	.....	2.60	.....
Columbia	.....	.42	.....	10.72	9.97
Cortland	.....	.84	4.39	.....	.....
Dutchess	.....	.17	.....	16.33	.....
Erie	4	1.73	3.87	14.79	8.23
Genesee	.....	1.19	15.77	29.82	7.61
Livingston	.....	1.19	5.91	16.37	4.29
Monroe	4	1.78	12.24	19.69	2.84
Niagara	2	1.67	7.48	46.63	12.38
Onondaga	.....	3.73	7.83	24.85	.....
Ontario	.....	.....	3.43	10.11	4.01
Orange	.....	.....	.....	10.67	.....
Orleans	5.33	5.91	5.79	37.62	10.67
Rensselaer	.....	.....	.....	12.98	.....
Seneca	.....	2.56	.....	8.97	2.66
Tompkins	4	1.28	4.50	7.46	12.44
Ulster	.....	.....	.....	.....	6.40
Wayne	.....	2.07	10.38	9.25	9.36
Wyoming	.....	1.82	2.98	.....	4.94
Yates	.....	1.81	3.26	.....	.....

WHEAT JOINT WORMS

Harmolita tritici Fitch: *Harmolita vaginicola* Doane

The joint worms, particularly the wheat joint worm, H. tritici Fitch, have attracted little notice in recent years, though they occur in most wheat fields and occasionally become very abundant, in some instances causing nearly total destruction of the crop on account of the plants being unable to produce normal heads or because of the general breaking, lodging and consequent loss of the crop. In many cases both exert an appreciable influence.

The work of the wheat joint worm, H. tritici Fitch, is indicated at thrashing time by the hard bits of straw containing larvae which appear in the grain instead of being carried over into the straw. An examination of such bits of straw, either in the field or after thrashing, shows knots, swellings and twistings within which may be found small, yellowish larvae about one-eighth of an inch long when full grown. These abnormal growths interrupt the flow of sap and as a consequence the affected plants produce short heads with comparatively few kernels and those developing are apt to be small and more or less shrivelled.

The wheat sheath worm, H. vaginicola Doane, has very similar habits to the preceding except that the eggs are laid at the base of the leaf sheath just above one of the joints and as a consequence the walls of the infested sheath press upon the stem in such a way as to prevent the sap flowing readily and the plants therefore become stunted and produce only small, poorly developed heads or none at all. Infestation by this species is indicated by a peculiar

distortion of the leaf sheath and the adjacent stem. This insect is much less important in New York State than the wheat joint worm.

A survey of wheat insects would be incomplete without taking into account the joint worms. Data in relation to these two insects were collected by Prof. C. R. Crosby of Cornell University in cooperation with the late W. R. McConnell of the Bureau of Entomology. The latter has been succeeded in this work by P. R. Meyers of the federal Hessian fly laboratory at Carlisle, Pa. The data have been kindly placed at our disposal by Professor Crosby and is summarized below, since it may be utilized in determining the probabilities of injury by these insects in subsequent years.

Percentage of wheat straws infested with Harmolita (joint-worms) galls, August 1918

County	*Place*	*Harmolita tritici*	*Harmolita vaginicola*
Chautauqua	Sheridan	.....	4
Columbia	Niverville	.....	4
Genesee	Elba	12	4
Genesee	East Bethany	8	20
Genesee	Pavilion	32	8
Livingston	Cuylerville	12	.....
Livingston	Avon and Geneseo	36	.....
Oneida	Vernon	4	.....
Ontario	Canandaigua	20	.....
Ontario	Victor	3	2
Orleans	Albion	4	4
Orleans	Barre Center	24	20
Orleans	Barre Center	16	8
Orleans	Albion R. D. 5	4	8
Orleans	Kent	16	.....
Orleans	Point Breeze	32	.....
Orleans	Albion, R. D. 12	12	.....
Orleans	Albion	4	.....
Orleans	Albion	4	4
Schuyler	Bradford	48	4
Schuyler	Alpine	12	.....
Seneca	Lodi	8	.....
Seneca	Ovid	16	.....
Seneca	Romulus	36	.....
Tompkins	Ithaca	4	.....
Tompkins	Newfield	12	.....
Tompkins	Cayuta (near)	8	.....
Wyoming	Perry	24	4
Wyoming	Perry Center	8	.....
Wyoming	La Grange	20	28
Yates	Second Mills	4	.....
Jefferson	Evans Mills	2	.....
Jefferson	Theresa	8	.....
Suffolk	Millers Place	8	.....

Additional examinations, disclosing no infestation, were also made in the following counties, the numbers in parentheses indicating the number of localities: Alleghany (1), Cattaraugus (2), Chautauqua (4), Columbia (3), Cortland (2), Dutchess (9), Erie (3), Madison (3), Livingston (1), Montgomery (5), Nassau (5), Niagara (5), Oneida (1), Onondaga (4), Ontario (1), Orleans (9), Rensselaer (2), Seneca (2), Steuben (6), Suffolk (22), Tompkins (1), Westchester (1), Yates (1), Jefferson (3), St Lawrence (5), Franklin (5).

Percentage of wheat tillers infested wth Harmolita (joint-worm) galls 1919

COUNTY	No. fields examined	HARMOLITA TRITICI			HARMOLITA VAGINICOLA			ALL HARMOLITAS
		Max.	Min.	Aver.	Max.	Min.	Aver.	Aver. per cent
Cayuga	8	42	2	11.82	1.09	.....	.14	11.96
Cortland	5	1.18	.....	.24	.....	.....	.....	.24
Erie	8	2	.....	.25	22	.....	2.75	3.00
Genesee	28	56	2	9.52	11.20	.74	1.71	11.23
Jefferson	1	.....	.....	.....	.....	.....	.....	.....
Livingston	19	65.60	1	9.50	26	1.14	1.91	11.15
Monroe	20	36.80	.45	9.24	3.37	.80	.26	9.50
Niagara	10	24	2	3.97	16	.80	2.21	6.18
Onondaga	8	33.71	2	8.07	3.03	1.43	.81	9.51
Ontario	7	46	2	13.71	.....	.....	.....	13.71
Orleans	7	48.80	2	15.29	2.67	2	.67	15.96
Oswego	6	10	2.0	2.33	4	2	1	3.33
Schuyler	3	20	6	8.67	4	.....	1.33	10.00
Tompkins	4	4	2	2	2	.....	.50	2.50
Wayne	16	36.67	1.60	11.42	1.54	1.16	.17	11.59
Wyoming	10	16	1	2.68	14	2	1.91	4.59
Yates	13	34	1.05	10.59	2	.....	.31	10.90

It will be noted by referring to the above tabulation that the heaviest infestations, as in the case of the Hessian fly and wheat midge, occur in the important wheat-producing counties, namely Genesee, Livingston, Monroe, Niagara, Ontario, Orleans and Wayne. The same condition is shown in a general way at least in the tabulation for 1920, given below and also in the data secured the past season.

Percentage of wheat tillers infested with Harmolita (joint-worm) galls 1920

COUNTY	No. fields examined	HARMOLITA TRITICI			HARMOLITA VAGINICOLA			ALL HARMOLITAS
		Max.	Min.	Aver.	Max.	Min.	Aver.	Aver. per cent
Albany	13	16.77	.....	1.39	.....	.....	.....	1.39
Cayuga	3	2.60	.....	.87	.....	.....	.....	.87
Chautauqua	12	.....	.....	.....	.....	.....	.....	.....
Clinton	1	.....	.....	.....	.....	.....	.....	.....
Columbia	2	1.33	.....	.66	1.33	.....	.66	1.33
Dutchess	8	4	.....	1.42	2.67	.....	.33	2
Erie	8	1.33	.....	.33	1.33	.....	.17	.50
Genesee	30	35	.....	3.32	.....	.....	.....	3.32
Livingston	11	8.80	.....	3.42	.....	.....	.....	3.42
Monroe	25	17.33	.....	3.89	2.67	.....	.23	4.12
Niagara	14	15.20	.....	1.94	2.11	.....	.30	2.24
Onondaga	9	7.23	.....	1.63	.....	.....	.....	1.63
Ontario	26	29.33	.....	5.80	.....	.....	.....	5.80
Orange	1	.....	.....	.....	.....	.....	.....	.....
Orleans	29	14.67	.....	3.23	2.67	.....	.12	3.31
Rensselaer	6	.....	.....	.....	.....	.....	.....	.....
Seneca	8	22.40	.....	8.27	.80	.....	.10	8.30
Tompkins	2	2.67	.....	1.33	.....	.....	.....	1.33
Wayne	15	12.31	.....	3.18	3.08	.....	.21	3.31

Percentage of wheat tillers infested with Harmolita (joint-worm) galls
1921

COUNTY	No. fields examined	HARMOLITA TRITICI			HARMOLITA VAGINICOLA			ALL HARMOLITAS
		Max.	Min.	Aver.	Max.	Min.	Aver.	Aver. per cent
Cayuga	5	13.33	.....	3.20	5.33	.....	2.13	5.33
Columbia	5	1.54	.....	.31	.....	.....	.....	.31
Erie	7	1.33	.....	.39	.....	.....	.....	.39
Genesee	9	24.29	.....	6.99	.....	.....	.....	6.99
Livingston	27	30.67	.....	4.93	2.67	.....	.20	5.13
Monroe	8	24	.....	4.33	1.33	.....	.16	4.49
Niagara	10	3.55	.....	.98	.....	.....	.....	.98
Ontario	14	11.97	.....	4.49	.....	.....	.....	4.49
Orleans	3	6.67	.....	3.56	.....	.....	.....	3.56
Seneca	7	5.33	.....	2.67	.....	.....	.....	2.67
Tompkins	3	1.33	.....	.89	.....	.....	.....	.89
Ulster	4	5.33	.....	2.66	1.33	.....	.33	2.99
Wayne	11	14.67	.....	5.10	2.07	.....	.24	5.34
Wyoming	13	6.67	.....	1.15	.....	.....	.....	1.15

A summarized tabulation by counties for the four-year period, 1918–21 inclusive, indicates a local abundance of the wheat joint worm for the first two years of the period and a considerable reduction in its numbers for the last two years.

Harmolita tritici infestation; summary by counties

County	*1918* %	*1919* %	*1920* %	*1921* %
Albany	.....	.....	1.89	.....
Cayuga	.....	11.82	.87	3.20
Columbia	.....	.....	.66	.31
Cortland	.....	.24	.....	.....
Dutchess	.....	.....	1.42	.....
Erie	.....	.25	.33	.39
Genesee	17.33	9.52	3.32	6.99
Jefferson	5	.....	.....	.....
Livingston	24	9.50	3.42	4.93
Monroe	.....	9.24	3.89	4.33
Niagara	.....	3.97	1.94	.98
Oneida	4	.....	.....	.....
Onondaga	.....	8.70	1.63	.....
Ontario	12.5	13.71	5.80	4.49
Orleans	12.69	15.29	3.23	3.56
Oswego	.....	2.33	.....	.....
Schuyler	30	8.67	.....	.....
Seneca	30	.....	8.27	2.67
Suffolk	8	.....	.....	.....
Tompkins	12	2	1.33	.89
Ulster	.....	.....	.....	2.66
Wayne	.....	11.42	3.18	5.10
Wyoming	26	2.68	.....	1.15
Yates	4	10.59	.....	.....

The relative abundance of the wheat sheath worm appears to be governed by much the same conditions as those affecting the wheat joint worm and in the following summarized tabulation in relation

to H. vaginicola, it will be seen that the insect was more abundant during 1918 and 1919 than was the case in 1920 and 1921.

Harmolita vaginicola infestation; summary by counties

County	*1918* %	*1919* %	*1920* %	*1921* %
Albany	.....	.....	.....	.....
Cayuga	.....	.14	.....	2.13
Chautauqua	4	.....	.....	.....
Clinton	.....	.....	.....	.....
Columbia	4	.....	.66	.....
Dutchess	.....	.....	.33	.....
Erie	.....	2.75	.17	.....
Genesee	10	1.71	.....	.....
Livingston	.....	1.91	.....	.20
Monroe	.....	.26	.23	.16
Niagara	.....	2.21	.30	.....
Onondaga	.....	.81	.....	.....
Ontario	1	.....	.....	.....
Orange	.....	.....	.....	.....
Orleans	4.89	.67	.12	.....
Oswego	.....	1	.....	.....
Rensselaer	.....	.....	.....	.....
Schuyler	2	1.33	.....	.....
Seneca	.....	.....	.10	.....
Tompkins	.....	.50	.....	.....
Ulster	.....	.....	.....	.33
Wayne	.....	.17	.21	.24
Wyoming	10.66	1.91	.....	.....
Yates	.....	.31	.....	.....

Rotation of crops is considered one of the most effective checks upon both joint worms and is particularly advised in sections where data indicate that they are becoming somewhat abundant. Care should be taken in badly infested areas not to sow wheat close to fields in grain the preceding year; otherwise there may be considerable infestation as a result of migration. Both of these species winter in the stubble, consequently burning over the fields in fall or early spring is advisable so far as checking these insects is concerned.

CONFUSED FLOUR BEETLE

Tribolium confusum Duv.

This is one of the commonest pests of cereals and the numerous cereal preparations, it having been recorded in addition as occurring in such varied materials as ginger, cayenne pepper, baking powder, orris root, snuff, slippery elm, peanuts, beans and various seeds. More recently it has been reported as a museum pest.[1]

There was in the spring of 1918, a call for information respecting the breeding possibilities of this species and in order to obtain some information along this line a series of breeding jars were started. These were simply four ounce glass jars in which were placed a few beetles together with a level teaspoonful of flour, the

[1] Ent. News, 27: 234, 1916.

metal top being finely perforated to admit air. The following tabulation summarizes the data.

Tribolium confusum, biological data

Jar	A		B		C		D		E		F		G	
1918	A[1]	G[2]	A	G	A	G	A	G	A	G	A	G	A	G
May 27	2	....	4	..	4	....	2	....	..	....	..	....	..	...
June 18	2	2	4	..	4	2	2	....	..	....	..	....	..	...
July 6	2	20–30	4	..	4	12	2	9	..	....	..	....	..	...
16	2	40	4	..	4	25	2	10	2	....	4	....	2	...
23	....	40	4	..	..	24	....	7	2	....	4	....	2	...
Aug. 8	....	....	..	..	1	?24	5	?10	2	?5	4	?5	2	?5
17	6	?20	4	..	1	?24	15–20	....	2	?5	4	?5	2	?5
29	18	....	4	..	19	?	18	....	2	?7	4	?5	2	?7
Sept. 5	*a*18	....	4	..	18	1	17	....	2	?7	9	?7	5	?7
14	20	....	4	..	18	?3	17	....	3	?6	9	?7	6	?6
21	*b*19	....	4	..	22	1	18	....	3	?6	8	?7	7	?5
28	21	....	4	..	20	....	18	....	3	?6	8	?7	7	?5
Oct. 7	*c*17	....	4	..	16	....	16	....	9	2	9	?5	7	?3
23	16	?5	3	..	16	1	16	....	12	3	9	2	8	?3
Nov. 19	17	....	3	..	15	....	16	....	11	2	9	?7	9	?7
Dec. 10	15	....	3	..	15	....	16	....	10	5	7	10–12	9	3
31	13	2	3	..	13	....	15	....	11	5	7	10–12	8	?3

[1] Adult.
[2] Grub.
a Also two dead.
b Also two dead.
c Also one dead.

Jars A, B, C and D were started May 27th, with 2, 4, 4 and 2 adults respectively, and prior to the appearance of another generation of adults, namely, July 16th, the living beetles were transferred from A to jar E, from C to jar F and from D to jar G, and the records under these last three headings really belong with those for A, C and D respectively. It will be noted that a period of 81 days elapsed between the establishment of jar A and the appearance of a second generation of beetles, and in the case of jar C, this was extended to 93 days, while for jar D, the time was reduced to 72 days. These figures should be checked by those obtaining in jars E, F and G, probably more nearly normal, where the periods were respectively 59, 50 and 50 days.

The earlier statements credit this insect with being able to complete its life cycle under favorable conditions in 36 days. The investigations of Professor Dean in Kansas led him to state that the life cycle in summer may be completed in only 35 days while with a temperature of 70 degrees from 98 to 105 days are necessary. Our data were obtained in a large room in a cool stone building, the summer temperatures being by no means excessive, while those in the cooler months rarely varied much from 70

degrees. The work of R. M. Chapman[1] shows that from 40 to 50 days or even longer are required at temperatures ranging from about 73 to 84 degrees F., a considerable extension of the later developmental periods being due to differences in the food available.

Our data show an extended adult existence, in Jar E it being at least 148 days and in jars F and G 217 days, with no indication that these are the maxima. It should also be noted that although the life cycle in our breeding jars was completed in from about 50 to 90 days, there is no marked indication, except possibly in the case of jar G, of a second generation and this did not appear until into December or about 5 months after the first generation of larvae.

This suggests periods of inactivity between generations and consequently estimates of the number of generations annually based upon the time required to complete the transformations are inaccurate because no allowance is made for this interval. This condition may easily exist and be obscured to a very considerable extent by apparently constant breeding, owing to the overlapping activities of different individuals. The increase in our breeding jars was less than anticipated. This may be explained in part by the limited amount of food and the probability that some of the smaller larvae were devoured. It is certain that dead beetles were dismembered and it was therefore practically impossible to account for all adults, unless there were repeated separations into smaller groups. The low rate of multiplication could not have been due entirely to the lack of food because after two and a half years the flour was still in a somewhat fair condition, though decidedly contaminated, and this was true even in the jars containing the most insects. It is worthy of note that a living beetle was found in jar D and a living larva in jar F, November 24, 1920, about 30 months after the breeding was started. Nothing was alive in the other jars.

The figures obtained by Mr Chapman[1] show that individual pairs during a period of 42 days may produce from seven to as many as 50 larvae, the normal probably being nearer the higher than the lower figure. He also attempted to determine the influence of nutrition in affecting the liability of infestation and came to the conclusion that the coarseness of the product was a more important factor, since the beetles could more readily penetrate flaky materials. He found that the percentage ratios between coarse and fine bran

[1] Minn. State Ent. 17th Rep't, 1918, p. 73–93.

material was 60 and 40 per cent respectively, examined every 48 hours, though when the material was left for a period of 26 days, the ratios were 47 and 53 respectively, a nearly complete reversal of earlier conditions. The time from the hatching of eggs until the appearance of the first adult in Mr Chapman's work was as follows: middlings 37 days, sizings 39, low grade 38, tailings 38, bran 38, rye flour 39, barley flour 38, corn flour 40 and rice flour 47 at approximately 78 degrees F.

The confused flour beetle and several of its associates occur in such a variety of foods as to make control very difficult, particularly in situations where farinaceous materials are allowed to collect in crevices or inaccessible shelters. It is of first importance where practicable to eliminate nearby breeding places, since if this is not possible invasion of valued food products is almost certain to result, whether this be in a home or mill.

The possibility of introducing infested material should not be overlooked. This is particularly likely to occur with cereals from infested grocery stores or mills and even the shipping of uncleaned flour sacks or other containers may produce the same result. It is very easy to destroy insects in the latter, according to Mr Chapman by placing the empty sacks in an ordinary baker's oven and raising the temperature to about 450 degrees F. for a period of 5 minutes provided the sacks are not over three layers deep. They should be protected from scorching by being placed on pans or boards to keep them from coming in direct contact with the oven. The same treatment is effective in freeing boxes and other containers.

Infested cereals in packages may have been invaded by the insects prior to being put up or the trouble may be due to a defective type of package or breaking of the container. Well-sealed packages of cereal can not become infested if the material is clean when packed.

The experience of recent years has demonstrated the efficacy of killing these pests by the use of heat, a minimum temperature of 120 degrees F. being necessary. This treatment is ordinarily safer and more satisfactory than fumigation with either hydrocyanic acid gas or carbon bisulphide, both very dangerous and with a limited efficiency, particularly in ordinary buildings which are far from gas tight.

NOTES ON INSECTS

The spring of 1921 was one of the earliest on record. On March 21st, blow flies, cluster flies and mosquitoes were out and troublesome, the morning temperature being 78° F., and on the 27th ants (*Prenolepis imparis* Say) swarmed in the open at Nassau, this being an extremely early record according to Prof. W. M. Wheeler.

Weather conditions were also reflected in the unusually early development of vegetation. American elms were in bloom at Nassau on March 27th, arbutus blossoms were found April 3d and on the 6th Carolina poplar catkins were falling rapidly. Apple leaves were about one-half of an inch long, pear buds nearly as long and Forsythia in bloom on the 7th and two days later a few sheltered plum trees were in bloom and many others showed the white petals in the bud. Shad bushes began to show white at this time and an unusually early one was in blossom, though the normal time is the second Sunday in May.

Similar unusual conditions prevailed on Staten Island. William T. Davis states that white maples blossomed on New Dorp lane February 19th, and little blue butterfles (*Lycaena pseudargiolus*) had emerged from their chrysalids by March 28th. Most of the pear trees were in full bloom April 6th and on the 9th some apple trees had commenced to flower. For a time developments were from 3 to 4 weeks ahead of normal, though as the season advanced this became less marked and in early summer there was comparatively little divergence from the normal.

Shade tree pests were somewhat numerous in 1921. White-marked tussock moth caterpillars (*Hemerocampa leucostigma*) were generally prevalent in the Buffalo area the latter part of June, partially stripping a few trees. Somewhat the same condition obtained on the western end of Long Island. A very few bag worms (*Thyridopteryx ephemeraeformis*) were observed in the vicinity of New York City. At Cold Spring Harbor there was local and serious injury by the elm case bearer (*Coleophora limosipennella*) and where very abundant, some had evidently dropped from the trees and attached to nearby foliage of honey-suckle, dogwood and Forsythia, but without feeding.

Irregular blotch mines on the upper surface of sweet gale, *Myrica gale*, leaves were collected at Cold Spring Harbor, Long

Island, July 7, 1921 and produced the beautiful moth, Cameraria (Lithocolletes) picturatella Braun., and parasites, namely, Rhicnopeltoidea amsterdamensis Gir. and an Encyrtid, the insects being determined through the courtesy of Dr L. O. Howard, the moth by Mr Busck and the parasites by Mr Gahan.

Oyster scale (Lepidosaphes ulmi) was somewhat abundant the last of June on soft maples at Kenmore, near Buffalo. The young at this time had mostly established themselves under well-developed scales, though a few were still crawling. The scale was also somewhat numerous upon the smaller branches of elms at Forest Hills and in a few instances had caused an appreciable amount of injury. The infestation in this latter locality was also marked by the presence of the elm bark louse (Gossyparia spuria) on a few Scotch or English elms, though it was not observed upon the much more abundant American elms. Cottony maple scale (Pulvinaria vitis) was not very abundant in the Buffalo area or in the vicinity of New York City. Putnams scale (Aspidiotus ancylus) was numerous on a few soft maples at Kenmore in the environs of Buffalo, fairly encrusting small areas of the bark, though probably not seriously damaging the trees.

A number of trees in Kenmore bore evidence the last of June of being injured by the bleeding tree maggot (Mycetobia divergens), and in several cases the slender, whitish larvae were actually observed in the exudate and close to the living tissues.

Borers were somewhat abundant, though not particularly injurious, at Forest Hills, Long Island. Some of the trees were infested by elm borers (Saperda tridentata), they having entered the trunk at several places and also attacked the branches. The affected trees had a trunk diameter of about 6 inches and showed a considerable degree of vigor. Work of the leopard moth (Zeuzera pyrina) was also noted on a few trees in the near vicinity, though in no case was the injury severe.

Wooly aphis (Schizoneura ulmi) appears to be generally present upon elms in the vicinity of Forest Hills. There were a number of leaves upon trees here and there which had been deformed by the leaf inhabiting generations and many of the knotty enlargements caused by this insect were easily found.

The spruce gall aphid (Chermes abietis) was somewhat generally abundant on the western end of Long Island and in some localities caused material injury. Infestations were also noted in

Buffalo and vicinity and here likewise there was evidence of material injury.

The lightning leaf hopper (Ormenis pruinosa) was observed in small numbers on Forsythia near Cold Spring Harbor. It was also received from a number of localities in the State and appears to have been unusually abundant. Ordinarily it can not be considered as particularly injurious.

The spring of 1920 was cold, wet and therefore unusually favorable for root maggots and as a consequence there was considerable damage by both cabbage and onion maggots.

The taking of the large southern, rare moth, Thysania zenobia Cram., at Rochester, September 26, 1919 by Richard Lohrmann is worthy of special mention.

Notes concerning some of the more important or interesting species are given below.

FRUIT TREE INSECTS

Rose leaf beetle (Nodonota puncticollis Say). This is one of the smaller, common leaf-feeding beetles greatly resembling in general appearance the more active "flea beetles" and only occasionally comes to notice on account of somewhat marked injuries. It occurs generally throughout New York State during June and July and is recorded as common on roses, blackberry, raspberry and red clover. Some years ago Dr W. E. Britton, state entomologist of Connecticut, recorded injuries by this species to the foliage of Japanese chestnut trees.

This beetle was evidently unusually abundant in the State last year and in some cases at least spread from its more common food plants to others, since the special field assistant of the Dutchess county farm bureau, O. C. Plunkett, reported finding it working on the fruit of young apples June 19, 1920, and in one case the injury amounted to 10 or 20 per cent of the fruit. The affected apples had irregularly eaten areas, the epidermis being entirely devoured and the pulp exposed. The damage was so serious that the apples would certainly have been badly distorted if they had not dropped before they were half grown. The same species on apples was received June 19th from F. L. Pelton, Potsdam.

Injury similar to the above was observed in the vicinity of Chambersburg, Pa., by J. R. Stear (Jour. Econ. Ent. 13:433, 1920).

Outbreaks of this character are probably conditioned to a considerable extent upon the occurrence of other food plants near apple

trees, though Mr Plunkett stated that he was unable to find anything of the kind in the orchard coming under his observation. An early and thorough application of arsenate of lead would doubtless check the pest before serious injury was caused.

Apple and thorn skeletonizer (Hemerophila pariana Clerck). This European insect had become well established in Westchester and Rockland counties in 1917 and has continued to maintain itself in fair to rather large numbers, and in 1921 attracted considerable notice because of its unusual abundance.

The damage by this pest has been very severe, according to G. M. Codding of the F. A. Bartlett Tree Expert Co., in the southern part of Westchester county. This territory included New Rochelle, through Quaker Ridge and White Plains where literally hundreds of trees have been entirely defoliated and many others severely affected. There has been damage along the Hudson river as far north as Ossining; north of Mamaroneck, and also in Tuckahoe, entire orchards have been stripped. Mr Codding, writing under date of October 3d, stated that he has observed larvae working since early in the season. Up to the present, he adds, the outbreak appears to have been generally severe throughout the southern part of Westchester county, while last year, with the exception of Dobbs Ferry and Hastings, there was little real injury. F. A. Bartlett observed serious injury in Mount Kisco and vicinity and particularly in adjacent Connecticut areas.

J. G. Curtis, manager of the Westchester farm bureau, stated that there was comparatively little injury by the thorn skeletonizer in the Tarrytown section as compared with 2 years ago. He is of the opinion that it is being controlled by more thorough spraying. He adds that the work of this pest was noticeable in a few orchards and on roadside trees in the vicinity of Rye and Port Chester.

P. L. Huested of Blauvelt states that the pest is somewhat more abundant than in previous years and that he is certain its range has been greatly extended. He has noted the insect from Nyack to Chester, a distance of about 45 miles.

The developments of the past season clearly established the occurrence of three and possibly of four generations in one season, in the opinion of Henry Bird who has been following the developments of the insect rather closely.

This pest skeletonizes apple leaves in much the same way as the well-known canker worms, except that the latter more generally devour all the tissues of nearly every leaf, whereas the small green-

ish caterpillars of this insect confine their attack to portions of many leaves (frequently practically all the leaves on a tree may be eaten in this manner), feeding near the center under a slight web and extending upward and outward to include most of the tip of the leaf. Areas on each side of the basal portion of the leaf are frequently left untouched, and not uncommonly the margins to the width of one-half of an inch or so are turned over. There is no webbing together and inclosing leaves in masses as does the fall web worm or, to a less extent, the brown tail moth caterpillars. Both of these last named species produce moderately firm to firm webs, which inclose the leaves, something never done by the apple and thorn skeletonizer.

The observations of Henry Bird, of Rye, showed that this insect was abundant on May 23d and in about the same numbers as the preceding fall, at which time the moths were unusually numerous. On June 12th he estimated that there might have been 10,000 larvae at work upon a moderate sized apple tree and yet the tree was not injured to any material extent, though the foliage had become somewhat thinned. He states that by September 8th the fourth larval brood were very generally spinning their cocoons, although there was considerable overlapping and moths from the previous generation were still to be seen depositing eggs. He adds that the moths are actively on the wing after 3 o'clock in the afternoon and have a characteristic swinging flight. He states that last year the brood appearing the latter half of September was the most conspicuous, whereas the past season the indications are that it was quite negligible. On October 7th he found a very few full-grown larvae on new foliage under conditions indicating that they might represent a partial fifth brood.

Mr Bird noted a marked, though unaccountable falling off in the numbers of the insects as the season advanced. He states that all kinds of insectivorous birds destroy the larvae, though it seems unlikely that they would act as a drastic check. He observed parasitism in the first brood only and this was less than 3 per cent in 1000 newly spun cocoons. The indications in early October were to the effect that fewer adults would go into hibernation than was the case last year.

A general account of this insect was published as Cornell Extension Bulletin No. 27 in February 1918 and a more detailed one appears in the Report of the Entomologist for 1917, New York State Museum Bulletin No. 202, pages 33–39. Both of these con-

tain illustrations of the various stages and of the more characteristic types of injury.

There is no question but what thorough and timely spraying with a poison such as arsenate of lead will destroy the caterpillars and, owing to their feeding almost entirely upon the upper surface of the leaves, a general application to all trees on which the pest can subsist would mean its early control and practical elimination so far as material damage is concerned. Owing to the development of several broods each season, it is perhaps unnecessary to state that it is by all means advisable to destroy the earlier generations. The usual spraying schedule advocated for commercial orchards ought to prevent serious injury by this insect, excepting possibly in restricted areas where the skeletonizer might be excessively abundant.

Dock false worm (*Ametastegia glabrata* Fall.). Small numbers of the greenish larva of this sawfly were found in October 1915, boring cylindrical holes with a diameter of about 2 mm, straight into the sides of Baldwin apples in the orchard of J. A. Talbot, Spencerport. The percentage of fruit affected in this manner was infinitesimal and the damage, so far as observed, was limited to one portion of the orchard where a small amount of polygonum or dock was growing at the base of the trees or in nearby uncultivated areas. The insect in this particular case was of no great importance though the injury is worthy of record in connection with its identification. This species has been noticed in some detail by E. J. Newcomer,[1] and an illustration of recent work by the larva is given on plate 11 of Museum Bulletin 186.

Tree crickets (*Oecanthus* sp.) **and canker.** A striking instance of the connection between tree crickets and apple canker was brought to our attention by H. W. Fitch, assistant farm bureau manager of Albany county. A number of young apple trees on the farm of L. L. Jones, Feura Bush, were examined April 22, 1920, and considerable injury was found on 15-year old apple trees resulting from oviposition by this insect and the frequently accompanying inoculation by canker spores. A few of the trees were so badly affected that many of the characteristic oval areas on the bark were to be found within 3 inches of one another. This injury is most easily recognized by the irregular, circular or oval dead area, generally with a minute circular puncture about one-sixteenth of an inch in diameter, near the center. These areas vary in diameter

[1] 1916 U. S. Dep't Agric., Bul. 265.

from one-half to 1½ inches, the larger ones usually being oval. The boundary between living and dead tissues is marked by one or more rather distinct cracks, and on cutting away the surface tissues it will be found that the underlying soft bark has been killed.

There was also some injury due to the oviposition of the Buffalo tree hopper, Ceresa bubalus Fabr., though there was distinctly less damage and the scars were due solely or almost so to mechanical injury.

Investigations (N. Y. Agric. Ex. Sta. Tech. Bul. 50, 1916) by W. O. Gloyer and B. B. Fulton demonstrate the connection between tree crickets and this type of injury, and their studies have shown that clean culture and the use of arsenical sprays as for codling moth appear to give satisfactory control. It might be added that the growing of raspberry bushes among apple trees, as practiced by Mr Jones and others, seems to be particularly favorable to the existence of tree crickets and the combination on this account is considered undesirable.

GRASS AND GRAIN INSECTS

Army worm (Heliophila unipuncta Haw.). The army worm has appeared in a new role for New York State, since partly grown caterpillars about three-fourths of an inch long were found in April 1919 hibernating in corn stalks near Ballston, Saratoga county, and at Indian Fields, Albany county, April 22, 1920. This is a new record for the State and is of particular interest in view of the statements published by Mr Vickery[1] relative to the tropical or subtropical origin of the species and his belief that it was problematical if it would survive a mild winter so far north on the Atlantic coast as the city of Washington. The winter of 1919 was exceptionally mild and this may have been the reason why the larvae survived though it should be remembered that corn fields in New York State have never been examined so carefully as they have since the discovery of the European corn borer at Scotia, N. Y. The winter of 1919–20 was exceptionally cold with a large amount of snow from fall to spring. The latter presumably favored successful hibernation. It is well known that the army worm occurs annually here and there in the State and this, taken in connection with its known survival of the winters of 1918–19 and 1919–20 leads us to believe that it may withstand the rigors of

[1] 1915, Economic Ent. Jour., 8:390.

our climate, at least when conditions are somewhat favorable. The wintering caterpillars were found in soft or punky corn stalks and had evidently entered for shelter. They were about three-fourths of an inch long and though usually distinctly striped, presented a somewhat general resemblance to the larvae of the European corn borer.

Army worm caterpillars were reported as somewhat abundant to extremely numerous early in August 1919, especially in the Mohawk valley west to Rome. They were so numerous in some fields as to threaten considerable injury unless they were destroyed by the use of a poisoned bait. In one case they ruined 11 acres of oats. Many of the caterpillars established themselves at the base of the leaves, remaining there some days; in such places they would not be likely to find the poison bait before considerable damage had been caused.

June beetles (*Lachnosterna* sp.). May or June beetles were somewhat abundant in southern Rensselaer and northern Columbia counties. According to statements by B. D. Van Buren made June 10, 1920, his red raspberries were seriously injured; many of the leaves of the bushes were eaten off and in some cases the blossoms also, though not infrequently the blossoms were left after most of the leaves had fallen. He estimates his loss from these pests at from $50 to $75 and states that black cap raspberries and purple cane raspberries nearby were not injured by the beetles. He also noted that the work was almost entirely on foliage 2 feet above the ground or higher and that the lower leaves of the plants were practically free from attack.

Wireworms. These are the yellowish, hard, cylindrical larvae sometimes found in numbers in sodland or recently turned grass. They occasionally cause serious injury to young corn and potatoes and may be easily distinguished from the myriapods sometimes incorrectly called wireworms, by the yellowish color and the presence of but three pairs of legs at the anterior extremity of the body, whereas the millipedes are usually brown or dark brown and invariably have series of legs along the entire under surface of the body.

Specimens of the wheat wireworm, *Agriotes mancus* Say, were received under date of July 7, 1920, from James Pringle, acting county agricultural agent, Jamestown, accompanied by the statement that they were injuring corn and, judging from the specimens sent, the infestation was probably somewhat serious.

Examples of this species were also submitted for identification

July 17, 1920, by H. W. Fitch, assistant manager of the Albany county farm bureau. He stated that these pests had seriously damaged one corn field of 5 acres, destroying another of about one-third of an acre and causing a 50 per cent loss on another 11-acre farm, all in the vicinity of Albany. The pests were so numerous on the farm of Charles Adams at Berne as to destroy all the plants for several rods and the owner stated that the plants might be killed overnight. Specimens submitted for examination showed the work of the wireworms at the very base of the plant and the destruction overnight, as mentioned above, could be caused by these insects only through practically destroying the bulb and thus causing the upper part of the plant to shrivel from lack of nourishment.

Another species of wireworm, Drasterius elegans Fabr., was submitted for identification by Mr Fitch May 20th, accompanied by the statement that two to three or four were at work upon recently set cabbage plants on the outskirts of Albany. An examination of the infested field showed that comparatively few plants were affected and that most of the damage was restricted to a lighter ridge. The owner, John Lawton, stated that this ground had been in continuous cultivation for some 16 years, two and three crops being obtained annually and that at no time was it allowed to become weedy. There appeared to be nothing in the way of manurial applications which would tend to increase the infestation and in view of the fact that such reports had been received from this general area from year to year, it appears probable that this and perhaps other wireworms may successfully maintain themselves in land under continuous cultivation, although these insects are commonly regarded as grass-feeding pests, only occasionally present in cultivated soil. This is further supported by the statement of Mr Lawton to the effect that dock plants were very likely to have a number of wireworms about their roots.

Mr Lawton added that ordinarily there was not serious injury and that the damage was particularly great in cold wet springs when the development of the plants was slow. It was his opinion, furthermore, that good cultivation was one of the best methods of enabling the young plants to outgrow injuries by these pests. It was suggested in case the injury was sufficient to justify the precaution, that it might be well to forestall damage by providing the wireworms with some cheap, relatively valueless food, such as a row or two of oats or rye between the transplants and located so that this temporary crop could be up-rooted with a horse-drawn implement.

There are no very satisfactory methods of preventing injury by wireworms aside from avoiding the planting of susceptible crops such as corn and potatoes upon badly infested and recently turned sod. Even this, in view of the statements of Mr Lawton, is a measure of limited application. Peas and buckwheat are relatively immune and may sometimes be sown advantageously in badly infested ground. Deep and thorough cultivation of the soil in late July or August will break open the pupal cells and destroy the pupae and recently transformed adults, thus reducing the number of beetles the following spring. Plowing late in the fall is of little value in destroying wireworms.

Poisoned baits of various kinds destroy numbers of the parent insects, the familiar brown "snapping beetles" and "click beetles," and it is possible that the use of poisoned baits would result in keeping these pests well controlled, even in areas where they are unusually troublesome, as for example in the immediate vicinity of Albany.

Stalk borer (Papaipema nitela Guen.). The stalk borer, like other pests of corn, received special attention during the summer of 1919 and as a consequence an unusually large number of reports accompanied by specimens were received. The partly grown stalk borer is easily distinguished from all other corn-boring insects by the characteristic caterpillar one-half to three-fourths of an inch long and strongly marked with purplish brown and five white stripes, one down the middle of the back and two on each side, the latter wanting near the middle of the body due to the blotchlike extension of the purplish brown. This gives the active moving caterpillar the appearance of having been injured.

There is an older larger stage which has received comparatively little attention, possibly because of uncertainty regarding its identity. It is distinctly lighter than the younger stages and usually has no well-defined blotch on the anterior abdominal segments. A detailed description of this stage is given below:

Larva. Length 2.5 cm. Head, thoracic shield and suranal plate mostly pale yellowish, the thoracic and abdominal segments reddish or yellowish red and with distinct median and sublateral whitish stripes and a well-defined broad, white lateral stripe on the first, second and the anterior portion of the third thoracic segment.

Mouth-parts dark brownish, the anterior margin and the teeth of the mandibles nearly black. Five ocelli in a semicircle, the four posterior in a black or dark brown area which is continued indistinctly to form a broad, darkish stripe resting upon the lateral margin of the thoracic shield and a portion of the segment just

below. Second and third thoracic segments with anterior, narrowly linear submedian tubercles and broader submedian posterior tubercles, the latter somewhat expanded laterally. Near the middle of the segment and just below the sublateral white line there is an irregularly oval large tubercle with a roughly triangular one a little posterior and ventral and a smaller, slightly anterior and ventral. There is a circular, moderately large tubercle on the base of the true legs. Abdominal segments with the anterior, submedian tubercles relatively much larger, irregular and extending nearly across the brownish or reddish submedian stripes. The posterior submedian tubercles a little more lateral and much smaller than the anterior pair. Around the spiracle there is a dorsal, a posterior and a ventral tubercle, all rather large and irregular and a much smaller anterior tubercle, all but the ventral being more or less fused on the second and third abdominal segments. The ninth abdominal segment with an irregular, somewhat illy defined chitinous area, somewhat emarginate mesially, covering the posterior two-thirds of the dorsum of the segment and joined by a slender extension to a broadly oval, lateral tubercle. Suranal plate covering most of the segment and in well-marked specimens with the lateral angles more or less fuscous. True legs mostly dark brown or black, prolegs unicolorous except that the row of hooks is more or less fuscous.

This older stage of the stalk borer was found repeatedly during July in corn, working in a manner very suggestive of European corn borer though the burrow was usually larger and the borer itself markedly distinct.

The stalk borer occurs in a number of thick-stalked plants, specially potatoes, tomatoes and dahlias. It is a local pest and its operations are mostly confined to the outer rows in cultivated fields or to those weedy the preceding season. Clean and thorough cultivation is a most effective control measure. The cutting and crushing or burning of wilting tips is also of service.

Lined corn borer (Hadena fractilinea Grote). The yellowish, dull reddish-brown striped, rather slender caterpillars about 1 inch long, may work in early June in the heart of young corn, tunnelling the stalks and giving evidence of their presence by the irregular holes near the base of the leaves and the wilting of the earlier injured plants. The work of this pest is very similar to that of young stalk borers, though the striking blotchy markings of the latter make it very easy to distinguish between the two. The caterpillar of the lined stalk borer presents a superficial resemblance, size and all, to the recently introduced European corn borer though it can be easily distinguished therefrom by the practical absence of brown spots, really chitinized or horny tubercles, and the fact that usually it works only in young corn, generally in early June.

The lined corn borer appeared up to 1919 to have been a comparatively rare insect in New York. It was first recognized in the State in 1913 on account of injury caused at Stone Ridge, Ulster county, and last summer because of its work in a corn field near Chenango Bridge, Broome county. In this latter instance more than half of the corn appeared to be infested with the pest.

The extraordinary interest in corn borers in 1919 resulted in bringing this pest to light in many localities and in practically every instance its operations were confined to young corn usually less than 5 inches high which had been planted on recently turned sod. Complaints of injury accompanied by specimens were received from various places in Albany, Columbia, Dutchess, Onondaga, Rensselaer and Saratoga counties, in some instances enough corn being injured as to necessitate replanting. One farmer estimated that one-third of his corn had been destroyed. The caterpillars evidently migrate along the row to some extent, since here and there most of the plants for a distance of several feet were infested or had been destroyed and in several instances the borers were found upon the leaves, head downward, evidently about to enter the growing center of the young plant. Infestation is most easily recognized by the irregularly eaten area near the base of the leaves and a central hole, sometimes filled by the borer, leading to the tender young growth. Older injury or more serious damage is indicated by wilting.

Comparatively little is known regarding the life history and habits of the lined corn borer. The moths appear the latter half of July or in early August. It is probable that the partly grown caterpillars winter in the sod much as do those of a number of other noctuids, as well as the frequently associated grass webworms. When the presumably natural food, grass, is destroyed they are compelled to turn to whatever may be at hand and consequently seriously injure corn. Their work is limited as mentioned above to plants 2 to 4 inches high or thereabout, therefore replanted corn or late planted corn is very likely to escape injury, the latter partly because of the more favorable weather making it possible for the plant largely to outgrow the ravages of this pest. The somewhat general prevalence of the lined corn borer, even if not heretofore suspected, is another reason for being careful about planting corn upon recently turned sod land.

Hadena dubitans Walk. There are a considerable series of cut worms, a few of which have become well known on account of

frequent and serious injury to garden and field crops. The larvae of this comparatively unknown form were received May 28, 1919, from William Russell of Ballston who stated that they appeared to be feeding on the grasses or weeds in the corn hills though they were not found in corn. Another lot was forwarded June 18th from Harry C. Morse, county agricultural agent, Gloversville, accompanied by the statement that they were eating the corn off at the surface of the ground and that a considerable number of the pests were found under sod which had not rotted. There were in this sending a few specimens of a more common cut worm though most of them were dubitans larvae.

These larvae or cutworms differed so much from the better known pests that at first they were supposed to be a species of Gortyna, possibly the hop vine borer. The rearing of moths July 14th established the true identity of these peculiar larvae which are described below:

Larva. Length when at rest 3 cm. Head and thoracic shield light brown to black, body a shining fuscous yellow or dull purplish, stout with rather coarse setae having a length one-third the width of the body. The submedian tubercles on the thoracic segments, both the anterior and posterior pair, are more or less coalescent. The anterior fold bears two transverse, slender, nearly approximate tubercles while on the posterior fold there are submedian groups of two large ovate tubercles one just laterad of the other. An annulation between the two segments bears rudimentary tubercles much like those of the anterior fold. Sublaterally on the major fold there is a large circular tubercle, just below that a smaller tubercle and just below the spiracular line there are two large, subcircular tubercles, one almost behind the other, and just below the anterior and larger of the two there is a smaller circular tubercle. The submedian tubercles on the anterior fold of the abdominal segments are separated by a distance decidedly greater than the diameter of the tubercle, those on the posterior fold with the inner margin laterad or nearly so of the lateral margin of the tubercle on the anterior fold. A large, unisetose tubercle occurs just above the spiracle, a minor one a little anterior and slightly above the spiracle, a medium-sized one posterior of the spiracle and directly ventrad of the spiracle is a large, unisetose tubercle. The submedian tubercles on the posterior fold of the eleventh body segment are separated from each other by a distance less than their transverse diameter. Suranal plate large, the anterior margin slightly excavated, the lateral margins rounded to a somewhat pronounced lateral angle. Ventrally, there is also a moderately large, unisetose tubercle at or near the base of each leg.

Spindle worm (Achatodes zeae Harr.). A great interest in corn insects the past season has led to a closer scrutiny of corn

fields than ever before and one consequence was a report from F. D. Condeman, Waterville, under date of June 9, 1919, to the effect that caterpillars of this insect infested about 5 per cent of the plants in his corn field. An examination of the affected corn disclosed feeding at the base very suggestive of grass webworms. The small caterpillars apparently eat a little hole below the surface of the corn and in that way produce an unthrifty condition.

This insect has also been recorded from dahlia and is known as an inhabitant of tender elder shoots, the infested tips hanging because the interior is gnawed away until only the thin bark remains. Apparently elder is the preferred food plant, and if this is correct it is obvious that injury in corn fields must either be limited to the margins near wild growth or to fields which have been indifferently cultivated and are therefore infested with thick-stemmed plants which would prove attractive to the moths when ovipositing.

The general interest in corn insects and the desirability of positively recognizing various borers have led us to prepare the following detailed description:

Larva, half grown, length, 15 to 18 mm. Head mostly yellowish orange, the body yellowish white, with broad, broken submedian and lateral purplish brown stripes and between a narrow broken purplish brown longitudinal line. Below the lateral stripe there is a narrower broken line, obsolete on the thoracic segments, and ventrad of that, namely on the base of the true and prolegs, a broader broken line subobsolete anteriorly, and on the leg-bearing abdominal segments extending to include most of the prolegs and the ventral area between.

The quadrate portions of the submedian broken dark bands of the abdominal segments bear near the anterior mesial fourth a circular unisetose tubercle and near the posterior lateral angle a similar tubercle. There is a similar tubercle just above the spiracle, a small one a little above and anterior, a larger one almost directly posterior and a smaller one ventrad. There is a somewhat oval, unisetose tubercle at the base of the prolegs or in the corresponding position on the legless abdominal segments. The eighth abdominal segment has four large, oval, unisetose, nearly equidistant submedian tubercles, two on the anterior and two on the posterior margin of the segment, this arrangement contrasting strongly with the normal arrangement on the seventh and other abdominal segments. On the ninth abdominal segment there is a submedian pair of narrowly oval, unisetose tubercles, a sublateral, circular, unisetose tubercle and close to it and a little ventrad and caudad a narrowly oval setose tubercle with an oval lateral one farther ventrad. Suranal plate a dark reddish brown, covering the entire segment and near the middle with a pair of submedian setae and along the lateral edge a series of sparse somewhat irregularly placed long setae.

Green clover worm (Plathypena scabra Fab.). There was an unprecedented outbreak of this insect in New York State in 1919, it causing general and somewhat serious injury to bean foliage in midsummer. Observations and reports indicate general injury not only in this State but also in Massachusetts and Connecticut and apparently much more serious damage in North Carolina and Virginia. This insect is a recognized enemy of clover and alfalfa, the turning to beans being unusual.

The light-green, white-striped caterpillars are only 1½ inches in length when full grown. They eat irregular holes in the foliage and when numerous may reduce the plants to loosely webbed masses of skeletonized leaves. They have a peculiar semilooping motion due to the fact that there are only four pairs of prolegs or body legs; they thus approach the condition found in the well-known looping canker worms or measuring worms and their allies. The caterpillars wriggle rapidly and usually drop to the ground when disturbed. The development is very rapid and within 10 days the outbreak may be at its height, the decline beginning in about 2 weeks.

Dusting or spraying is the most effective method of checking this insect. Owing to its rapid development, as mentioned above, the poison should be applied very promptly and preferably before there has been material injury. Experiments conducted in North Carolina show that powdered arsenate of lead, used at the rate of 1 pound to 8 pounds of lime, killed the caterpillars and did not injure the plants.

Leather-jackets (Pedecia albivitta Walk.). A number of the yellowish slaty gray maggots of this crane fly were received under date of June 10, 1919, from H. G. Chapin, county agricultural agent, Watkins, accompanied by the statement that they were found in large numbers in an oat field near a small brook, and directions for control measures were requested. The probabilities are that an appreciable amount of damage was being caused though nothing further was learned regarding the case. We are indebted to Prof. C. P. Alexander of the Illinois state laboratory of natural history for the specific identification.

The larvae varied in length from 2.8 to 4 cm and in diameter from 4 to 5 mm, the larger size being most prevalent. The following description presents characters of the nearly full-grown maggots.

Larva. Length 4 cm. Diameter .5 cm. Color a yellowish slaty gray. Segmentation rather distinct. Head indeterminate. Antennae long, slender, narrowly conical, somewhat curved, with a length

about 3 mm. and apically with about ten rather long, radiating hairs. Mouth structures apparently represented by six long, biarticulate fleshy processes. First segment small, the second moderately large and with a suggestion of a rounded ventral sclerite, the third to sixth segments with distinct prolegs on the ventral surface. The other segments apodous, the posterior extremity broadly rounded.

SHADE TREE INSECTS

Elm ribbed cocoon-maker (Bucculatrix species, not ulmella Zell.). Larvae and pseudococoons of this species, kindly passed upon by Mr Busck through the courtesy of Doctor Howard, were received under date of July 8, 1919, from John Dunbar, assistant superintendent of parks, Rochester, accompanied by the statement that the insect was rather seriously injuring European elms. The young larvae eat away irregular, somewhat angular areas on the under side of the leaves, never crossing the principal veins. The boundaries of the work were also invariably determined by the veinlets. The larvae very frequently fed along one of the lateral veins for a distance of one-fourth or nearly one-half of an inch, the width of the skeletonized area being about one-eighth of an inch. The characteristic small whitish pseudococoons, presumably molting cocoons, were found here and there upon the foliage. These were approximately oval or circular in outline and had a diameter of two to 2.5 mm.

A description of the presumably partly grown larva is as follows:

Larva. Probably partly grown. Length 4 mm, rather slender, a pale grayish green, the head light brown, the thoracic shield pale yellowish, it and the body with sparse, moderately long, dark setae, those on the thoracic segments forming a nearly transverse row, with two submedian ones near the posterior third of the segment. True legs and prolegs pale yellowish.

The full-grown larvae constructed the characteristic ribbed cocoons of Bucculatrix, they differing from those of our native apple and birch species by being grayish black. Adults were reared July 14th.

This is probably another introduced species. It may become extremely abundant here and there though the rearing at Washington of parasites, namely Copidosoma sp. and Cirrospilus sp., indicates that natural enemies either native or foreign are preying upon this insect and may serve to keep it under control fairly well.

Should the elm Bucculatrix become exceedingly abundant we would advise spraying with a poison early in July, taking special

pains to throw the insecticide upon the under surface of the leaves. Subsequent information suggests that the insect may have been completely exterminated by unusually thorough spraying.

Elm leaf beetle (*Galerucella luteola* Mull.). The somewhat general systematic spraying for the control of this pest has resulted in a very great reduction in its numbers and comparatively slight injury particularly in the cities of Albany and Troy, though the fact should not be overlooked that during the last few years there has been comparatively slight injury in some adjacent villages where there has been no spraying of any moment.

Personal examinations and reports in 1919 indicate local and in some instances rather severe injury by this insect in the city of Johnstown and the villages of Canajoharie and Hoosick Falls. Very similar conditions obtained at nearby Bennington, Vt., and there was serious injury in portions of Pittsfield, Mass.

The most effective method of controlling this pest is by early and thorough spraying with arsenate of lead, using about 3 or 4 pounds of the paste to 50 gallons of water. The treatment just as the leaves are beginning to expand and while the beetles are feeding is most effective since a very large proportion of the insects succumb before eggs are deposited, provided there is thorough work. Another excellent time is just as the leaves are nearly developed, namely the first or second week in June for the latitude of Albany, and then special pains must be taken to throw the poison on the under side of the leaves, since the grubs feed only on the lower surface and this treatment is directed against them rather than the parent beetles.

Bronze birch borer (*Agrilus anxius* Gory). An examination July 30, 1919, of trees in Washington Park, Albany, showed that one large white birch tree, with a trunk diameter of approximately 15 inches, leaved out this spring and later most of the foliage died. Numerous borings of the pest were found in the inner bark of the trunk of the tree, the only external sign being a moderate number of oval holes in the bark. There were also some evidences, though by no means abundant, of the work of this borer in the larger limbs and to an even less extent in the smaller limbs. It was evident that the tree had been girdled by the operations of this pest last year and had strength enough to develop a crop of leaves, though not to maintain them the following season.

The unhealthy condition of the tree was evidenced by the presence of the pigeon tremex on the limbs and engaged in ovipositing.

There were also a few Hymenopterous parasites upon the bark, evidently searching for an opportunity to oviposit in the borers.

On the east side of the lake near the upper end there are two large white birch trees with decidedly thin, dying tops. The bronze borer is evidently established in these. We advised cutting out the upper third of these trees in order to remove and destroy all the affected wood.

There are three large birch trees at the east end of the park not far from Willet street. One has lost most of its limbs and the other two show either dying tips or a very thin foliage, indicating a probably serious infestation. The cutting out and burning of these sometime during the winter or early spring is advised. Near these three trees, which all lie west of a curved walk and approximately in a row, there is on the other side of the walk near the easternmost trees, another large birch which appears healthy. This latter should be watched very carefully and affected wood removed on the initial signs of injury.

Callous borer (Sesia acerni Clem.). The larvae of these beautiful, wasplike red-tailed moths occasionally cause serious injury to soft maples in particular, especially in the vicinity of Buffalo and farther west.

An examination June 27, 1921, of numerous soft maples about 15 years old in the village of Kenmore, Erie county, disclosed a somewhat general infestation by this insect, the borings of successive years having resulted in some cases in a semigirdling of the trunk, and in many others there were numerous unsightly scars or wounds, which would probably be greatly extended if no effort was made to check the borers. There were frequently six to ten pupal skins projecting from the bark, especially on the edges of wounds, though in a few cases a number of exuviae were seen upon areas presenting superficially a normal appearance, though a closer examination showed that most of them were diseased below the surface.

Observations of the late Dr D. S. Kellicott show that the adults fly about Buffalo from May 20th to June 15th. The eggs are deposited on the bark of both soft and sugar maples, the female preferring as a rule to place them on roughened areas, especially in the vicinity of wounds, if one may judge from the injuries inflicted. The young borers commence work in the bark and sap wood and by fall are about half an inch long. Growth is completed in the spring and the moths issue as stated above.

Any treatment which results in keeping the bark smooth and normal will afford considerable protection from this pest; conse-

quently trunks should be protected from injury by horses, boys and other agencies and existing wounds should be carefully cleaned and covered with a protective coating such as grafting wax or paint. Since the caterpillars bore near the surface, they are easily dug out and destroyed. Infested trees should be examined the latter part of the summer and the borers killed and again looked over in early spring for evidences of recent borings. All cut surfaces should be protected as indicated above.

False maple scale (Phenacoccus acericola King). The report of the State Entomologist for 1913 page 59, describes a very serious infestation of certain hard maples near the New Haven Railroad station at Mount Vernon. These were so badly infested then that practically every leaf bore six to twenty-five of the conspicuous cottony females, while the portions between were thickly spotted and in some instances practically coated with the numerous yellowish young. The trunks were also liberally plastered with the white cocoons of the male.

An examination of this tree in September 1914 showed it to be in a somewhat weakened condition, there being a few limbs bare of leaves and a few small dead branches. The infestation was not nearly so severe as the year before, though the trunk of the tree was irregularly spotted with white cocoons and a large proportion of the leaves bore cottony females, there being three to five on almost every leaf.

Observation in this same locality in 1921 failed to reveal any evidence of permanent injury by this insect. This conclusion was supported by a later statement from J. James de Vyver, a former resident of that city, who accompanied the Entomologist when making the original observations in 1913. It is evident that the more severely infested trees, though injured for a time, were able to recover from the attack in a comparatively short period.

Spruce bud scale (Physokermes piceae Schr.). This European species appears to have been first detected in America in 1906 and was brought to our attention 2 years later on account of serious injury to Norway spruce trees throughout Prospect Park, Brooklyn. The identity of the insect was not established at that time, though its work was admirably illustrated (N. Y. State Mus. Bul. 134, fig. 18). Five years later[1] it came to notice again on account of injuries to Norway spruces at Mount Vernon and the following year it was reported as occurring so abundantly on spruces

[1] N. Y. State Mus. Bul. 175, p. 59, 1915.

at Amherst, Mass., that the honey dew attracted swarms of bees and this in turn called attention to the infestation.[1]

In 1914[2] the species was recorded as occurring at Albany and Port Henry, in addition to the locality given above, and the statement was made that it was probably widely and somewhat generally distributed in the State, a belief which has been supported by subsequent developments. It was rather common in 1921 on spruce near Cold Spring Harbor, Long Island, and also on Norway spruce at Buffalo, in which latter locality eight or ten of the scale insects were found at the base of many branchlets of sickly trees. Nearby healthy trees were free from the insect and, judging from general conditions, it appears very probable that this scale insect may have seriously weakened and presumably was an important factor in killing branches and even large portions of Norway spruce trees in at least one of Buffalo's parks. This conclusion was supported by the observations of F. A. Fenton in 1917 on Norway spruce about the University of Wisconsin campus. He states that it was especially numerous on the lower branches, many of which were killed by it and were rendered unsightly by a black fungus thriving on the honey dew secreted by these insects. The excretion was also very attractive to flies and especially to honey bees.

The obscure character of infestation by scale insects, simulating almost exactly the appearance of buds, makes it especially dangerous because the true condition is rarely appreciated until there has been serious damage to groups of limbs and perhaps entire trees.

This scale insect winters in a partly grown condition on the under side of spruce needles, becoming active the latter part of March and early in April, and by the middle of that month the females have established themselves upon the twigs. The males issue within 2 weeks after the migration to the twigs. The females become full grown early in June and the hatching young may be found the latter part of July. Fortunately this species is subject to attack by parasites, Holcencyrtus physokermis Gir. and Cheiloneurus albicornis How. having been reared from this insect by Mr Fenton.

The most promising method of controlling this scale insect is by spraying in early spring with a contact insecticide, especially with an oil, as for the somewhat closely related Lecaniums.

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[1] Econ. Ent. Jour., 2: 466–67, 1919.
[2] N. Y. State Mus. Bul. 180, p. 85, 1915–1916.

FOREST INSECTS

Antlered maple caterpillar (Heterocampa guttivitta Walk.). The work of this insect was very abundant in sections of Chautauqua county, sugar bushes in some portions being entirely defoliated, according to a report received the last of July, 1919 from T. J. Rupert, assistant county agricultural agent.

This insect has been rather abundant and injurious during recent years in the Berkshires adjoining the eastern border of the State and in some cases the pest doubtless extended its work into the New York area. The previous outbreak in this State of any moment occurred in 1917. A brief account of the species may be found in the report for that year, Museum Bulletin 124.

The control of most forest leaf-eating caterpillars under present conditions, depends very largely upon the efficiency of natural checks such as insect parasites and birds. The former have presumably not been greatly influenced by changes within the last 50 years, whereas there appears to have been a material decrease in the abundance of birds, and if entomological records of recent years are comparable with those of earlier times, insect ravages in forests have been more extended. It is therefore suggested in this connection that better protection of birds is one of the most promising methods of avoiding serious injury by this and associated leaf feeders.

Gipsy moth (Porthetria dispar Linn.). The menace of the gipsy moth is increasing with the passing of time. This is evidenced by the discovery in 1920 of very small, scattering infestations on Long Island, at Brooklyn, Greenport, Patchogue, Orient Point, Shelter Island and Southhold and a smaller colony at Garrison. A somewhat extended and serious infestation was discovered in New Jersey in July 1920 and it is quite possible that some of the above-mentioned infestations in this State originated from this older and much more wide-spread infested area in New Jersey.

The season of 1921 was marked by the finding of the gipsy moth in a southwest town of Vermont, which means that as a result of natural spread, the insect has virtually reached the New York State line and the same is almost true for the northwest corner of Massachusetts. There has also been a marked extension in the southwestern portion of Massachusetts, the insect now occurring in small numbers in the towns of Becket, Otis and Sandisfield, all within about 15 miles of the New York State line.

The isolated infestation in New York and New Jersey have been given the best possible treatment by federal and state officials working in cooperation, and those at Brooklyn and Garrison in this State are at the point of extinction. The marked progress in handling the situation is best seen in New Jersey where the larger and denser infestation with its three million egg masses in 1920 was reduced to less than one hundred at the end of the past season. This is a marvelous reduction and indicates the possibilities of well-directed exterminative measures. In this connection it should be stated that two earlier infestations in New York State, namely, one at Mount Kisco and the other at Geneva, were exterminated. There is no question as to the possibilities in this direction.

It is very difficult to prevent the dissemination of this insect through repressive and quarantine work of the federal government in cooperation with the interested states, though this has accomplished much in slowing up or checking what would otherwise have been an extremely rapid spread. The western extension in southern Vermont and Massachusetts means that New York State in the near future will have a gipsy moth problem of its own. It is considered advisable, however, to continue the general practice of earlier years and exterminate remote infestations and at the same time interpose every practicable barrier to the rapid spread of this insect.

Snow-white linden moth (Ennomos subsignarius Hubn.). Full-grown or nearly full-grown measuring worms of this species were received under date of July 7, 1920, from C. L. Williams, Laurens, Otsego county, accompanied by the statement that the insects were exceedingly abundant and causing material injury over large areas of woodland. Most of the measuring worms were full grown or nearly so when received and several had pupated, indicating that there would be comparatively little additional injury. Mr Williams stated that the pests fed upon basswood, ash, beech, soft maple and a little on hard maple, the preference being in about the order designated.

After these trees were stripped, they ate everything except cherry. He added that this was the third and the worst year of attack, nearly all timber being stripped. The preceding year the woods were so full of the moths that if a branch was thrown in to the trees, the multitude of flying insects suggested a snow storm.

Similar injuries extending over a considerable area were reported in the nearby town of Lisbon by B. J. Churchill.

The snow-white moths of this species appeared on the streets of Albany July 21st, being moderately abundant over a considerable area. They very probably had drifted from the infested areas northeast. The English sparrows fed greedily upon the moths and by noon little was to be seen except scattering wings.

Insect-feeding birds appear to be the most effective checks upon such outbreaks and occurrences such as noted above are additional arguments for the better protection of birds, since under present conditions at least, the cost of artificial control in ordinary woodland areas would be prohibitive.

Maple leaf cutter (*Paraclemensia acerifoliella* Fitch). This interesting insect came to notice in 1911, and again in 1919, both outbreaks being in the vicinity of Lake George and causing some concern because of the unfortunate condition of the infested trees. This is very apparent because the feeding is confined largely to the lower limbs of large trees and to fairly well-shaded small trees, consequently it is easy to overestimate the injury. A somewhat detailed account of this insect is given in the Entomologist's report for the year 1911, State Museum Bulletin 155.

Imported willow beetle (*Plagiodera versicolora* Laich.). This new introduction has become well established in New York State. Dr F. J. Seaver of the New York Botanical Garden brought it to our notice in June 1919. It was then known to occur on Staten Island and in various New Jersey localities.

Observations, July 7, 1921, showed the insect to be abundant in the vicinity of Syossett. There it was feeding upon the willows in considerable numbers and disfiguring the foliage to a marked extent. Records of the occurrence of this insect in Port Chester adjacent to the Connecticut state line have been kindly placed at our disposal by Dr W. E. Britton, state entomologist of Connecticut.

It is evident that this insect has become generally established in the southern part of the State and may be expected to spread over a considerable territory. Both adults and grubs feed upon poplars and willow, the latter confining their operations to the under surface of the foliage. The moderately stout, metallic blue beetles are about one-eighth of an inch long, hibernate, and issuing in late April or early May feed for a time and then commence to deposit eggs, a process continuing through the greater part of the month. The beetles of the second brood appear in early June and continue to issue until into July.

Early and thorough spraying or dusting with a poison should control this insect on ornamentals. It is advisable to make the application to the under side of the foliage, because the grubs feed only upon the lower surface of the leaf.

Dogwood twig borer (Oberea tripunctata Swed.). The work of a borer provisionally identified as the above-named species was received from R. E. Horsey, Foreman, Highland Park, Rochester, under date of September 6, 1921, accompanied by the statement that they were killing young twigs in the azalea collection, the affected branches being indicated by the dried-up leaves. The yellowish green borer confines its operations at first to the smaller twigs and then works downward in the shrub. One borer, presumably the same, was also found in rhododendron.

An examination of the material transmitted with the above statement showed that twigs, one-eighth to one-fourth of an inch in diameter, were inhabited by an active, yellowish larva, which lives in tunnels some 4 inches long and about one-tenth of an inch in diameter. Here and there along the infested twigs, circular orifices about one-twenty-fifth of an inch in diameter were to be found, and hanging from these there were frequently yellowish strings of borings. The yellowish legless grubs have a length of about three-fourths of an inch and, judging from the borings ejected, are active and very efficient workers.

There was serious injury to elm twigs in northern Illinois by a twig girdler described by Chittenden[1] as Oberea ulmicola and subsequently a more general account[2] of this same insect as an elm pest, was given by Doctor Forbes.

There is a brief note[3] by Dr J. J. Davis, which records this insect as infesting much of the dogwood plantings in the park system of Chicago, though he found some 44 per cent of the borers infested by an ichneumonid parasite.

A somewhat full account[4] of the insect and its work in dogwood was given the following year by Doctor Forbes.

The varied food habits of this insect are illustrated by the record[5] of its presence in large numbers from various parts of New Brunswick, where it is reported by Swaine as an apple insect.

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[1] Webster, F. M. Ill. State Lab. Nat. Hist. Bul. 7:1–13. 1904.
[2] 24th Ill. Rep't, p. 118–34. 1908.
[3] Econ. Ent. Jour., 3:184. 1910.
[4] 1911, Ill. Agr. Expt. Sta. Bul. 151, p. 506–9; also 26th Ill. Rep't, p. 44–47. 1911
[5] 42d Rep't, Ent. Soc. Ont., p. 72. 1912.

H. B. Weiss records[1] its general occurrence in New Jersey on dogwood and states that its presence is indicated by withering leaves at the tips of infested shoots, though as a rule it never occurs in sufficient numbers to cause material damage.

The work of this insect as an elm twig pest in the parks of St Paul, Minn., is discussed in some detail[2] by Prof. A. G. Ruggles. He states that all the trees along one of the finest avenues in St Paul had numberless dead leaves hanging from the terminal twigs in June 1911. Doctor Britton in 1917 records[3] this species from the twigs of sorrel trees or sour weed, Oxydendrum arboreum and in dogwood and azalea.

In connection therewith, Doctor Howard has informed us in a recent communication of the very abundant occurrence of O. tripunctata, in Connecticut where it attacks various species of laurel.

It is evident from the above summary that this insect occasionally becomes somewhat abundant and apparently is more injurious to elms than to the smaller trees or shrubs in which it also breeds. It does not appear to have attracted attention before in New York State and may not prove to be of any particular importance.

Pales weevil (Hylobius pales Hbst.). Specimens of young larch trees were received June 13, 1921, through the State Conservation Commission from John Barford, East Chatham, accompanied by the information that some 50 per cent of about 1000 recently set trees had been seriously damaged or killed by the work of an insect provisionally identified as this species. The portion of the shoot, with a diameter of one-fourth of an inch or a little more, was generally roughened and with numerous accumulations of resin, evidently due to recent wounds. In a few places fresh, irregularly oval areas about one-eighth of an inch in diameter, had been gnawed out by an insect.

The general appearance of the work and of the shoots agrees very closely with the illustration of the work of the European Hylobius abietis Fabr., as delineated by Gillanders in his "Forest Entomology," page 72.

Hickory gall aphid (Phylloxera caryaecaulis Fitch). This common insect was unusually abundant. It first attracted notice June 10, 1920, at Nassau where the developing galls were extremely numerous upon the leaf stems and particularly

[1] Can. Ent., 48:142; see also Circular 26, N. J. Dept. Agr., p. 44-46, for additional details.
[2] Econ. Ent. Jour., 8:79-85. 1915.
[3] 17th Rep't, Conn. State. Ent., p. 360. 1917.

at the base of the catkins. The galls ranged in diameter from one-half to three-fourths of an inch and were mostly oval in shape. There was no orifice or marked discoloration to attract notice. As the leaves had been out for only a comparatively short time, it is probable that the infestation occurred in the bud and that subsequent developments were comparatively rapid. A gall broken open was found to have the interior literally lined with young gall aphids.

Specimens received June 19th from Dr J. Burton Meeker, Chelsea-on-Hudson, were very badly infested, in some cases practically the entire leaf had been transformed into abnormal gall tissues. Doctor Meeker stated that the tree was literally covered with the galls. The probabilities favor serious damage to the hickory in this particular case.

Ordinarily the large size of the host tree and its general occurrence in fields where ornamental values are relatively low make it unadvisable to recommend remedial measures on account of the relatively great expense.

Hickory Insects

The hickory is one of the more valuable forest trees which has unfortunately suffered very seriously in recent years from insect attack, particularly from the work of the hickory bark beetle, Eccoptogaster quadrispinosa Say. Many thousands of trees have been killed in New York State by this pernicious insect though it should not be forgotten that climatic conditions, particularly extended droughts and the consequent reduced vitality of the trees may have had an important influence in bringing about conditions favorable for a development of this bark borer.

Aside from this insect there are a considerable number of other borers occurring in this tree and the following notes relate to some of the more common observed during recent years. They are placed on record in order to more clearly establish the economic relationships of the various species, something of importance in dealing with all insect pests.

Rustic borer Xylotrechus colonus Fabr.). The parent beetle is blackish, variegated with yellowish or slate-white markings and ranges in length from a little less to a little over one-half of an inch. It occasionally appears in great numbers, since in 1903 over 600 beetles were reared from two sections of a hickory tree some 15 inches in diameter, the larvae making very irregular, shallow galleries one-fourth to one-eighth of an inch in

diameter in the bark and outer sap wood, mostly the latter. It was reared again in 1915 from a small hickory log cut in February, the insects appearing in March and continuing to issue until toward midsummer. This species has been recorded as infesting logs and dead trees of black oak, white oak, hickory, chestnut, ash and elm, though in our experience it freely invades trees in a weakly condition.

Neoclytus erythrocephalus Fabr. This is a small, reddish beetle about three-eighths of an inch long and prettily marked with three yellow nearly transverse lines on each wing cover. It breeds rather commonly in sickly and dying elm and hickory and apparently in a variety of other trees, particularly locust, tulip, cornus, red bud and grape.

It was reared in late March 1915, from a hickory log cut in February, the insects continuing to emerge in considerable numbers during the summer and one living specimen was found in January 1916. The data appear to indicate an annual generation for this species with some tendency toward an extension to the next season under unfavorable conditions.

Common flat-headed borer (Chrysobothris femorata Fabr.). The adult is a somewhat inconspicuous, metallic, grayish, flattened beetle one-half to five-eighths of an inch long. It occurs on various trees. The legless, flat-headed grub makes shallow galleries in the wood. The beetles appear from the end to the middle of February and may often be seen resting on the trunks of trees or flying around them during the day time. The eggs are probably deposited in bark crevices and the young grubs feed on the sap wood and inner bark, the galleries increasing in size and sinking deeper in the wood as the borer develops. This insect is recorded as attacking a considerable variety of both native and cultivated trees.

Adults were reared April 9 and 10, 1915, from a hickory log cut the preceding February, and an examination in February 1916, resulted in finding no signs of flat-headed borers, evidence in favor of an annual life cycle for this species.

Quercitron bark beetle (Graphisurus fasciatus DeG.). This is an elongate, rather slender, grayish, black-spotted beetle with a length from one-third to a little over one-half of an inch. It is recorded as a borer of beech and hickory and was reared the latter part of March 1915, from a log cut the preceding February. It is apparently limited to weakened or dying trees. The

exit hole is broadly oval with dimensions about three-eighths by five-eighths of an inch. This leads into a gallery which penetrates the wood perpendicularly for a distance of 2 or 3 inches. Packard states that the eggs are deposited the latter part of June, in the bark, the young grubs running galleries mostly lengthwise and well filled with borings.

Pigeon tremex (Tremex columba Linn.). The grubs of this large horn tail or four-winged fly are very common in diseased or dying portions of the larger limbs and trunks of various trees, particularly elms and maples. The parent insect has a length of about 2 inches, a wing-spread of 2½ inches, a prominent horn at the posterior extremity and may be recognized by its cylindrical dark-brown abdomen with its yellowish markings. Not infrequently these flies are found upon affected trees and are occasionally trapped and perish through inability to withdraw the needlelike ovipositor from the wood.

This insect was reared in small numbers the following midsummer from a hickory log cut in February 1915, and an examination the following February resulted in finding fully formed living adults which would suggest a two-year life cycle, since conditions were such that the initial infestation might well have occurred in 1914. The probabilities were certainly against these Tremex adults having developed from eggs deposited the preceding summer.

Hickory timber beetle (Xyleborus celsus Eich.). This is one of the longer of our ambrosia beetles, it being about three-sixteenths of an inch long, cylindrical and brownish. It makes a series of galleries of nearly uniform diameter in hickory and oak. The entrance holes usually lead to a perpendicular gallery 1 or 2 inches long from which there are branches at irregular intervals and sometimes with a decidedly sinuous course. They cut the wood at right angles to the grain and lie in nearly the same horizontal plane, occasionally penetrating the trunk to a depth of 7 inches. This insect, like its allies is of unusual interest because it lives upon a peculiar fungus or ambrosia which develops in the galleries.

A considerable number of these timber beetles were reared in late March from a hickory log cut the preceding February and a careful examination later in the season showed practically nothing alive. The insects had presumably ceased breeding and deserted the log because of unfavorable conditions.

Monophylla terminatus Say. This insect is a small, cylindrical,

nearly black beetle about one-fourth of an inch long, remarkable because of the very large terminal antennal segment which equals in the female and greatly exceeds in length in the male the remainder of that organ. The larvae of this little beetle prey upon a number of wood borers and in our experience it was reared from late March until July from a hickory log cut the preceding February. This log and accompanying branches were badly infested with a number of insects, Sinoxylon basilare Lec. being the most abundant in the branches.

Agrilus otiosus Say, one of the small Buprestids, has been taken on ash, oak, butternut and locust foliage and has been recorded as boring in maple, dogwood, red bud, hickory, black walnut and as probably infesting butternut, box elder, and perhaps locust. It was reared in March from a hickory log cut in February 1915, and did not issue after July 20th.

Hickory snout beetle (Magdalis olyra Herbst.). This black, long snouted beetle about three-sixteenths of an inch in length breeds commonly in dying or dead hickory limbs. It appears to confine its attacks very largely to sickly trees or parts of trees and sometimes occurs in enormous numbers, in which event the inner bark and sap wood may be almost riddled by the many irregular branching galleries. This species was reared in small numbers the latter part of March 1915, from branches collected the preceding February.

Hickory twig borer (Chramesus hicoriae Lec.) This is a minute, short, stout, black beetle about one-sixteenth of an inch in length occurring quite commonly in hickory twigs ranging from three-fifths of an inch to an inch in diameter. The burrows are mostly in the wood and lightly score the bark. There is a single main gallery about an inch long, the eggs being deposited at nearly regular intervals on each side and the larvae working for a short distance at approximately right angles and then turning and boring nearly parallel with the wood fibers. A few specimens of this insect were reared the last of March 1915, from twigs collected the preceding February.

Red-shouldered twig borer (Sinoxylon basiiare Say). This small, cylindrical, stout, black, red-shouldered beetle about one-fifth of an inch long has been recorded as occurring in the twigs and branches of a considerable variety of trees, such as hickory, persimmon, mulberry, apple, peach and grape vine and Doctor Hopkins states that it breeds in most other deciduous trees.

This borer was exceedingly abundant in hickory limbs 1 to 3 inches or so in diameter and was reared in large numbers from the latter part of March and throughout the summer of 1915, and in February 1916 some larvae were still active in limbs cut the year before. The probabilities are that by far the greater number of the insects had emerged, indicating an annual life cycle normally with a tendency on the part of a few to carry over to a second season. This species runs galleries in hickory in the inner wood. They are about one-twelfth of an inch in diameter and nearly riddle the branches from a depth of about one-eighth of an inch to the center. The galleries of this borer are tightly packed with a very fine mealy sawdust. Many of them are longitudinal, almost contiguous, frequently branched and occasionally one may find transverse galleries following around the branch at an approximate depth of one-eighth of an inch. The exit holes are circular, at right angles to the surface and one-sixteenth of an inch in diameter or a little larger.

The larvae of this twig borer resemble those of the hickory bark beetle superficially, though they are easily distinguished by the different location, the Sinoxylon larvae being almost invariably in galleries at some depth in the wood while the hickory bark beetle larvae rarely penetrate to a depth equal to the diameter of the gallery. There is also a more marked ventral flexing of the posterior abdominal segments while the thoracic legs are long, slender and with the apical segment or segments bearing rather thick tufts of long, conspicuous setae, a strong contrast to the rudimentary or wanting thoracic legs of the hickory bark beetle.

GARDEN INSECTS

Asparagus beetles. The common asparagus beetle, Crioceris asparagi Linn., and the twelve-spotted asparagus beetle, C. 12-punctata Linn., were unusually abundant and injurious in the vicinity of Albany in 1920. An examination of the asparagus bed of George Curran at West Albany in company with the assistant farm bureau manager, H. W. Fitch, disclosed a very interesting condition. The owner had allowed one row to grow and this was very badly infested, eggs of the two species being so numerous upon a number of stalks as to occur in thick rows. In some places they gave a decidedly black or sooty appearance to the asparagus. The owner stated that the insects were so numerous as to cause serious loss because it was necessary to wash the eggs from the asparagus prior to marketing it.

A week later the common asparagus beetle was much less abundant though the twelve-spotted species was extremely numerous and Mr Curran expressed the opinion that this latter was more injurious and that it fed more actively. He added that he had sprayed the uncut row two or three times a week with Paris green and one morning an hour or two after spraying he found twenty-eight dead beetles under one plant. A portion of a row had been sprayed with pure kerosene by Mr Fitch and this application killed many of the beetles and apparently caused very little injury to the asparagus.

The infestation in this particular locality was so severe that trap crops and the collecting or destroying of the beetles afforded only partial protection. The probabilities are that there had been no spraying of the asparagus to prevent breeding the latter part of the preceding season.

The interesting little parasite, Tetrastichus asparagi Crawf., was decidedly abundant on the trap row, one to three or four frequently being found upon individual stalks. The insects are rather slow in their movements and it is comparatively easy to snap them into a cyanid bottle. The eggs of this little species are laid in the eggs of the asparagus beetle, though the parasites do not leave the host until the grubs are fully grown, have entered the soil and completed the pupal cell. Later parasites instead of asparagus beetles issue.

The most effective method of controlling these pests is to protect the uncut asparagus, usually in midsummer, with arsenate of lead, thus preventing breeding during the latter part of the season and making impossible a superabundance of beetles the following spring.

Asparagus leaf miner (Agromyza simplex Lw.). The small, shining black flies of this species were abundant May 28, 1920, upon the asparagus of George Curran at West Albany. They were found crawling upon the stalks and also resting upon the partly expanded tips of the foliage. The insect was so numerous that it was regarded as of some economic importance in that particular planting.

Cabbage maggot (Phorbia brassicae Bouché.). This insect was unusually abundant and injurious in the vicinity of Albany during early summer, 1920, probably on account of the unusual amount of rain keeping the soil about the plants somewhat moist. W. F. Anamier of West Albany, who was rather seriously

troubled with this insect, stated that the maggot was more injurious on the lighter, dryer parts of the field and that it was decidedly more abundant during the last few years. He was advised to water the infested plants which were not so badly injured as to be beyond recovery with a solution of corrosive sublimate, one part to 1000, using about one-half of a cup full for each affected plant and going over the field several days later, to treat others which might show signs of injury.

A nearby field of radish was also rather badly infested by this root maggot.

Investigations and studies of Professor Caesar in Ontario the past summer have led him to make the following suggestions for control of maggots. He advises the using of corrosive sublimate, one to 1000, and for cabbage he suggests the first treatment 2 or 3 days after transplanting and the second 5 days later. For radish, he would make the first application 3 days after the plants came through the ground and the second 5 days later. He finds that several fine days are necessary to bring the flies out and five such days before eggs are deposited; consequently as a general rule he favors making the first application 10 days after the first warm spell of at least 5 days occurring after April 25th.

The experimental work of Messrs Treherne and Rhuman showed comparatively little difference between three and four treatments for the control of maggots. They advocate three treatments, the first 3 days after transplanting and two others at 10-day intervals. The results obtained were superior to those secured with tarred paper disks.

Carrot rust fly (Psila rosae Fabr.). A rather general though not serious infestation by this insect was observed on parsnips at Nassau, March 27, 1921. This appears to be the first record of the occurrence of the insect in this section of the state, though it was reported from Fulton county in 1901, from Long Island in 1916, and caused considerable injury in the vicinity of Rochester at about the same time. It is evidently widely distributed, since it is known to occur in the northern states from Maine to Michigan, and under certain conditions it is a serious enemy of carrots and celery, though it also attacks parsnips, parsley and wild carrots. A detailed account of this species has been given in New York State Museum Bulletin 64, pages 99–103, and a brief note occurs in Museum Bulletin 198, page 73.

The presence of this insect in carrots and parsnips is most easily

recognized by the rusty colored burrows in the roots or the thicker portion of the stem of infested plants. When the insects are abundant, the whole root may be riddled with burrows, which run in every direction. Seriously affected carrots decay and the lower part breaks off when one attempts to pull them. Frequently, the outer leaves of infested plants turn yellowish and in the more serious cases, the whole top may wilt down and die. In the case of celery the fibrous roots are eaten off and the infested plants become stunted and take on a sickly whitish color.

No very satisfactory control measures have been demonstrated, though it seems advisable to rotate crops in such a way that those susceptible to attack will be on ground remote from that which may have become infested in earlier years. This should be supplemented by late sowing whenever it is practicable and if necessary the use of a repellent, such as carbolic soap wash, during the month of June at a time when the flies are abroad and depositing eggs. The use of a sweetened sodium arsenite mixture for the destruction of the flies has been tentatively recommended.

MISCELLANEOUS

European hornet (*Vespa crabro* Linn.). The reception October 26, 1921, of a large nest of this recently established European insect from F. E. Adsit, a resident of the town of Schodack, Rensselaer county, is a new record for this hornet and indicates a considerably greater northern extension of its range than has heretofore been recorded, although it is well known as common in the vicinity of New York City, and as having extended its range in an easterly direction to New Haven, and as occurring throughout New Jersey. It was received in 1920 from Highland Falls. The nest, according to Mr Adsit, was some 30 feet from the ground, attached to the underside of a large limb, and was about 3 feet long and 18 inches in diameter.

This insect is easily distinguished from the well-known and rather common American white-faced hornet, *Vespa maculata* Linn., an insect familiar on account of its nearly globular, paper nests rather commonly seen hanging from the eaves of buildings or the branches of trees. This European species is even larger and unlike its American relative, commonly nests within cavities in trees, in confined places in buildings, as between rafters, and underground. The nests in trees may consist of a series of combs occupying the entire cavity, entrance to which is usually

gained through a small opening. The underground nests are entered by a broad gallery, which turning slightly at its extremity, gives access to the lower portion of the nest. The nest itself or "paper" is considerably darker than that of our white-faced hornet.

This European insect commonly gnaws the bark from living twigs and small limbs and in this way may cause an appreciable amount of injury to ornamentals, whereas our native hornet is content to levy for its paper-making material upon exposed wood surfaces, such as old stumps, rail fences and the like.

Odontocynips nebulosa Kieff. Specimens of this gall on oak were received under date of January 3, 1922 from J. M. DelCurto of the state department of agriculture, Austin, Texas. The mass was a very irregular one with a length of about 10 cm and a diameter of approximately 6 cm, and composed of numerous fused cells or individual galls, each with a diameter of 1 cm or less.

A considerable part of the mass consists of older, blackened tissue with numerous exit holes from which the insects presumably escaped last year. There is a smaller part, dark brown, approaching the blackened color of the older mass and containing fully developed gall wasps evidently due to escape next spring.

There is in addition a smaller reddish brown mass with small cells containing eggs or very small larvae. A section through one shows that all the tissue is decidedly softer than in the older galls and moreover the central part is nearly filled with a whitish, cheesy, nutritive material easily distinguished from the surrounding protective woody part. The gall evidently develops to nearly full size before the larvae feed to any extent. The above conditions suggest a two-year life cycle, though there may be fall and spring broods and an annual life cycle.

The above is supplementary to and confirmatory of the account by L. H. Weld (U. S. Nat. Mus. Proc., 59: 210–11, 1921).

Cotton moth (Alabama argillacea Hubn.). Northern flights of this insect were noted in early October 1919, the insect being specifically reported from Lockport, Rochester, Schenectady and Albany. They were somewhat abundant in the last two cities, the moths being numerous in show windows and in Schenectady at least fairly festooning the upper portions of electric light poles. They were also noted at Malden, Mass., October 3d and reported by R. W. Braucher as quite common October 9th, and the preceding 3 days at Lincoln, Ill.

Moths appeared again in 1921 and were observed in small numbers at Silver Creek September 13th, Sandusky, Ohio, September

15th and at Albany September 23d and 25th. Under date of September 12th, a specimen was received from Henry W. Bell of Utica accompanied by the statement that it was one of several millions which had been in Utica the preceding 5 or 6 days.

Anthrenus verbasci Linn., a 17-year breeding record. April 4, 1902, two ears of popcorn, infested by this insect, were received and placed in a two-quart Mason jar and the latter kept tightly closed with no moisture aside from that in the somewhat dried corn. Breeding has continued uninterrupted for a period of 17 years, namely to April 4, 1919, at which time a living larva was found and there are presumably others alive, though on June 26, 1918, rather close search failed to disclose anything living. In the spring of 1909 (Econ. Ent. Jour., 2:193) the bottom of the jar was nearly covered with fine, white, globose particles, apparently starch grains, fallen from the eaten kernels of corn, and there was a thick mass of brown larval skins and other debris. Conditions were practically the same in the spring of 1912 (Econ. Ent. Jour., 5:297) except that there was more debris. There then remained much uneaten corn and the same is true at the present date, March 28, 1919, except that breeding appears to be reduced to a minimum, though not from any scarcity of food. There would seem to be no reason why breeding may not continue under these conditions for a considerable series of years unless the strain has become depleted through continued inbreeding.

Those interested in the ability of Dermestidae to adapt themselves to untoward conditions are referred to the very interesting account by J. E. Wodsedalek (Science 46:366–67, 1917) in which he records the curious results following 5 years of starvation of larvae of Trogoderma tarsale, which resulted in a gradual decrease in the size of the larvae, the size shrinking even to the hatching length, and increasing with the scarcity and abundance of food respectively.

Says blister beetle (Pomphopoea sayi Lec.). This large, strikingly colored blister beetle appears to have attracted considerable notice in recent years. This may be due in part to the closer attention now being paid to insects and partly to increased abundance. Last summer Prof. C. R. Crosby, of Cornell University, called our attention to the apparent biennial appearance of the insect and later submitted data showing the receipt at that institution of a considerable number of reports concerning this beetle in 1917 and even more in 1919. He adds that no records were

kept prior to 1917. It is well known that most complaints of this insect are based upon swarms of the beetles feeding upon the blossoms and foliage of various trees and consequently the above records doubtless indicate swarms in different localities in the State.

Reference to the published records of the State Museum indicates reports in 1900, 1909, 1911, 1912, 1914, 1915, 1917, and 1919, the insect apparently, judging from reports, being most abundant in 1911 and 1914. It will be noted that there is at least a suggestion of biennial periodicity though this is not strictly true for the 20 years covered. The developments of 1917 and 1919 led Professor Crosby to suggest that this blister beetle might have a two-year life cycle. Granting that this latter is the case, one would hardly expect a marked biennial appearance owing to the fact that this blister beetle has a variety of food plants and could therefore easily escape observation, and moreover it is doubtless influenced to some extent by climatic conditions and the available food supply. The above records must be considered suggestive at least.

American holly leaf miner (Phytomyza ilicicola Loew). Specimens of the work of this insect were forwarded for identification under date of April 29, 1921 by C. H. Zimmer, Lynbrook, accompanied by the statement that a small percentage of the leaves were affected on the estate of Victor Morowietz near Syossett, L. I. An examination of the affected leaves shows the upper surface to be badly scarred by the mines of this insect, the under surface being practically undamaged. The mines contained numerous puparia, some alive, and it is evident that adults are likely to emerge in the near future.

The eggs are laid in all probability on the underside of the leaves and the young maggots work in the foliage through most of the season and perhaps winter in this condition, the flies issuing the following spring. This latter is evidenced by the condition of the material noted above.

The holly leaf miner appears to be a southern insect and statements at hand indicate considerably more damage in the vicinity of Philadelphia. It is quite possible that the injury noted above was the indirect outcome of the unusually early, warm season.

Melander (N. Y. Ent. Soc. Jour., 21:270, 1913) places this species as a variety of obscurella Fall. The insect was described by Loew. as P. ilicis (Dipt. Amer. Sept. Indig., p. 156, 1861), this being changed to ilicicola because the earlier

name was preoccupied. The type locality is the District of Columbia. It has also been recorded from Massachusetts, Oregon, California and Alaska. The species is probably closely related to Phytomyza ilicis Kalt., a European species recorded as very abundant in certain English localities by Collinge and Gillanders, the latter illustrating the work and giving an outline of the life history after Collinge[1] (see pages 359–60 of his "Forest Entomology").

Since holly leaves remain upon the trees for 2 years or more, the destruction of fallen leaves would have no effect upon the miner, because by the time they dropped most of the insects would have deserted the leaves. The most promising method of controlling this miner would be to spray with a tobacco soap solution, such as three-fourths of a pint of black leaf 40 to 100 gallons of water to which should be added 6 to 8 pounds of any cheap soap to serve as a spreader. Make the first application the last of May or very early in June and then watch the trees; if there are signs of small mines in the new foliage in late June or July repeat the spraying. This latter treatment will presumably be more effective if given after the insects have commenced their mining operations and the injury is therefore relatively inconspicuous.

Leucopomyia pulvinariae Mall. A considerable series of these little flies kindly identified by the describer were reared from the cottony maple scale, Pulvinaria vitis Linn. on Crataegus collected July 6, 1916 at Shushan, by Frank Dobbin. The fly larvae evidently prey upon this scale insect. The fly itself is only about three-sixteenths of an inch long, mostly a light bluish gray and with red eyes. This is the only occasion the species has been brought to our notice, though there is a possibility that it is a more efficient enemy than available data would seem to indicate. Mr Malloch states that he has had one specimen for a long time, presumably from Illinois.

Asteia beata Aldr. A specimen of this drosophilid was taken at Wells, N. Y., July 14, 1921, by D. B. Young. This is a new record for the Adirondacks and apparently only the second for the species, since the one female type was taken at Chester, Mass., August 6, 1914 by C. W. Johnson. The Wells specimen was captured upon the blossoms of spreading dogbane, Apocynum andromaesifolium. Nothing appears to be known con-

[1] Third Report on the Injurious Insects and Other Animals observed in the Midland Counties during 1905, p. 41–42, 1906.

cerning the life history of this insect. The original description appears in Psyche, 22:95, 1915.

Chrysanthemum midge (Diarthronomyia hypogaea F. Lw.). Badly infested plants were received under date of September 6, 1921 from L. F. Strickland, agent of the Department of Farms and Markets, Lockport. Mistletoe was the variety of chrysanthemum affected and the probabilities favored serious injury. It also came to hand October 21st from J. James de Vyver, Oneonta, accompanied by the statement that it had appeared recently in a local greenhouse. This pest was very abundant last year in an Albany greenhouse. This, in connection with its known occurrence here and there from the Atlantic to the Pacific coast, indicates a wide and probably more general distribution than has been suspected. It is undoubtedly carried by shipment of infested plants. It multiplies freely under greenhouse conditions upon certain species of chrysanthemums and may cause very serious, if not total loss in certain varieties. This midge occurs or breeds in Chrysanthemum leucanthemum, C. corymbosum, C. atratum, C. japonicum and C. myconis in Europe, the first named at least being deformed as seriously as the cultivated chrysanthemum in this country. Most cultivated chrysanthemums appear to be susceptible, and owing to the apparently local habits of the midges, the infestation is apt to be very uneven.

Observations[1] in Ottawa, Canada, indicate that the following varieties are freely attacked: Chrysolora, Naomah, Radoelii, Ramapo, Hortus Tulsoms, Mrs Clay Frick, December Gem, Madam G. Rivol, Dr Enguehardt, Anna, Pacific Supreme, Early Snow, Elberon, Ursula Griswold, Aesthetic and Etherington. The Blended varieties of Chrysanthemum indicum and C. morifolium, such as Bob Pulling, Gertrude Peers, Daily Mail, Oconta, Mrs. G. C. Kelly, Wood Mason, F. T. Quilleton, and E. T. Quittington were fairly free from injury.

In Victoria, B. C., greenhouses: Smith's Advance, Halliday, Ivory, Polepheum, Chrysolora, Bonnafon, Wm. Turner, Western King, Mrs Thompson, Englehart and various Pompons were infested, Smith's Advance, Ivory, Bonnafon, Wm. Turner, Western King and Englehart being practically ruined.

The damage is caused by a small reddish midge about one-fifteenth of an inch long, which deposits its eggs[2] ranging in num-

[1] 1917 Gibson, A., Ent. Soc. Ont. 47th Rep't 1916, p. 118–20.
[2] Guyton, T. L., Econ. Ent. Jour., 12:162–64. 1919.

ber from 80 to 150 upon the young growing parts of the host plant, the life cycle being completed in 40 to 50 days in greenhouses at a temperature of 70° F. The subsequent infestation may be so

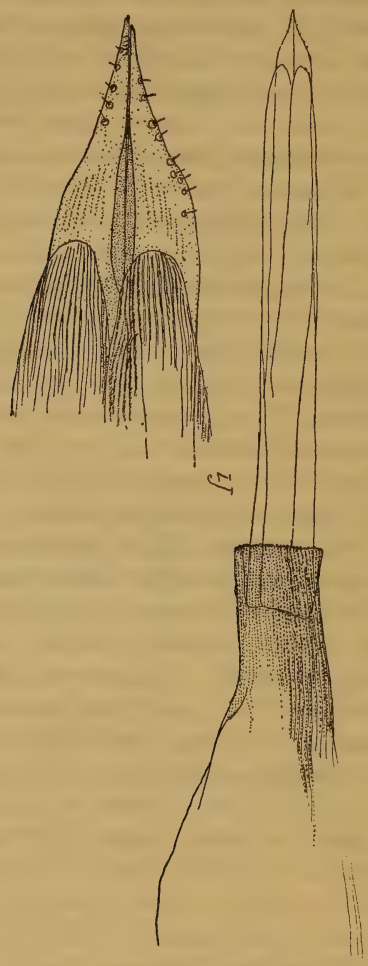

Fig. 1 Thurauia aquatica Rubs., ovipositor greatly enlarged, the tip more enlarged (original).

severe in young plants 3 to 5 inches high as to result in greatly enlarged, irregularly swollen stems (these sometimes being twice their normal diameter), deformed rudiments of leaves caused by an arrested development, and a failure to produce blossoms, the infested plants making an ill-shaped head.

A less serious infestation, especially if this occurs after the plants have secured a good start, may result in a few comparatively insignificant swellings or galls on the stems or leaves and more or less deformation of the flowers. One of the easiest methods of detecting the young inconspicuous galls is to allow the leaf to slip through loosely closed fingers, a process which will readily disclose the presence of slight swellings. The small developing galls appear as slight nodular elevations with darker centers protected to some extent by an unusually abundant mass of short, white hairs, while the fully developed galls have comparatively few of these short hairs and the discolored apical portion makes them relatively conspicuous.

It is by all means advisable to avoid the introduction of infested plants, hence the directions for the recognition of a slight infestation. It is much easier to keep the pest from establishing itself than to control an infestation.

Badly affected plants should be removed and destroyed, particularly if the stems are seriously deformed, since the chances are decidedly against the production of satisfactory blossoms. A few galls on the leaves or scattering ones on the stems would probably not affect the vitality of the plants to any great extent. Systematic fumigation with burning tobacco paper or spraying with black leaf 40, 1 to 500, and fish oil soap at 3 or 4-day intervals, preferably toward midnight, since 95 per cent of the flies emerge after midnight, has given very satisfactory results provided the treatment is continued until the insect is practically eliminated.

Additional details concerning this insect are given in the 31st Report (for 1916) of this office, State Museum Bulletin 186, p. 51–55, 1917.

Cypress twig gall (Thecodiplosis ananassi Riley). This rather common gall midge usually produces a somewhat fusiform enlargement of the twig, frequently with a length of 1.25 cm. Specimens received from Prof. W. E. Hinds, Auburn, Ala., October 25, 1921 show an aborted type not unusual among gall midges. In this particular instance, the gall appeared as a budlike enlargement on one side of a small twig about 2 mm in diameter. A section of the gall, the latter with its major diameter less than that of the twig, revealed the orange-red larvae associated with this species and inhabiting a small central cavity surrounded by light cellular tissue as in the case of the larger and more typical deformation. This condition is presumably the result of a very sparse infestation,

possibly the work of a nearly spent female or it may be due to an unusually late infestation.

Oak pill gall (Cincticornia pilulae Walsh). Scarlet oak leaves bearing from two to eight good-sized galls of this species were submitted for examination under date of October 25, 1920, by Robert D. McCarter, 50 Church st., New York, accompanied by the statement that practically all the leaves on a very fine oak tree at Rye were affected in this manner.

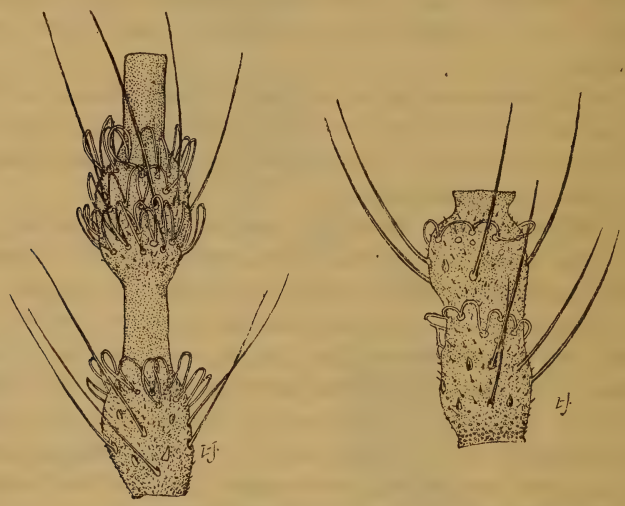

Fig. 2 Dichrona gallarum Rubs., fifth antennal segment of male (left) and female (right), greatly enlarged (original).

Examination of these galls showed from three to five or six large reddish orange larvae in a central, irregular cavity. Most of the interior had been destroyed and the outer walls were more or less granular and cracked. It is evident that the galls are in a condition to disintegrate readily with the coming of warm weather in the spring. It is comparatively easy to reduce a severe local infestation by raking and burning the fallen leaves, specially if this be done in the autumn.

Elm bud gall (Dasyneura ulmea Felt). This species was first reared May 7, 1886 from aborted elm buds evidently taken in the vicinity of Washington, D. C., by Mr Pergande. Apparently the same gall was collected at Jamaica Plain, Mass., by J. G. Jack. The gall is somewhat common in the vicinity of Albany. The

insect seems to be local in habit, since clusters of slippery elm sprouts are very likely to have a considerable proportion of the buds blasted by the work of this midge. The infested buds expand to a varying degree, the green leaves just pushing out of the dark-brown bud scales in some cases, and in many others the young leaves form an irregular, somewhat flattened mass of aborted leaves with a diameter of nearly one-half of an inch or thereabouts. Many of the buds affected in this manner fail to develop any leaves and eventually dry up and remain upon the twigs for some months. In a few instances leaves may develop successfully from closely adjacent buds.

The very few midge larvae observed in these deformities in New York led to some questioning as to the true gall producer. It was therefore with more than usual interest that an examination was made June 18, 1921 of a number of galls provisionally identified as those of this species and just at hand from Prof. F. A. Fenton, Ames, Iowa. This disclosed in the larger galls, numerous minute midge larvae here and there in cavities formed by partly developed, greatly aborted leaves. The larvae were upon the active green

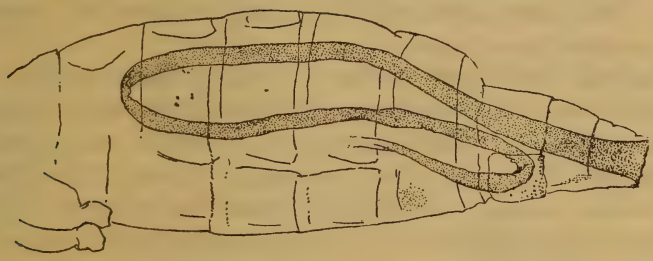

Fig. 3 Xylodiplosis aestivalis Kieff., side view of abdomen showing portion of the extremely long ovipositor within, greatly enlarged (original).

tissues and were sufficiently abundant in our opinion, to account for the deformation observed. This applied to the larger type of gall with a diameter of about three-quarters of an inch. There were also on these slippery elm shoots a few blasted, partly dried galls at the base of well-developed leaves. These latter had a diameter of approximately one-quarter of an inch and an examination showed five or more small larvae on the somewhat limited green tissues near the base of the swollen bud while the apical half was mostly brown. It appeared as though the infestation in the case of these smaller galls had been so severe as to almost blast the development of all leaves and make impossible anything but a very rudimentary growth.

Colpodia trifolii Felt. A series of males and females of this species was received from P. R. Lowry, April 8, 1921, all labelled as having been reared from wheat stubble in Hessian fly cages at Sandusky, Ohio, September 12–18, 1920. There were no data to suggest the part of the stubble infested by this gall midge. A related species, C. sanguinia Felt, was received in 1915 from Dr J. M. Aldrich accompanied by the statement that the insect was reared from an almost pure blue grass turf. Another species, C. pratensis Felt, was taken under such conditions as to suggest a host relationship with Kentucky blue grass.

The midges referable to the genus Colpodia are remarkable for their very narrow wings. They presumably represent an extreme type of specialization and as two other American species, C. pectinata Felt and C. temeritatis Felt. have been reared from galls on linden and ash respectively under conditions suggesting an inquiline relation, it is quite possible that the various species do not produce galls but subsist upon the distorted tissues resulting from the activities of other gall insects or they may find at the base of the roots of certain grasses approximately similar conditions. This latter may be the reason why midges of this genus have been obtained from grassy areas.

Panorpa? rufescens Ramb. A larva approximately three-quarters grown and presumably referable to this species was found in the environs of Albany July 27, 1921 within a fine specimen of the fungus, Sebacina incrustans (Pers.) Tul. The larva had probably entered the fungus in search of animal food, since it appears to be predaceous. It is quite possible that it was in a burrow excavated by some other insect, though there was no evidence of other invaders. Adult specimens of Panorpa were said to be somewhat common in the area where this larva was found.

Periodical cicada (Tibicen septendecim Linn.). The brood of this most interesting insect which appeared in 1919 is the largest which occurs in the United States though it is restricted to a very limited portion of New York State.

Early records show that there were large swarms in Queens and Suffolk counties in 1902 and that it was observed that year at Wantagh, Nassau county, and also in Richmond and Kings counties, thus confirming earlier records.

A circular letter was given to the press at about the time the insects were due to appear and the following is a summary of the information received.

William T. Davis of New Brighton, Staten Island, well known because of his enthusiastic love for nature, states that this insect appears to have been limited to that part of Long Island extending from Central Park and Farmingdale south to Massapequa and east to Mastic. He states that there were countless numbers of small, dead branches in the areas between Farmingdale and Massapequa and rightly concludes that the cicadas were extremely abundant. He states that there were a great many eggs or attempts to lay eggs in Baptisia and that as in previous years there was a marked restriction to colonies or groups. There was one thickly infested area east of Massapequa along the railroad track and another about 2 miles north. In both the insects occurred in countless numbers.

He further states that Charles P. Benedict of Staten Island heard several periodical cicadas singing about his house on the Manor road. He adds that in 1902 several of the insects were taken at West New Brighton not far from where Mr Benedict resides.

H. Schmucker of Islip, under date of June 3d, reported that he had seen great numbers of the periodical cicadas in the shrubs about a mile north of his home. Prof. C. R. Crosby of Cornell University informed us July 24th that he had seen a large cicada colony west of Farmingdale.

The earlier Columbia county record is based on a report in the Saugerties Telegraph of June 26, 1902, to the effect that the insect was reported at Claverack. A special effort was made to locate individuals the past season and as no results were secured the infestation must be very sparse if existent.

It was found impossible to secure any confirmation of the occurrence of this brood in the western portion of the State, namely in Monroe, Niagara and Ontario counties, and if colonies occurred in these sections they must have become greatly reduced.

Bat bug (*Cimex pilosellus* Horv.). There are several bugs very closely resembling the widespread and sometimes common bed bug of dwellings, *Cimex lectularius* Linn., which are occasionally found in buildings.

An exceptionally interesting case of this kind came to our attention early in June 1921, at which time evidence of the previous abundant presence of *C. pilosellus* were noted in a bat-frequented attic of a brick building at Rensselaerville, N. Y. The bats, we were informed, had been destroyed previously by fumigating with burning sulphur and several pailsful of their bodies were removed. The bugs or their remains were extremely numerous in

the portion of the attic frequented by the bats and pieces of mortar and boards were thickly spotted with dead bugs or the cast skins of the insects. This condition was the result of a liberal use of kerosene oil and corrosive sublimate prior to our examination.

It is difficult for anyone but an expert to distinguish between this bat bug and our common bed bug. The bat insect, however, is more hairy or pubescent, with the surface rather coarsely punctured and the abdomen narrower than in the common bed bug or the barn swallow bug, Oeciacus vicarius Horv. This last named is somewhat common in and about the nests of barn or chimney swallows and when the birds nest in chimneys an occasional invader enters sleeping quarters to the great perturbation of the housekeeper.

Ordinarily the bugs living at the expense of bats and swallows are not troublesome in dwellings. They are very likely to disappear when their normal hosts are obliged to seek shelter elsewhere.

Azalea bark scale (Eriococcus azaleae Comst.). Azalea twigs somewhate badly infested wit hthis insect were received under date of April 19, 1920, from John Dunbar, assistant superintendent of parks, Rochester, accompanied by the statement that this scale insect was quite troublesome to azaleas in the greenhouses and seemed to multiply very rapidly under cool conditions, this being a striking contrast to the behavior of the common mealy bug of the greenhouse. He also adds that it is extremely difficult to control this scale insect with any kind of a spray. It did not prove troublesome when the plants were plunged out in the summertime.

An examination of the material showed full-grown females and recently hatched young. The probabilities are that this species breeds more or less continuously under greenhouse conditions. Records available indicate that this may be a native species which ordinarily lives in the open, since Professor Comstock has reported this species as occurring commonly upon wild azalea, Azalea nudiflora, in Coy Glen, near Ithaca, and far from any cultivated plant. This species has also been recorded upon greenhouse azaleas at the Michigan State Agricultural College.

The probabilities are that this insect can be most effectively treated in greenhouses by fumigating with hydrocyanic gas at two-week intervals, the repeated treatments being designed to catch all the insects while young and therefore particularly susceptible and also to insure thoroughness. Mr Dunbar states that this scale was

controlled by laying the plants down on a board surface outside the greenhouse and literally washing off the insects with a forceable stream of water.

Japanese spotted camel cricket (Diestrammena japonica Blatchl.). This interesting species was found in New York State for the first time in 1916, when it occurred in large numbers in the cellar of a Buffalo greenhouse. A few specimens were received October 24, 1921 from Henry W. Thorne, Johnstown, accompanied by the statement that it occurred in several cellars in his vicinity. This latest record would indicate that the insect is becoming somewhat widely distributed in the country, presumably through shipment of greenhouse plants, especially as it has been recorded previously from Massachusetts, Ohio, Illinois, Rhode Island, Wisconsin and Canadian greenhouses.

This camel cricket has a body length of about one-half of an inch, while the distance from the tip of the slender antennae to the extremity of the extended hind leg is 2½ to 3 inches. It was earlier identified as D. marmorata Haan. but has since been referred to the above-mentioned species. A brief account of this insect is given in the 32d Report of this office (N. Y. State Museum Bulletin 198, page 88).

Camel crickets are nocturnal in habit and in nature are usually found under logs and stones, along streams or in moist woodlands. Occasionally they occur in cellars. They are recorded as having nearly omnivorous habits, readily eating meat, fruit and vegetables. There is little probability of appreciable injury following an infestation by this insect.

PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist. The titles [1], time of publication and a summary of the contents of each are given. Volume and page numbers are separated by a colon.

New Philippine gall midges with a key to the Itonididae. Philippine Jour. Sci., 13:281–325, pl. 1, 1918

The following new genera and species are characterized: Luzonomyia n. g., L. symphoremae type, Diceromyia n. g., D. vernoniae type, Kronodiplosis n. g., K. uichancoi type, Kamptodiplosis n. g., K. reducta type, Heliodiplosis n. g., H. spatholobi type, and the following new species described: Asphondylia vitea, A. callicarpae, Schizomyia acalyphae, S. diplodisci, Lasioptera manilensis, Profeltiella orientalis, Tricontarinia luzonensis, Hyperdiplosis banksi and H. relicta.

There is also a key to the subfamilies, tribes and genera of the gall midges of the world.

Key to American Insect Galls, N. Y. State Mus. Bul. 200, p. 1–310, figs. 250, pl. 16, 1918

Contents

Thirty-third Report of the State Entomologist on Injurious and Other Insects of the State of New York. N. Y. State Mus. Bul. 202, Oct. 1, 1917, 1918. p. 1–240, text fig. 82, pl. 12.

Contents

[1] Titles are given as published, in some instances articles appearing in a number of papers have been given different titles by the various editors.

European Corn Borer, Knickerbocker Press, Feb. 12, 1919, p. 12.
Brief general notice and an appeal for cooperation.

New Corn Pest in New York.
Circular letter issued Feb. 20, 1919.
A request, accompanied by directions, for cooperation in detecting the occurrence of this pest.

European Corn Borer (Pyrausta nubilalis Hubn.) Econ. Ent. Jour., 12:124, 1919
A note recording the occurrence and winter characteristics of this pest.

European Corn Borer. Cornell Extension Bull. 31, 1919, p. 35–42
Brief, popular, illustrated account of Pyrausta nubilalis Hubn.

Insect Pests and the Fruit Grower. N. Y. State Fruit Grower, April 1919, p. 6
General discussion of fruit tree insects and methods of controlling them.

Insect Galls and Gall Insects, Ottawa Naturalist, 32:127–31, 1919
A general popular discussion of insect galls and their makers.

European Corn Borer. N. Y. State Hort. Soc. Proc. First Annual Meeting, p. 216–18, 1919
Record of occurrence in New York with a discussion of its importance as a pest and a suggestion regarding the policy of the state in relation thereto.

The European Corn Borer. Cornell Countryman, 16:176–78, 194, 196, 1919
A general discussion of the problem from a national standpoint.

Alternation of Generations. Guide to Nature, 12:13, 1919
A brief summary of alternation of generations among gall wasps with references to other insects and alternation of food plants among plant lice.

How the Corn Borer Is Exterminated. State Service, v. 3, no. 6, p. 42–44, 1919
A discussion of the problem and of the methods adopted.

Army worm (Heliophila unipuncta Haw.) Econ. Ent. Jour., 12:272–73, 1919
Record of larvae hibernating at Saratoga.

Anthrenus verbasci Linn., a Seventeen-year Breeding Record. Econ. Ent. Jour., 12:273, 1918
Records continual breeding for 17 years by this species in unusually dry popcorn kept in a tight jar.

European Corn Borer, Univ. of the State of N. Y. Bulletin to the Schools, v. 5, no. 16, June 1, 1919
Warning placard illustrated by four colored plates, and summarizing the life history and habits of Pyrausta nubilalis Hubn.

Five Non-gall-making Midges. Ent. News, 30:219–23, 1919

The genus Hormosomyia is erected and the following new species are described: Prionellus eremi, Hormosomyia oregonensis, Porricondyla consobrina, P. fultonensis and Colpodia colei.

New Philippine Gall Midges, Philippine Jour. Sci., 14:287–94, 1919

The following new species are described: Ctenodactylomyia antidesmae, Lasioptera falcata, Asphondylia grewiae, Contarinia saltata, Bremia macrofilum, Arthrocnodax coprae, Itonida paederiae and Cecidomyia philippenensis.

European Corn Borer, Pyrausta nubilalis Hubn. Econ. Ent. Jour. 12:408, 1919

But one generation occurred in New York. An infestation at North Collins, Erie county, is recorded.

The Plant Galls Collected by the Canadian Arctic Expedition, 1913–18. Rep't of the Canadian Arctic Expedition, 1913–18, v. 3, Insects, p. 37g–38g, 1919

Notes and comments upon a number of Salix galls, insects and mites. Typical galls of Phytophaga rigidae O. S. were found in the collection.

The Life History of the European Corn Borer and a Summary of the Possibilities of Exterminating the Pest in New York State. Proceedings of the Conference on the European Corn Borer held by the National Commissioners of Agriculture with State Entomologists and Representatives of the United States Department of Agriculture. State of N. Y. Dep't Farms and Markets, Div. Agr., Bul. 123, p. 20–27, 1919

A general discussion of the life history and habits of Pyrausta nubilalis, urging that no reasonable prospect of control or extermination be left untested.

The European Corn Borer Problem. Econ. Ent. Jour., 13:59–73, 1920

A general summary and discussion relating to control of Pyrausta nubilalis Hubn.

New Gall Midges or Itonididae from the Adirondacks. N. Y. Ent. Soc. Jour., 27:277–92, 1920

A number of new Adirondack records are given and the following new genera and species described: Tritozyga borealis, Konisomyia borealis, Neptunimyia flavida, Neocatocha sylvana, Joannisia borealis, Campylomyza monticola, Parwinnertzia, n. g., P. notmani, Didactylomyia robusta, Porricondyla johnsoni, P. bidentata, P. spinigera, P. tumidosa, Asynapta borealis, A. dolens, Camptomyia antennata, C. dentata, C. pectinata, Holoneurus inflata, Dicrodiplosis insolens, Bremia syl-

vestris, Lobodiplosis borealis, Mycodiplosis intermedia, M. lenis, Hyperdiplosis insolens and Lestodiplosis satiata.

Insect Pests of Ornamental Plants. Garden Magazine, 31:182–85, May 1920

Brief popular accounts of the iris borer, stalk borer, rose beetle, rose scale, box leaf midge, pitted ambrosia beetle, arbor vitae leaf miner, juniper scale, European pine shoot moth, spruce gall aphid, spruce bud scale, pine bark aphid, chrysanthemum midge and some of the general pests of ornamentals.

Entomology, American Year Book, 1919, p. 679, 681, 1920

A brief résumé of the more important contributions in systematic entomology.

Corn Borers and Grass Insects. Univ. of the State of N. Y., State Dep't of Education, State Museum, p. 1–7, 1920 (issued June 29).

Brief descriptive account of grass webworms, Crambus luteolellus Clem., lined corn borer, Hadena fractilinea Grote, stalk borer, Papaipema nitela Guen., corn ear worm, Heliothis obsoleta Fabr. and European corn borer, Pyrausta nubilalis Hubn.

New Indian Gall Midges. Mem. Dept. Agric. India, Ent. Ser. VII, no. 1, p. 1–11

The following genera and species are described as new: Raodiplosis, type, R. orientalis, Horidiplosis, Type H. fici and the following species: Asphondylia lantanae, A. phyllanthi, Schizomyia assamensis, Contarinia caudata, Mycodiplosis indica, Diadiplosis indica, Raodiplosis orientalis, Orseoliella a'pludae, Itonida penniseti, and Cecidomyia penniseti.

European Corn Borer, A Call for General Control (in collaboration with G. G. Atwood) Dep't Farms and Markets, Div. Agr. Circ. 199, p. 1–2, pls. 2, 1920 (issued Nov. 19)

A brief summation of injuries, habits and the repressive measures advised for Pyrausta nubilalis Hubn.

Four New African Gall Midges. Natal Museum, Annals, v. 4, p. 2, p. 491–96

Xenhormomyia was erected and X. africana and X. natalensis described. Another new genus Heterobremia and two species, H. furcata and H. agilis were also described.

Insects and the State. N. Y. State Museum Bul. 219, 220, p. 227–31, 1920

A brief discussion of the numbers and importance of insects in relation to the development of the state collections.

Later Developments in the European Corn Borer Situation. Ent. Soc. of Ontario, 50th Rep't, for 1919, p. 110–11, 1920

Summary of conditions prevailing at the end of 1919 in relation to Pyrausta nubilalis Hubn.

New Philippine Gall Midges. Philippine Jour. Sci., 17:231–234, August 1920

The following new species are described: Scheueria schefflerae, Lasioptera panicula, Toxomyia brideliae and Mycodiplosis spondiasi.

European Corn Borer in New York State. Econ. Ent. Jour., 14: 85–88, 1921

A summary discussion of Pyrausta nubilalis Hubn. work in the new York areas in 1920.

White Grubs and Corn. Nassau Courier, Mar. 8, 1921

Brief outline of injuries, probabilities and preventive measures.

European Corn Borer, Pyrausta nubilalis. Ore. State Bd. Hort., 16th Biennial Rep't, p. 113–14, 1921

Brief general summary of distribution and the economic status of Pyrausta nubilalis Hubn.

New Species of Reared Gall Midges. N. Y. Ent. Soc. Jour., 29: 115–18, 1921

The following species are described: Rhopalomyia sabinae, R. weldi, Walshomyia insignis and Winnertzia fungicola.

Three new Subtropical Gall Midges. Ent. News, 22:141–43, 1921

The genus Alexomyia was erected with A. ciliata as type and the following new species described: Porricondyla pennulae and Phytophaga floridensis.

Indian Grass Gall Midges. Mem. Dep't Agric., India, Pusa, Ent. Ser. VII, no. 3, p. 15–22, 1921

The following species are described: Dyodiplosis indica on Andropogon schoenanthus, D. monticola on Androp. monticola, D. plumosa on Androp. annulatus and Iseilema laxum and Orseoliella graminis on Androp. squarrosus. There is also a key to the Indian species of Dyodiplosis.

Observations on Johnsonomyia Felt with a Description of a New Species. Canadian Ent., 53:96, 1921

A résumé of the distribution of the genus and a description of Johnsonomyia alexanderi n. sp.

Adaptations among Insects of Field and Forest. Scientific Monthly, 13:165–70, 1921

A general discussion of the problems of the insect world with special reference to adaptation.

Lasioptera apocyni Felt. Canadian Ent., 53:148–49, 1921

The above midge, reared from dogbane stems, Apocynum androsaemifolium, is described.

The Number of Antennal Segments in Gall Midges and a New Species. Brooklyn Ent. Soc. Bul., 16:93–95, 1921

A brief discussion of the number of antennal segments in the Itonididae and a description of Lasioptera howardi.

Methods for Combating the Corn Borer. Canning Age, Dec. 1921, p. 25–27

Summary discussion of conditions in New York State with special reference to quarantine and control measures.

Javanese Gall Midges. Treubia, 1:139–151, 1921

The following new species are described: Dasyneura elatostemmae on Elatostemma sp., Stefaniella falcaria on Avicennia officinalis, Stefaniella orientalis on Lepidagathis javanica, Schizomyia laporteae on Laportea stimulans, Schizomyia nodosa on Moschosma polystachum, Schizomyia villebrunneae on Villebrunnea rubescens, Asphondylia leeae on Leea sambucina, Asphondylia litseae on Litsea sp. and Asphondylia strobilanthi on Strobilanthus cernuus.

Notes are also given on the following species: Lasioptera javanica, L. manilensis, Asphondylia callicarpae and Procontarinia matteiana.

A new Javanese gall midge, Treubia, 1:270–71, 1921

Trishormomyia pandani reared from Pandanus nitidus is described as a new species.

European Corn Borer Situation. N. Y. State Hort. Soc. Proc. 66th Meeting, p. 68, 1921

Brief general summary of Pyrausta nubilalis Hubn. conditions for 1921.

White Pine Weevil and Reforestration. The Conservationist (Albany, N. Y.). 4:189–90, 1921

Summary discussion of control methods for Pissodes strobi Peck.

A new Diadiplosis. Zoologica (N. Y.), 3:225–26, 1921

Diadiplosis pseudococci preying on mealy bugs, Pseudococcus bromeliae, in British Guiana is described.

New Javanese Gall Midges, Treubia, 2:89–92, 1924

The genus Thorodiplosis is erected, type T. impatientis n. sp., reared from impatiens and the following additional new species described: Orseoliella orientalis on Oplismenus compositus, Parallelodiplosis javanica on Panicum indicum and Parallelodiplosis paspali on Paspulum scrobiculatum.

ADDITIONS TO COLLECTIONS

The following are the more important additions to the collections:

DONATION

Hymenoptera, 1919

Kaliofenusa ulmi Sund., elm leaf miner, larvae on elm leaves, June 9, C. F. Curtis Riley, Syracuse. Same, work on elm, June 21, Lucy C. Allen, Wilton

Aylax pisum Walsh, galls on Lygodesmia, September 22, C. N. Ainslie, Rugby, N. D.

Andricus coronus Beutm., gall on oak, April 17, H. Garman, Lexington, Ky.

Andricus cornigerus O. S., gall, October 3, 1919, J. J. Davis, Riverton, N. J.

Rhodites fulgens Gill., gall on Rosa gymnocarpa, May 16, J. S. Boyce, San Francisco, Cal.

Coleoptera, 1919

Pomphopoea sayi Lec., Say's blister beetle, adult on peach, June 5, G. G. Atwood, Onondaga county. Also received in June from Watkins, Buffalo, Rochester and South Byron

Galerucella luteola Mull., elm leaf beetle, larvae and pupae on elm, July 14, E. T. Horton, Whitehall

Plagiodera versicolora Laich., poplar and willow beetle, adults on willow, June 17, F. J. Seaver, New York

Oberea bimaculata Oliv., raspberry cane borer, adults and work on Raspberry twigs, June 26, L. M. Allen, Saratoga Springs

Microclytus gibbulus Lec., adults, November 13, F. J. A. Morris, Peterborough, Ont.

Popillia japonica New., Japanese beetle, adults, larvae and pupae. May 27, J. J. Davis, Riverton, N. J.

Laemophloeus pusillus Schon., adult on corn, September 18, Sylvester F. Virkler, Castorland, through Agricultural Department, from shipment of corn from Argentina, S. A.

Diptera, 1919

Crane flies. A series of ten species, three represented by paratypes were received December 3, 1918 from C. P. Alexander, now of Amherst, Mass.

Camptocladius, larva in human stomach, November 5, through State Department of Health, Johnstown

Diarthronomyia artemisiae Felt, galls on artemisia, November 14, 1918, E. G. Titus, Yakima, Wash. Same, gall on sage, April 24, F. R. Cole, Pullman, Wash.

Rhopalomyia alticola Ckll., galls on artemisia, November 14, 1918, E. G. Titus, Yakima, Wash.

Hormomyia crataegifolia Felt, thorn cockscomb gall, July 28, George S. Graves, Newport

Obolodiplosis robiniae Hald., galls on Robinia, August 10, A. Cosens, Toronto, Ont.

?Cecidomyia balsamicola Lintn., balsam midge, galls on white spruce, July 10, J. M. Swaine, Fort Coulonge, Quebec. Same August 25, C. L. Shear, North Creek

Cuterebra cuniculi Clark, rabbit bot fly, November 18, H. H. Johnson, Poughkeepsie

A series of twenty-seven specimens belonging to seven genera and representing fifteen species were received March 3; from M. C. VanDuzee, Buffalo

Lepidoptera, 1919

Laspeyresia molesta Busck, oriental peach moth, larvae and work on peach, June 27, T. F. Niles, White Plains

Apantesis virgo Linn., harness moth, July 23, A. W. Palmer, Johnstown

Hadena fractilinea Grote, lined corn borer, larvae on corn, June 2, F. H. Lacy, Poughkeepsie. Also received during the same month from Old Chatham, Skaneateles, Eagle Bridge, Glen and Argyle

Macronoctua onusta Grote, Iris borer, larvae on iris, July 10, Mrs Charles Gannon, Ballston Lake

Heliophila unipuncta Haw., army worm, young larva on corn, July 24, William J. Schreiber, Mechanicsville. Same caterpillars on corn, August 5, W. J. Hagar, Canajoharie. Same, August 7, J. Leonard, Feura Bush road. Same, August 18, W. K. Agne, Rome. Same, August 23, Harry C. Morse, Gloversville

Papaipema nitela Guen., stalk borer, larvae on corn, June 20, G. W. Bush, Utica. Also received from Rome, Coxsackie, Mineola, Salem, Cambridge, Skaneateles, Schuylerville, East Quogue, Amenia, Mechanicville, Oriskany Falls, Mount McGregor, Fredonia, Charlotteville, Hudson Falls and Watkins

Hadena dubitans Walk., caterpillar on corn, May 23, William Russell, Ballston Spa

Chloridea obsoleta Fabr., corn ear worm, in corn June 5, T. B. Clausen, Schenectady. Also received in October from Akron, Jamestown, Buffalo, Clarence Center, Alden and South Byron

Plathypena scabra Fab., green-striped clover worm, caterpillar on beans, August 5, Harry Cook, Albany

Heterocampa guttivitta Walk., antlered maple caterpillar, larva on maple, July 25, T. J. Rupert, Jamestown

Notolophus antiqua Linn., ancient tussock moth, eggs, March 21, G. W. Crawford, Ballston

Pyrausta ainsliei Heinr., larvae on smartweed, April 14, G. G. Ainslie, Knoxville, Tenn. Same, on polygonum, May 29, W. P. Flint, Urbana, Ill. Same, on corn, August 12, H. E. Gossard, Ravenna, Ohio, through Ohio Agricultural Experiment Station. Same, October 2, F. A. Fenton, Ames, Iowa

Pyrausta nubilalis Hubn., European corn borer, larvae in corn, January 30, V. V. Osterhoudt, Scotia. Also received from Saratoga Springs, Ballston Lake and Esperance

Evetria buoliana, European pine shoot moth, larvae, April 18, F. J. Seaver, Bronx Park

Laspeyresia caryana Fitch, galls on pecan twigs, May 12, J. M. Del Curto, Austin, Texas

Hemerophila pariana Clerck, apple and thorn skeletonizer, work on apple, December 11, 1918, J. R. De la Torre-Bueno, White Plains

Sitotroga cerealella Oliv., angoumois grain moth, adult on corn, September 18, Sylvester F. Virkler, Castorland, through Agricultural Department, from shipment of corn from Argentina, S. A.

Gnorimoschema tetradymiella Busck, gall on Tetradymia spinosa, July 19, A. O. Garrett, Castle Dale, Utah

Paraclemensia acerifoliella Fitch, maple leaf cutter, larvae on maple, July 28, Geo. S. Graves, Newport. Same, work, September 17, Raymond C. Donnan, Horicon

Hemiptera, 1919

Pachypsylla venusta O. S. and P. gemma Riley, hackberry galls, April 1, E. Bethel, Denver, Col.

Chermes cooleyi Gill., gall on Colorado blue spruce, May 15, F. A. Bartlett, Stamford, Conn. Same, galls on spruce, November 3, 1919, H. R. Hagan, Lehi, Utah

Chermaphis pinifoliae Fitch, pine leaf aphid, adults and eggs on pine, July 23, M. L. Minor, St Huberts

Pemphigus imbricator Fitch, beech tree blight, affected leaves, September 15, John A. Losee, Richfield Springs

Olliffiella cristicola Ckll., gall on Quercus emoryi, June, G. F. Ferris, Benson, Ariz.

Corythuca pallida Osb. & Drk., C. bulbosa Osb. & Drk., C. betulae Drk. paratype, C. elegans Drk., Leptostyla clitoriae Heid., Teleonemia belfragei Stal., Nezara viridula Linn., one bearing the eggs of a Tachinid fly, Trichopoda pennipes Fab. on the thorax. All from Professor Carl J. Drake, Syracuse

Acarina, 1919

Eriophyes rhoinus Ckll., mite gall on Rhus glabra cismontana, October, 1918, T. D. A. Cockerell, Boulder, Col. (Desc. Science, Dec. 2, 1910, p. 796)

?Eriophyes ribis Nal., galls on gooseberry, June 19, S. B. Fracker, Madison, Wis.

Hymenoptera, 1920

Vespa crabro Linn., European hornet, adult, August 21, 1920, Mrs Cora P. Flood, Highland Falls.

Andricus cornigerus O. S. horned oak gall, on Quercus imbricaria, June 2, 1920. W. O. Hollister, Cuyahoga Falls, Ohio

Andricus parmula Bass. Gall on Quercus, Sept. 22, 1920. E. Bethel, Denver, Col.

Disholcaspis persimilis Ashm., Galls, April 10, 1920, J. M. Langston, Hattiesburg, Miss.

Disholcaspis bassetti Gill., gall on Quercus imbricaria, June 2, 1920, W. O. Hollister, Cuyahoga Falls, Ohio.

Systole species, gall on Pleuraphis rigida, March 2, 1920, H. J. Quayle, Riverside, Cal.

Pontania petiolaridis Cosens, Gall on willow, December 8, 1919, Roy Latham, Orient

Coleoptera, 1920

Galerucella luteola Mull., elm leaf beetle, larvae and eggs on elm, July 15, 1920, Edwin Styring, Whitehall

Nodonota puncticollis Say, rose leaf beetle, adults on apple, June 19, 1920, F. L. Pelton, Potsdam

Typophorus canellus Fab., strawberry root worm, adults on strawberry, June 21, 1920, S. Reynolds, Ballston Spa

Phyllotreta pusilla Horn, western cabbage flea beetle, Brownwood, Texas, William A. Hoffman

Mezium americanum Lapl., adult, October 15, 1920, Miss Goldring, ? Cadosia

Agrilus viridis Linn., galls on Rosa rugosa, May 9, 1920, H. B. Weiss, New Brunswick, N. J.

Adistemia watsoni Walleston, in box with mouldy beetles, December 1920, L. B. Woodruff, New York

Byturus unicolor Say, raspberry Byturus, larvae on raspberry, July 17, 1920, M. M. Kennedy, Coxsackie

Craspedonotus tibialis Schaum., J. J. Davis, Riverton, N. J. introduced from Japan

Coleoptera comprising 648 specimens representing 368 species new to the State collections were very generously donated by D. B. Young

Diptera, 1920

Psila rosae Fab., carrot rust fly, larvae on carrots, January 14, 1920, S. B. Winans, Pine Plains

Anthracophaga distichliae Mall., galls on Distichlis apicata, March 7, 1920, E. Bethel, San Diego, Cal.

Aplonyx sarcobati Felt, gall on Sarcobatus vermiculatus, June 26, 1920, A. O. Garrett, Manti, Utah

Diarthronomyia hypogaea H. Lw., Chrysanthemum gall midge, on chrysanthemum, February 4, 1920, John Barlow, Kingston, R. I. Same, galls and adults on chrysanthemum, November 5, 1920, city greenhouses, Albany, through G. G. Atwood, Department Farms and Markets

Rhopalomyia grossulariae Felt, galls on Ribes indecorum, Grosmont, Calif., E. Bethel, February 20, 1920

Rhopalomyia utahensis Felt, galls on Chrysothamnus, May 10, 1920, A. O. Garrett, Salt Lake City, Utah

Rhopalomyia gutierreziae Felt, gall on Gutierrezia, June 26, 1920, A. O. Garrett, Manti, Utah

Asphondylia chrysothamni Felt, galls on Chrysothamnus, September 15, 1920, E. Bethel, San Diego, Cal.

Lepidoptera, 1920

Papilio troilus Linn., green clouded swallowtail, chrysalis, September 30, 1920, E. S. Miller, Wading River

Hadena dubitans Walk., ? larvae on potato vines, June 28, 1920, G. W. Bush, Utica. Same, larvae on corn, June 18, 1920, G. H. Gunn, Aurora

Chloridea obsoleta Fab., corn ear worm, November 10, 1919, H. G. Chapin, Watkins

Sesia pyri Harris, pear borer, work on apple bark, August 5, 1920, Joseph H. Dodge, Rochester

Crambus caliginosellus Clem., grass webworm, larvae on corn, June 21, 1920, James E. Petta, Saratoga Springs

Crambus luteolellus Clem., grass webworm, larvae on corn, July 8, 1920, G. W. Bush, Utica. Same, June 18, 1920, G. H. Gunn, Aurora. Same, injuring corn and soy beans, June 11, 1920, James Pringle, Jamestown. Same, June 10, 1920, E. C. Weatherby, Auburn. Same, June 9, 1920, W. H. Bates, Hyndsville. Same, June 8, 1920, G. W. Bush, Utica.

Pyrausta nubilalis Hubn., European corn borer, larva on corn, September 16, 1920, Alfred Morrison, North Collins. Same, larva, September 3, 1920, P. M. Eastman, Schenectady.

Argyresthia thuiella Pack., Arbor vitae leaf miner, Arbor vitae, June 12, 1920, P. G. Taddiken, Ogdensburg

Bucculatrix canadensisella Chamb. Birch leaf skeletonizer, cocoons on birch, September 18, 1920, Mrs A. M. Harris, Schroon Lake

Coleophora limosipennella Dup., European elm case bearer, on elm, June 9, 1920, Mrs James A. Glover, Garrison

Tinea defectella Zell., reared from fungus, William A. Hoffman, Brownwood, Texas

Hemiptera, 1920

Macrosiphum granaria Buck., grain aphis, aphid on oats, July 8, 1920, A. B. Buchholz, Hudson

Phyllaphis coweni Ckll., galls on Manzenite (Arctostaphylos) September 22, 1920, E. Bethel, Denver, Col.

Eriococcus azaleae Comst., Azalea bark scale, full grown females and young on azalea, April 19, 1920, John Dunbar, Rochester

Lepidosaphes grandilobis Mask, on Banksia marginata, T. D. A. Cokerell, Victoria, Australia, received November 14, 1919

Chionaspis micropori Marlatt, T. D. A. Cockerell, China

Acarina, 1920

Eriophyes cephalanthi Cook, galls on Cephalanthus, December 8, 1919, Roy Latham, Orient

Eriophyes nyssae Trott., on black gum (Nyssa), December 8, 1919, Roy Latham, Orient

Hymenoptera, 1921

Cephus pygameus Linn., wheat saw-fly borer, larvae on wheat, June 28, J. F. Rose, South Byron

Cynips plumbella Kins., gall on oak, November 28, L. J. Childs, Santa Rose Mt., Cal.

Rhodites gracilis Ashm. regal rose gall September 16, Mrs E. P. Gardner, Canandaigua

Prenolepis imparis Say, male and female, March 27, Nassau. Through W. M. Wheeler

Vespa crabro Linn., European hornet, nests and adults, October 26, F. E. Adsit, Castleton

Coleoptera, 1921

Xyleborus sp., ambrosia beetles, adults in balsa wood, April 18, Costa Rica, through Dr Hermann Von Schrenk, St Louis, Mo.

Anthonomus robustulus Lec., adult, June 20, S. C. Bishop, Juanita Island

Smicronyx sculpticollis Casey, galls on Cuscuta (dodder), August 12, H. B. Weiss, Monmouth Junction, N. J.

Hylobius pales Hbst., Pales beetle, work on larch, June 11, John Barford, East Chatham

Lyctus parallelopipedus Melsh., powder-post beetle, adults and larvae on black walnut, October 6, Frank T. Sullivan, Buffalo

Olibrus semistriatus Lec., adult, July 20, S. C. Bishop, Juanita Island

Antherophagus ochraceus Melsh., adult, on bumble bee, July 28, W. J. Schoonmaker, Rensselaer

Cyphon padi Linn., adult, September 9, S. C. Bishop, Lake Bluff

Agrilus viridis ? Linn., larvae in Rosa rugosa, August 8, Holland, through G. G. Atwood, Department of Farms and Markets. This was imported material for budding and the Agrilus had bored and so nearly girdled the stocks as to make them worthless for budding purposes. Same, work on rose, August 18, H. B. Weiss, Trenton, N. J.

Malporus cinctus Say, adult, September 9, S. C. Bishop, Lake Bluff

Diptera, 1921

Dasyneura rhois Coq., adults and galls, May 9, Prof. T. H. Jones, Baton Rouge, La.

Dasyneura ulmea Felt, elm bud gall, galls on elm, March 15, J. M. Swaine, Ottawa, Can. Same, galls on slippery elm, May 26, F. A. Fenton, Ames, Iowa. Same, galls and larvae on slippery elm, June 18, F. A. Fenton, Ames, Iowa

Diarthronomyia artemisiae Felt, gall on Artemisia, March 12, L. J. Childs, Hesperia, Cal.

Diarthronomyia hypogaea F. Lw., chrysanthemum midge, galls on chrysanthemum, October 21, J. James De Vyver, Oneonta. Same, galls on mistletoe chrysanthemum, September 6, L. F. Strickland, Lockport

Phytophaga ? destructor Say, Hessian Fly, adult on wheat, March, T. B. Fletcher, Baghdad, Mesopotamia

Phytophaga celtiphyllia Felt, gall on hackberry, September 16, T. H. Jones, Baton Rouge, La.

Rhopalomyia audibertiae Felt, gall on Audibertia, March 12, L. J. Childs, Hesperia, Cal.

Rhopalomyia californica Felt, adults and galls on Baccharis pilularis, June 30, E. O. Essig, Berkeley, Cal.

Rhopalomyia clarkei Felt, galls and midges, June 27, W. E. Britton, East Haven, Conn.

Lasioptera ephedrae Ckll., gall on Ephedra, March 12, L. J. Childs, Hesperia, Cal.

Lasioptera nodulosa Beutm., nodula stem gall, gall and adults on Rubus, March 7, T. H. Jones & W. G. Bradley, Baton Rouge, La.

Indodiplosis mangiferae Felt, adults on mango, March, D. d'Emmerez de Chamroy, Port Louis, Island of Mauritius

Hormomyia crataegifolia Felt, thorn cocks comb gall, June 19, J. M. Swaine, Ottawa, Can.

Itonida anthici Felt, gall on cypress, August 5, T. H. Jones, Baton Rouge, La.

Itonida taxodii Felt. galls on bald cypress, August 23, T. H. Jones, Magnolia, La.

Monarthropalpus buxi Lab., box leaf midge, pupae on box wood leaf, April 27, C. H. Zimmer, Wheatley Hills. Same, pupal skins in box, June 25, John D. Rockefeller Est., Pocantico Hills

Phytomyza ilicicola Loew, American holly leaf miner pupæ and work, April 29, C. H. Zimmer, Syossett. Same, May 11, C. H. Zimmer, Syossett

Olfersia americana Leach., adult on Great Horned Owl, October 25, S. C. Bishop, Albany

Lepidoptera, 1921

Chloridea obsoleta Fabr., corn ear worm, larvae on corn, July 14, C. B. McEwan, Loudonville. Larvae were also received from Rochester, Lowville, Hyde Park, Fayetteville, Belmont, Utica, Gloversville, Watertown, Nassau, Red Hook, Ballston Spa, Cobleskill, North Java, Fonda, Corinth, Glens Falls, Middletown, Mechanicville, Slingerlands and Hoosick Falls

Alabama argillacea Hubn., cotton moth, adult, September 14, H. W. Bell, Utica

Plathypena scabra Fab., imago, December 22, Roy Latham, Orient

Ennomos subsignarius Hubn., snow white linden moth, work and pupae, July 20, J. F. Rose, Stafford. Same, adults in swarms, June 28, R. E. Horsey, Rochester

Rachela bruceata Hulst, Bruce's measuring worm, male, No. 18, William Russell, Ballston Spa

Zeuzera pyrina Linn., leopard moth, larvae on apple twigs, September 16, P. L. Huested, Blauvelt

Crambus caliginosellus Clem., larvae on corn, N. G. Farber, Troy

Gnorimoschema baccharisella Busck., gall on Baccharis pilularis, June 30, E. O. Essig, Berkeley, Cal.

Ectoedemia populella Busck, gall on poplar, J. S. Houser, Wooster, O., from western Ontario, Canada

Bucculatrix canadensisella Chamb., birch leaf skeletonizer work, September 9, F. C. Smith, Westport. Same, work on birch, September 22, L. E. Allen, Plattsburg

Odonata, 1921

Anax longpipes Hag., adult, June 22, William T. Davis, Staten Island.

Hemiptera, 1921

Ormenis pruinosus Say, lightning leaf hopper, adults and young on elm, July 12, Phillip W. Hausman, Albany. Same, adult on grape and berry bushes, July 14, F. A. Weller, Cambridge

Okanagana magnifica Davis, paratype, June 17, W. T. Davis, James Springs, N. M.

Okanagana synodica Say, June 21, W. T. Davis, Clear Creek Canon, Col.

Idiocerus cognatus Fieb., October 10, Chris. E. Olsen, Maspeth

Euscelis stagtogalus Fieb., September, Chris. E. Olsen, New York

Pachypsylla mamma Riley, gall on Celtis crassifolia, October 2, James R. Weir, Cabin John, Md.

Phyllaphis coweni Ckll., gall on Arctostaphylos, August 2, L. J. Childs, Rialto, Cal.

Illinoia pisi Kalt., pea aphis, aphids on peas, July 18, Asa L. Brower, Morrisville

Tetraneura ulmisacculi Patch, elm sac gall, gall on U. montana May 24, Dr H. D. House, Kenwood
Phylloxera devastatrix Perg., gall on Carya (Pecan), May 24, Prof. R. N. Lobdell, Cary, Miss.
Tetraleurodes mori Q., larvae on Norway maple, September 12, A. R. Brown, New Rochelle
Chionaspis euonymi Comst., Euonymus scale, November 25, R. E. Horsey, Rochester
Lethocerus americanus Leidy, electric light bug, adult, August 9, Mr Cuyler Reynolds, Albany
Cimex pilosellus Horv., adults on bats, June 15, E. N. Huyck, Rensselaerville

Orthoptera, 1921

Diestrammena japonica Blatchl., japanese spotted camel cricket, adults in cellar, November 24, Henry W. Thorne, Johnstown

Archnida, 1921

Eriophyes eucricotes Nal., gall on Lycium, July 6, Prof. H. A. Gossard, Salem, Ohio. Same, galls on Lycium chinense, August 22, Emile Kostal, New York, through E. R. Sasscer
Eriophyes negundi Hodgk., plant mite gall on boxelder leaves, October 14, Carl F. Gronemann, Elgin, Ill.
Eriophyes populi Nal., galls on balm of gilead, August 12, Geo. E. King, Logan, Utah
Eriophyes ? tenuis Nal., gall on Bromus ciliatus, August 24, S. H. Burnham, Ithaca
Eriophyes tiliae Pag., var. exilis Nal., galls on linden, July 1, Carl F. Gronemann, Elgin, Ill.

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