

A STUDY OF THE INSECT FAUNA
OF THE CULTIVATED BLUEBERRY,
VACCINIUM CORYMBOSUM,
LINNAEUS

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE
Donald Monroe Tuttle

1947



This is to certify that the

thesis entitled

A STUDY OF THE INSECT FAUNA
OF THE CULTIVATED BLUEBERRY
VACCINIUM CORYMBOSUM,
LINNAEUS
presented by

Donald Monroe Tuttle

has been accepted towards fulfillment
of the requirements for

M. S. degree in Entomology

Ray Hudson
Major professor

Date August 5, 1947

PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.
MAY BE RECALLED with earlier due date if requested.

DATE DUE	DATE DUE	DATE DUE
FEB 07 2002 12 06 02	AUG 31 2004 08 31 04	

A STUDY OF THE INSECT FAUNA OF THE CULTIVATED
BLUEBERRY, VACCINIUM CORYMBOSUM, LINNAEUS

By

Donald Monroe Tuttle

A THESIS

Submitted to the school of Graduate Studies of Michigan
State College of Agriculture and Applied Science
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Entomology

1947

ACKNOWLEDGMENTS

Particular acknowledgment is made to Professor Ray Hutson of Michigan State College under whose guidance this work was carried out. Appreciation is expressed to Miss M. I. McDaniel of Michigan State College for her many suggestions and assistance. Thanks are given to other members of the Department of Entomology of Michigan State College for their help and encouragement. Acknowledgment is also made to Professor Stanley Johnston, supervisor of the South Haven Experiment Station, for the facilities and many helpful suggestions during the course of this work. Assistance of other members of the South Haven Experiment Station is deeply appreciated. For determinations acknowledgments are expressed to C. W. Sabrosky of the U. S. National Museum for the determination of the bulk of diptera collected; to Mr. Alan Stone and Mr. Greene of the U. S. National Museum for determination of special groups of diptera; to C. F. W. Muesebeck of the U. S. National Museum for determining parasites from reared material; to Herbert H. Ross of the Museum at Urbana, Illinois for determinations of tenthredinidae; to J. H. Newman of South Lyon, Michigan for determinations of lepidoptera; to Mr. Moore of Detroit, Michigan for determinations of micro-lepidoptera; and to Dr. Townes of the U. S. National Museum for determinations of ichneumonidae.

CONTENTS

	Page
Introduction.....	1
Pollination Observations.....	3
Studies on the Habits of Insects Infesting Blueberries	
Coleoptera.....	6
Diptera.....	11
Hemiptera.....	16
Homoptera.....	18
Hymenoptera.....	21
Lepidoptera.....	26
Neuroptera.....	39
Odonata.....	40
Orthoptera.....	41
Insect Faunal Survey	
Coleoptera.....	44
Diptera.....	50
Hemiptera.....	63
Homoptera.....	66
Hymenoptera.....	68
Lepidoptera.....	72
Neuroptera.....	75
Odonata.....	76
Orthoptera.....	77
Summary and Conclusions.....	79
Bibliography.....	81

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 84

INTRODUCTION

This paper is based upon a study of the insect fauna of the cultivated blueberry, Vaccinium corymbosum Linnaeus, during two growing seasons. Most of the survey work and investigations were carried out in the South Haven and Grand Junction areas which are the growing centers in Michigan.

The summer of 1946 was very dry and the year of 1946 was the driest on record at South Haven.* Average precipitation at South Haven for a 51 year period is 33.13 inches. Whereas, the total rainfall for 1946 was 17.65 inches. Contrasted to this, the first part of 1947 was marked by much more rainfall than average:

| | |
|------------------------|-------------|
| Rainfall in April 1947 | 7.75 inches |
| Average for April | 2.76 inches |
| Rainfall in May 1947 | 4.03 inches |
| Average for May | 3.60 inches |
| Rainfall in June 1947 | 3.75 inches |
| Average for June | 3.69 inches |

It was under these two extremes of rainfall that the studies detailed were made.

Included in the first part of this work are the studies on the habits of insects infesting blueberries. Most of the work was done during the blueberry season in the field and in the laboratory.

Under the second portion of this work, Insect Faunal Survey, extensive collecting was done, specimens were mounted,

labeled, and determined. In collecting everything found on the blueberry plants and in the field, a complete picture of the insect fauna of the blueberry is presented. It is quite evident that a number of transient insects have been included. Also many parasitic and predacious insects have been collected. An attempt has been made in the first part of the work to segregate the insects causing definite damage to the blueberry.

* Weather data from records of South Haven Experiment Station, cooperative observing station, U. S. Weather Bureau.

POLLINATION OBSERVATIONS

No attempt was made in 1946 to segregate the pollinating insects from collected specimens since bloom was well advanced at the time collecting commenced.

The spring of 1947 was cool and marked by more rainfall than normal. The following quotations are taken from Climatological Data (Michigan Section), U. S. Department of Commerce, Weather Bureau:

"April 1947 was cold and wet.....sunshine was generally deficient."

"May 1947 was the fourth coldest and the fifth wettest since the beginning of the record in 1937....."

Under these conditions only a partial list of the blossom visitors could be obtained. However, the list does indicate more important species which would be present any normal year.

During the morning hours when the temperatures were below 65° F only a few flies were active. At temperatures of 65° F and above the activity of the honey bee and bumble bees increased. On warm afternoons as many as five honey bees could be found working on the same bush at one time.

The honey bee, besides being the most numerous of the blossom visitors, seems to be the most efficient. It travels from blossom to blossom in the shortest routes and

works very rapidly. Bumble bees follow the same pattern somewhat but have a tendency to fly from bush to bush instead of exhausting the supply of blossoms with nectar on any one bush. Most other bees, wasps, and flies visit blossoms at random. Meanwhile, they take rest periods on leaves that are exposed to the sun.

Many ants and small diptera inhabit the bushes during the bloom period. Their role in pollination, if any, needs more study.

The following blossom visitors were collected or determined:

Diptera

Eristalis tenax L.

Eristalis dimidiatus Wd.

Toxomerus geminatus Say

Sphaerophoria robusta Curr.

Sphaerophoria cylindrica Say

Metasyrphus wiedemanni Johns.

Bufolucilia silverum MG.

Phormia regina MG.

Villa sinuosa Wd.

Villa lateralis Say

Winthemia sp.

Hymenoptera

Agapostemon radiatus Say

Apis mellifica Linn.

Hymenoptera (cont.)

Bremus bimaculatus Cress.

Bremus imbatiens Harris

Bremus pennsylvanica DeGeer

Bremus vagans concinilis Cress

Vespula maculata Linn.

Halictus rubicundus Christ.

Polistes fuscatus variatus Cress.

STUDIES ON THE HABITS OF INSECTS INFESTING BLUEBERRIES

COLEOPTERA

Oberea myops Hald.

Blueberry Stem Borer

In the latter part of June and the first part of July the presence of this insect was observed frequently in most fields. In the initial stages of infestation the tips of the current growth attacked wilt.

The female oviposits her egg between two girdles which are approximately one half inch apart. Three to six inches of the shoots are involved. The girdling of the stem is accomplished by small punctures circling the stem. Upon examination of several wilted stems a small whitish larva was always found immediately below the lowest girdle. Later observations showed that the larvae continued to bore downward tunneling the stem. No adults of this insect were found.

The wilted shoots are very noticeable when looking over the field. Within a week to ten days the affected parts turn brown. During the summer the part above the upper girdle usually breaks off.

According to Driggers (29) this insect apparently works at night.

It appears that by merely pruning out the infested shoots below the point of the egg or larva would provide a practical means of control. The larvae are unable to crawl back upon the plants so the prunings may be dropped to the ground.

Paria sp. resembling sellatus Horn

In a nursery of 5,000 plants 1-5 beetles per plant were riddling the leaves. Several holes in each leaf measuring 1/8 inch in diameter had been eaten out. These young plants averaging 10-20 leaves would have been defoliated or nearly so if control measures had not been taken. A lead arsenate spray (8 lbs. per 100 gal.) applied with a hand sprayer reduced the number of beetles greatly. On the following night a heavy rain washed a considerable amount of the residue off. Some of the beetles still remained on the plants. The next day a thorough application of lead arsenate spray was applied. Examinations following this showed very good control and good growth being resumed by the plants.

This specimen was determined by H. S. Barber of the U. S. National Museum. There is much confusion in the genera and the six specimens sent to him were placed near sellatus. A series of preserved specimens were sent to him for further study. Careful observations of all nearby vegetation failed to give any clue to the host plant. The field of the nursery was plowed in 1946 which was the first time that it had been turned over in several years.

Diabrotica 12-punctata Fab.

12-Spotted Cucumber Beetle

One of the first beetles found on blueberries in the spring. It is more abundant in June but can be found continuously through August. During the blooming period the adults have been observed feeding on the blossoms.

Systema frontalis Fabr.

Red-Headed Flea Beetle

In fields where cultivation was meager or insufficient these insects appeared in numbers especially on the grasses between the rows. Only occasionally were they found feeding on blueberry leaves. Where sufficient cultivation was employed this insect was never found. Injury is leaf skeletonizing.

Trirhabda canadensis Kirby

Goldenrod Leaf Beetle

These beetles were found in abundance on Solidago sp. that were common along the borders of several blueberry fields. Only a few adults were observed on the blueberry bushes and doing no apparent injury.

Coccinella 9-notata Herbst.

Nine-spotted Ladybird Beetle

Many coccinellids were found on the blueberry bushes. This species was the most abundant throughout most of the summer. Presence of aphids on blueberry leaves probably explains their presence. Eleven species of coccinellids were collected during 1946.

Brachyrhinus ovatus Linn.

Strawberry Root Weevil

Specimens (adults) were collected July 29 and August 19, 1946 and June 10, 1947. They were all found in the soil near the roots of the blueberry while searching for the cocoons of the cranberry fruitworm, Mineola vaccinii Riley. It was never found in numbers.

Conotrachelus nenuphar Hbst.

Plum Curculio

Six berries were found July 6, 1946 with the characteristic oviposition mark. The berries were turning blue prematurely and appeared slightly shriveled which called them to attention. They were placed in a rearing jar and on July 8, 1946 the larvae apparently had entered the soil. On August 11, 1946 three beetles were found in the jar. The remaining soil in the jar was then sifted carefully but no trace of other beetles or any other form of the insect could be accounted for in the other three berries. It is possible that only three larvae were in the six berries.

Elatерidae

Wireworms

While searching for cocoons of the cranberry fruit-worm several larvae of apparently a single species were found. The number of larvae found were not sufficient to cause any alarm.

Podabrus tomentosus Say

No common name

Although this insect was frequently observed and collected during June and July it was causing no damage that was noticeable.

Macroductylus subspinosus Fab.

Rose Chafer

The adults of rose chafer were commonly found in the axil of small shoots. Their presence was indicated by the shot hole appearance of several leaves in a group. These

holes were about 1/16 of an inch in diameter for the most part. Toward the latter part of June, beetles were frequently found in copulation. During this process the female was observed to keep on feeding. The last adult seen in the fields or collected was July 1st after which time they disappeared for the 1946 season. These beetles were never found in abundance.

Phyllophaga spp.

June Beetles

Definite damage by the larvae (white grubs) of June beetles was uncovered and reported by several growers in their experiences with new plantings. In one particular field two year old plants were set out in ground that had been broken and worked up a year previous. Approximately twenty five per cent of the plants in this five acre field were dead. The replacement of blueberry plants is very costly. Several of the dead plants were pulled up the first part of July. The work of white grub was distinct but no grubs or beetles were found at that time. The manager of the field stated that a month earlier grubs or adults were usually always found about the roots of the bushes when pulled up and examined. This piece of information could be assumed to be true since it corresponds with the life history of this insect. Other owners related similar experiences in the past. Land that is cultivated a year or two previous will serve to avoid damage by white grub.

DIPPERA

Although several species of flies were taken on blueberry, only one of importance, the blueberry maggot, will be considered.

Rhagoletis pomonella Walsh.

Blueberry Maggot

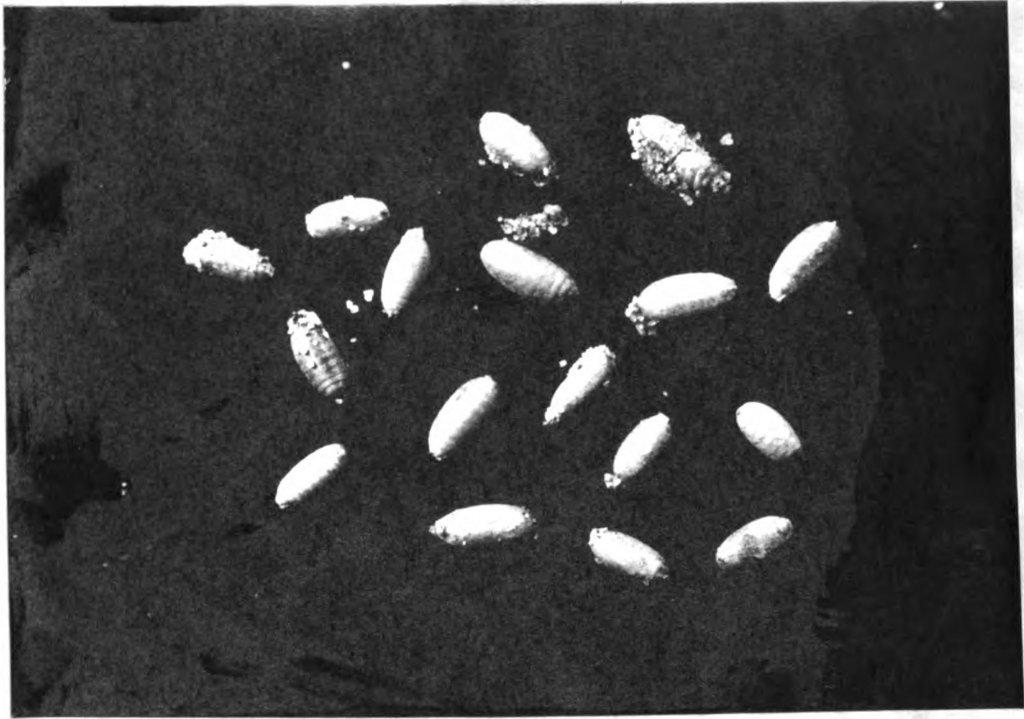
At the time maggots were found the berries were ripe and ready for picking. This means several maggoty berries will be included by pickers. Care in picking and sorting must be employed if there is an infestation of any sort in the field.

Usually it is possible to detect berries with maggots by punctures or the watery appearance of the berry. The punctures are irregular and circular in outline measuring approximately $1/32$ of an inch in diameter. Watery-like pulp gives berries a dark reddish coloring which is characteristic for maggoty berries. Maggots will be found approaching maturity when berries show this watery condition.

Punctures appear to be deeper in some berries (probably riper) so that the pulp was shoved back $1/16$ of an inch or more at a slight angle. Here the egg is oviposited by the female. Apparently one egg per berry is laid.

When mature the white maggot $1/4$ inch long enters the soil for pupation. Maggots may drop to the soil if the berry does not drop to the ground at the time the larva is ready to pupate.

Upon opening maggoty berries the larva was always



Puparia of Blueberry Maggot, Rhagoletis pomonella Walsh.

situated near the center where the pulp was hollowed out and the maggot surrounded by the juice of the berry. Apparently, upon hatching, the larvae eats to the center of the berry and remains there.

Rearing jars were constructed from large lamp chimney jars. Three inches of soil was placed in the bottom and an elevated 1/8 inch mesh screen inserted firmly into place. The maggoty berries were dumped on this screen to a two inch depth. When ready to pupate the maggot left the berry, bored downward, and dropped through the screen to the soil below. Most of the larvae entered the soil but a few pupated on the soil. At first the puparia are whitish but gradually they darken (very light brown) within a day or two. A few puparia were formed July 25th and pupation was rapid thereafter. The rearing jars were returned to the College and placed in the outside insectary for the winter. On April 1, 1947 one of the rearing jars was brought indoors for observation. Fly emergence from the latter jar occurred as follows:

| | |
|--------------------------|----|
| May 12 and 20, 1947..... | 6 |
| May 21, 1947..... | 2 |
| May 26, 1947..... | 4 |
| May 30, 1947..... | 2 |
| June 3, 1947..... | 1 |
| Total..... | 15 |

Many blueberry flies were collected by net in the field during the middle and latter part of July. The flies are rapid in flight and seem to appear suddenly upon the

leaves that are exposed to the sun. More frequently they choose the inner part of the bushes.

Determination of Dusting Dates of Blueberry Maggot

A week prior to July 1, 1946, blueberry maggot traps were installed at eighteen plantations which covered a circular route of seventy miles from South Haven Experiment Station. These traps were made from waxed paper cartons resembling cottage cheese containers. The inner surfaces were coated with tanglefoot and hung upside down on four foot stakes in the row. Ammonium carbonate which was used as bait was purchased in 3/4 inch cubes and wrapped in heavy paper. The bait was secured in the carton by shoving a pin through the bottom and bending. The effectiveness of the bait persisted not more than four days so traps were usually rebaited every three days to insure best results.

In most all cases the traps were placed in or near rows of Harding, Cabot, and Pioneer. These early varieties are the most susceptible to attack.

The first fly was trapped on July 3rd and only five were trapped up to July 10th. On this date observations revealed flies present in a moderate number in an older field where nothing had been trapped. A series of rapid experiments proved the tanglefoot to be repellent. A change over to dead-line as a sticker yielded good results immediately. The placement of traps in the bushes also improved results.

It was later learned that the oil used in tanglefoot was the repellent factor. A wax was used in place of the oil by the manufactures of deadline.

July 15th four deadline traps were installed at a plantation where flies were known to be present by field observations. By July 22nd 195 flies were caught with deadline traps and only five with four tanglefoot traps that were hung near the deadline traps for a check. Flies in the tanglefoot had barely entered, suggesting and supporting the fact that blueberry flies are repelled by tanglefoot.

On July 12th the first airplane dusting with 2.5 per cent rotenone on blueberries was done from 5-7 A. M. This date being set from the first appearance of the fly. Observations in the afternoon of July 12th revealed very few insects in the dusted field. A few spittle bugs, aphids, and occasional flies such as sarcophagids, bombyliids, and tachinids were seen. On July 17th insect population appeared almost normal again except blueberry flies could not be seen nor were any trapped since dusting.

In a row of Harding some maggot infested berries were found July 22nd and more the following days. Maggots that were collected July 22nd and 23rd began pupating July 25th. Assuming that it requires twenty days for the larval stage, 2-5 days for the egg, and 7-12 days for a preoviposition period, it seems very likely flies did emerge prior to July 3rd and fruit does not need to be entirely ripe for the female to oviposit.

Three flies were observed in an old planting on July 24th (12 days after the first maggot dusting). A second maggot dusting with 2.5 percent rotenone was applied July 29 to August 1st. In all fields dusted by plane only eight flies were seen or caught between the first and second dusting.

New traps were installed August 23rd in all fields where the blueberry fly was found. Not until August 23th were any flies trapped when two were found in one trap and an additional fly on August 30th in the same trap. About September 15th it was reported by the manager that this trap had about twenty five flies in it. This slight rise in emergence during the latter part of the season is common with many insects.

HEMIPTERA

Orius insidiosus Say

No common name

One of the predacious hemiptera that attack aphids, their larvae, and eggs.

Lygaeus kalmii Stal.

Milkweed Bug

Though never abundant, this lygaeid was collected in many blueberry fields during the early part of the summer. The host plant of this insect is the common milkweed, Asclepias syriaca Linn. All of the specimens on blueberry were adults feeding on both green and ripe berries. A few specimens were collected and placed in a jar containing some ripe berries. Small darkened areas appeared about the points where the insect inserted its mouthparts. The first specimen in 1947 was seen June 23rd which was two weeks later than they appeared in 1946.

Nysius ericae Schill.

False Chinch Bug

The adults of "the false chinch bug" were found feeding on the leaves of blueberries in small numbers.

Lygus pratensis Linn.

Tarnished Plant Bug

Many adults of the tarnished plant bug were observed feeding in the terminal growth of the older plants. They were more commonly seen in nursery rows. Fields that received thorough cultivation seemed to have fewer of these bugs. The tarnished plant bug is very common in this part of the state.

Adelphocoris rapidus Say

Rapid Plant Bug

This mirid appeared during June, July, and August but never in numbers. Occasionally one was seen sucking juice from a ripe berry. It breeds on Rumex crispus L. and other species of dock. The adults are generally found in moist localities.

Poecillocapsus lineatus Fabricius

Four-lined Leaf Bug

A few incidents of damage were noted by this mirid. The adults, apparently voracious feeders, feed by sucking out pulp between veinlets in small patches. Several of these patches occur on the same leaf and many leaves in the terminal growth are attacked by the same bug. The leaves that have been fed upon appear blighted and in a short time the entire leaf turns brown. In numbers such damage to the terminal growth may be of some consequence.

Banasa dimidiata Say

Green Stink Bug

Occurs frequently on the foliage of choke cherry, hazel, and other shrubs along the margins of swales and swamps. Only a few specimens were collected on blueberries.

Other Pentatonids

Several other species of Pentatonidae were collected in limited numbers. It is quite likely that they all feed on the juice of the ripe blueberry.

HOMOPTERA

Clastoptera proteus Fitch

Dogwood Spittle Bug

In one blueberry field the adults of this insect were found feeding on the leaves frequently. It seems likely that this species had strayed from its host plant in the adjoining brush and woods. Around most blueberry fields the wooded area and brush has been eliminated. This practice is a good control measure for many insects that otherwise might infest the blueberry.

Philaenus leucophthalmus varieties

Meadow Spittle Bug

During June the spittle of these insects can be seen in abundance on the vegetation along the borders of the fields. In July the nymphs mature and frequently move over on the new shoots of the blueberry. As many as 15-20 were found on a single shoot. Such numbers do produce damage. The curling of leaves and dwarfing of new growth was very evident in many cases. It is possible that the lack of rainfall during the month of June in 1946 favored the population of this insect. It is believed that rains, especially hard rains, serve to check this insect to some extent by washing the froth from the plants. Rotenone dust will control spittle bug but it is questionable whether the inclusion of the borders of the fields in the dusting program for the fruitworm would pay for the control of the spittle bug. A few frothy masses were collected in 1946 and placed in a rearing jar.

In a few days the nymphs left the mass and a covering of hardened frothy material was formed about them. June 20th six adult spittle bugs were taken from the jar. During the latter part of June, 1947 nymphs were occasionally found on the current season's growth.

Cicadula sexnotata Fall.

Six-spotted Leafhopper

Occasionally the adults of this species were taken from the leaves of the blueberry. It is possible they feed to some extent. Due to the low number of adults found they can be considered unimportant at this time.

Empoasca fabae Harr.

Potato Leafhopper

Specimens of this leafhopper were obtained for the most part night collecting. It is unlikely that the blueberry is a favorite host for this insect.

Empoasca maligna Walsh.

Apple Leafhopper

Remarks same as for potato leafhopper.

Lecanium corni Douché

European Fruit Lecanium

Most of the scales found were widely scattered. However, in one instance two bushes were found that were severely attacked by this scale insect. The leaves of these bushes were small and the fruit was undersize and unfit for picking. Several bushes surrounding this area had also suffered slightly from the spread of the infestation. Since the

infestation appears to be a local problem, control by use of dormant oil or some other scalecide might be advisable.

Aphids

Only a few aphids during the latter part of 1946 were found. They appear to be of a single species and were causing no noticeable damage. It may be that the abundance of coccinellids serve to check the aphid population or any subsequent outbreak.

HYMENOPTERA

Apanteles ornigis Weed

No common name

Two specimens were reared from tentiform leaf larvae, Gracilaria vacciniella Ely. One cocoon collected at Grand Junction July 19, 1946; parasite emerged July 25, 1946. The second cocoon was collected at Covert July 26, 1946; parasite emerged August 1, 1946.

Meteorus communis Cress.

No common name

The cocoon of this parasite was collected at Grand Junction June 21, 1946. It was attached to a blueberry leaf by a short silken thread. Emergence of the adult occurred June 23, 1946.

Meteorus hyanthriae Riley

No common name

July 15, 1946 a colony of fall webworms were placed in an open container in the laboratory. Within a week several cocoons of this parasite were found attached to the leaves. On August 1, 1946 fifteen parasites were introduced into an enclosed rearing jar containing a colony of webworms measuring one-half inch long. A few of the parasites remained alive until August 7, 1946. By August 12th a few dead larvae were seen in the jar as well as a few that appeared listless. On August 13th the first cocoon appeared. More appeared on the 14th so on the 15th the rearing jar was cleaned out. Twenty six parasite cocoons were removed to a vial

for emergence. Nineteen more parasite cocoons were removed August 20th. The emergence of these parasites occurred as follows: August 21 - 6, August 23 - 6, August 27 - 7, August 28 - 5, September 1 - 10. Observations hereafter, were discontinued.

Campoplex validus Cr.

No common name

A parasite of the fall webworm that was collected at South Haven. The adult specimen emerged August 28, 1946.

Cryptus albitarsis albitarsis Cr.

No common name

A single specimen of this parasite was reared from the cranberry fruitworm, Mineola vaccinii Riley. The parasitized larva was collected at Grand Junction and the adult emerged August 28, 1946.

Exochus sp. near pleuralis Cr.

No common name

From a tortricid larva collected at South Haven this parasite pupated and the adult emerged August 1, 1946.

(The above Ichneumonids were identified by Dr. Townes of the U. S. National Museum.)

Oncophanes atriceps Ashm.

No common name

A parasitized Tortricid larva was collected at Grand Junction June 5, 1946; six adults emerged June 19, 1946. A parasitized fruitworm larva, Mineola vaccinii Riley, collected June 29, 1946 at Grand Junction yielded four adults

on July 2, 1946.

Hemadas nubilipennis Ashm.

Blueberry Stem Gall

A few pithy galls, reniform in shape, were collected in August, 1946. More galls were taken in June of 1947 and from these a few adults were obtained for verification. Galls were rarely found during two years of collecting. Only one grower reported having any such growths several years previous. Any such galls should be pruned out when pruning is done during the dormant period and destroyed. Regardless of excising the infested stems the insects will emerge in the spring unless burned or otherwise destroyed.

Sympiesis binaculatipennis Gir.

No common name

A parasite that was reared from a small Tortricid larva collected at Bangor. The adult emerged July 1, 1946.

Telenomus sp.

No common name

Several specimens were reared from Pentatomid eggs. Emergence occurred July 30, 1946.

Trissoleus sp.

No common name

Some specimens of this parasite were reared from Pentatomid eggs July 30, 1946.

Polistes fuscatus variatus Cress.

Paper Wasp

Commonly found throughout the summer. Two small

nests were discovered on bushes of blueberry. During bloom they have been observed visiting flowers but their value as pollinators was not determined. Upon several occasions these wasps were observed feeding on the pulp of berries. Their mouthparts are adequate to break the skin of berries. However, more study is necessary before a definite statement can be made regarding this point.

Sawflies taken in Blueberry Fields 1946

Anetastegia tener

2 specimens -- host doubtful, probably thistle or Spiraea.

Taxonus terminalis

1 specimen, little is known about the biology of this entire genus but some probably live on Rubus and its allies.

Sofus zabrieski (formerly called Schizocerus or Sterictophora)

many males and females -- this is the common purslane sawfly and is not known to feed on any other host.

Eupria sp.

female from Grand Junction -- probably the rose species.

Caliroa sp.

1 female from Covert -- this belongs to a group that has been reared from only oak and hickory.

Priophorus sp.

1 female from Bangor -- host unknown.

(The above identifications and notations are by
Herbert H. Ross of Urbana, Illinois.)

LEPIDOPTERA

Apatela oblinita Abbot and Smith

No common name

A single larva was collected at Bangor July 5, 1946. Within a few days a cocoon was formed in the rearing jar. It approximated one inch in length and a quarter of an inch in diameter. For the most part the cocoon consisted of the coarse brownish hairs of the larva. The adult emerged August 5, 1946.

Datana ministra Drury

Datana or Yellow-necked Caterpillar

A gregarious feeding larva that was first taken at Lacota on July 8th. They were placed in a rearing jar and proved to be very easy to rear.

Several colonies of these larvae were collected. Undoubtedly, they are one of the most tremendous feeders of all insects. It is easy to understand how these larvae can strip a small bush of its leaves in a short time after observations in the laboratory. There is no webbing and the entire leaf is devoured by the larvae.

One of the most peculiar habits of the insect is the raising of the head and the last few abdominal segments to a 45 degree angle when disturbed.

Upon moulting the larvae collect in a group near the top of the jar leaving the foliage on which they have been feeding. The process requires about two days and occurred at 7-8 day intervals. As far as could be determined five

moult took place. When the larvae reached a length of two inches white hairs appeared sparsely from the entire body. With each succeeding moult the larvae fed at an accelerated rate and apparently fed continuously day and night. A typical example of damage incurred by their presence was found in a nine acre field near Pullman. Approximately ten six year old plants were discovered with colonies of datana. One third to one half of the foliage had been stripped from the bushes. Berries in this portion of the bush were sometimes nibbled on but regardless they were lost for picking as they shriveled up rapidly. It is possible that there were more plants in this field that had also suffered defoliation.

In another planting of three year old bushes two instances were found where consecutive bushes were defoliated completely. Five in one case and six in another which was probably accomplished by two colonies of datana. In the adjacent field of older bushes 12 colonies were located and two of the large bushes were more than half defoliated.

Larvae that were collected the first part of July pupated about August 10th. A few adults emerged in these jars August 27, 28, and the first week of September.

Gracilaria vacciniella Ely

Vaccinium Leaf Miner

The larvae of the moth were found working in the terminal leaves of blueberry plants during the first part of July until the latter part of August. Upon hatching this larva forms a simple mine but after the first moult it forms

a triangular housing from a single leaf by pulling the tip down and securing it with silken threads. Within this housing the small green larva skeltonized the inner walls. Several of the larval cases were collected from time to time but only six specimens were reared out. In all the reared specimens the larvae left the leaves when mature and spun a yellow silken cocoon on some white cloth that was placed in the jar. These cocoons measured 1/4 inch long. This insect was found in all blueberry fields but never in quantity. It was more prevalent in some fields than others.

Homocidus leucostigma Abbot and Smith - White Marked Tussock Moth

Four larvae were collected at South Haven on June 21, 1946. These pupated June 24th. Two adults emerged July 6 and two July 8th. Two more larvae were collected July 1st; pupated July 3rd; and both emerged July 14, 1946. Two days after the females emerged they proceeded to lay eggs in small masses of 50-40. The whitish eggs are covered with a frothy, sticky, white material that soon hardens. The small larvae skeltonizes the leaves of the blueberry especially the underside while the larger larvae eat the entire leaf or parts of it. The cocoons formed are rather loose and very thin. The hairs of the larvae are interwoven into this whitish cocoon. From all indications it appears that one brood a year occurs in this locality.

Hyphantria cunea Drury

Fall Webworm

Three webs of this species were collected July 7,

1946 and one egg mass. Generally the egg masses are attached to the lower side of the blueberry leaf and number 200-500. The eggs themselves are a light green and are covered with a white webbing. July 12, 1946 more colonies of webworms were collected and brought into the laboratory for observations. Until the larvae reach a length of 3/4 inch they feed by skeletonizing the leaves that are encompassed by the tent. After reaching a length of one inch the larvae devour the entire leaf except possibly the midrib. The berries that have been encompassed by the tent usually shrivel up so that they are unfit for picking. These berries usually drop to the ground if the bush is jarred. Pupation was occurring rapidly in all rearing jars August 23rd. By the 30th of August all the colonies that were collected in the first part of July had completely pupated. A jar of pupae were placed indoors in April 1947 and on May 2 moths began emerging. A discussion of the parasite reared from the fall webworm will be found under Hymenoptera, Meteorus hyphantriae Riley.

Nematocampa limbata How.

Filament Bearer

Two larvae collected July 21st; pupated July 24th; moths emerged August 8th, 1946.

Sparganothis lycopodiana Kearf

Leaf Roller

Larvae of this Tortricid were collected from the terminal leaves of blueberry. The upper surface of two leaves are loosely fastened together with webbing. Within this struc-

ture the larvae skeltonizes the leaves on the enclosed surfaces. Larvae that were collected July 29th pupated four days later. Emergence of the adults occurred about August 19th. The pupae were formed in the leaves slightly removed from the area in which the larvae had been feeding.

Zomaria interrupto-lineana Fevn

No common name

This insect is common in blueberry fields during the months of July and August. Though it was never found in numbers it appears frequently enough to cause alarm among some of the growers. By means of silken threads the larvae bring two terminal leaves together then proceed to skeltonize the inner portion. One larvae may form several of these shelters thereby giving a terminal shoot an unsightly appearance as well as some damage to leaf tissue. Larvae were collected July 15 - 20 and pupation occurred July 18 - 20th. On August 4th four moths emerged.

Personea minuta Rob.

Yellowhead Fireworm

One of the tortricids working in the terminal leaves of the blueberry. It brings two leaves together by means of silken threads and skeltonizes the inner surfaces. This type of injury seems to be characteristic of most tortricids found on blueberries.

THE EFFECT OF ROTENONE ON DATANA AND WEBWORM LARVAE

Tests were set up August 14, 1946 to determine the effect of both 1 and 2.5 percent rotenone dust on datana and fall webworm.

Four pint jars were employed for the experiment. Into each fresh blueberry foliage was placed after it had been thoroughly dusted. Larvae were introduced as follows:

| | | |
|-------|----------------------|-------------|
| No. 1 | Rotenone 1 percent | 10 webworms |
| No. 2 | Rotenone 2.5 percent | 10 webworms |
| No. 3 | Rotenone 1 percent | 10 Datana |
| No. 4 | Rotenone 2.5 percent | 10 Datana |

At the end of two hours five datana larvae in each of the jars No. 3 and No. 4 were dead. This indicated that datana larvae are very susceptible to rotenone at either percentage.

Examination the following day showed all the remaining datana dead but none of the webworms had died. However, they had stopped feeding and apparently chose to starve rather than feed on the dusted leaves.

For five successive days additional datana larvae were placed into the same jars No. 3 and No. 4. The results were always the same, that is, on the following morning they had all perished. Four or five day old dust in proximity of the larvae still seemed very effective as an insecticide.

After the third day three of the webworms in the No. 2 jar had died. Finally on the 23rd of August the last larvae

died in No. 2 (2.5 percent). At no time did these larvae feed.

One week after the larvae were placed in the No. 1 jar one larvae had died, three were feeding slightly, and the others appeared listless. The nine specimens were transferred to a clean jar and fresh foliage was added to determine whether larvae exposed to rotenone dust could recover. August 23rd, two days later, only three living specimens remained. Within a few days these died.

In preparation for departure from South Haven some jars of larvae were utilized in experimenting rather than disposing of them outright. Three jars of nearly mature webworms and several colonies of datana were dug up on the ground. This pile of specimens was thoroughly dusted with one percent rotenone dust by using a knapsack duster. Feeding of all the larvae stopped immediately and the webworm moved about frantically for several minutes. In a few hours all the datana were dead but the webworms had merely stopped feeding. Two days later many of the webworms were dead and the rest appeared lifeless.

From these tests and observations it is reasonable to assume that the dusting program for the control of the fruitworm and blueberry maggot holds in check, at least, the datana and webworm in blueberry fields. Not until the latter part of August were either of these larvae found in fields that followed the dusting program. At the time that they were discovered it had been a month since the last rotenone dusting. Colonies of both larvae could be found in July and August in most of

died in No. 2 (2.5 percent). At no time did these larvae feed.

One week after the larvae were placed in the No. 1 jar one larvae had died, three were feeding slightly, and the others appeared listless. The nine specimens were transferred to a clean jar and fresh foliage was added to determine whether larvae exposed to rotenone dust could recover. August 23rd, two days later, only three living specimens remained. Within a few days these died.

In preparation for departure from South Haven some jars of larvae were utilized in experimenting rather than disposing of them outright. Three jars of nearly mature webworms and several colonies of datana were dug up on the ground. This pile of specimens was thoroughly dusted with one percent rotenone dust by using a knapsack duster. Feeding of all the larvae stopped immediately and the webworm moved about frantically for several minutes. In a few hours all the datana were dead but the webworms had merely stopped feeding. Two days later many of the webworms were dead and the rest appeared lifeless.

From these tests and observations it is reasonable to assume that the dusting program for the control of the fruitworm and blueberry maggot holds in check, at least, the datana and webworm in blueberry fields. Not until the latter part of August were either of these larvae found in fields that followed the dusting program. At the time that they were discovered it had been a month since the last rotenone dusting. Colonies of both larvae could be found in July and August in most of

the fields that were not dusted with the four rotenone applications.

Mineola vaccinii Riley

Cranberry Fruitworm

The first evidence of the cranberry fruitworm was found June 13th in 1946. About half a dozen berries were found with pinhole entrances. Berries usually turned blue about this point. No webbing or frass could be found in this initial stage of attack. Most of the berries varied in diameter at this time from 1/4 - 3/8 of an inch. The collected berries were placed in a vial for observation.

On June 19th the berries that were collected June 13th had considerable frass about them indicating that the fruitworms were at work in the berries. Several more berries with pinhole entrances were collected and placed in vials. Many of the berries that had turned blue prematurely had dropped to the ground. Most of these had been the initial berry attacked by the fruitworm while others had been injured in some other manner.

Some of the berries collected to date were cut open and examined on June 20th. Berries in which the larvae were found usually had the seeds entirely eaten and a good portion of the pulp leaving a large chamber. Most of the larvae at this time measured 1/4 inch long. The head for the greater part is black and the body a light brown with a rosy appearance. Fresh green berries were placed in the vials in the laboratory. The larvae that had been extracted in examinations were replaced

in the vials again. Almost immediately these larvae began to bore their way into the berries.

June 31st more berries containing fruitworm were collected. One ripe berry in a cluster would usually indicate the presence of a fruitworm. Apparently there is but one worm per cluster. The worm feeds only a short time on the first berry and then proceeds to a second berry. One worm was found just making its way into a second berry at the stem end. For the most part the second berry was entered at a point where the initial berry made contact with it. By so doing it appears that the fruitworm avoids exposing itself any more than is necessary. This not only protects it from parasites and predators but also makes it difficult to control. For this reason it is understandable why rotenone is not more effective than it is in their destruction. Several berries in the field exhibiting indications of fruitworm presence were examined and in nearly all cases the worm was located. These worms now measured $5/16$ to $5/8$ inch long. The head for the most part was still a blackish color and the body had a rosy or greenish tinge. Those that were larger seemed to be mostly greenish in color. Some were dumped into pickle solution and very shortly lost their color. The borders of the fields seemed to be most heavily infested. In most fields the border is the only part with any fruitworm. So far the fruitworm has been found in Cabot, Pioneer, Concord, Harding, Rubel, and Rancocas. This seems to indicate that no variety is immune. Bruising and frost may also turn berries blue prematurely wholly or in part.

All the infested berries in vials and other small

containers collected to date (June 23th) were placed in one large jar. The jar was first filled to a depth of one inch with moist sand. Many of the larvae left the berries in the next few days and roamed over the inner surface of the jar. A close examination of the contents on July 2nd revealed four silky cocoons formed on a twig that had been included with the berries. Many of the larvae in the jar now measured 1/2 inch long and were either a reddish or green color.

Several more infested berries were collected July 2nd and placed into rearing containers. Infestation along the bordering rows of the field is very pronounced now. The further one goes into the fields the less fruitworm found. It now appears that all varieties are subject to attack. The damage in the cluster is now characteristic of all descriptions in literature, that is, the webbing and frass details.

A field with a rather moderate infestation was located and from this a large quantity of clusters (infested) were collected for rearing purposes. Some of the clusters were placed in tin pails and covered with cheese cloth. The latter appeared to be doing well but mold began to grow in a few days. On July 12th a great share of the berries on hand were dumped into a codling moth cage. The pan of the cage was filled with 2 inches of moist sand and the contents of the pails and jars dumped directly on the soil.

When the codling moth cage was examined on July 15th none of the fruitworms could be seen. Numerous ants were feeding on the berries and from general appearances it seemed this rearing project was through.

Much time was spent July 24th trying to locate fruitworms in the berries. The search was fruitless and the hibernation location could not be determined on this date either.

An afternoon was spent in a field where there was a fairly heavy infestation of fruitworm (August 26th) in an effort to locate the hibernating larvae. Soil was sifted about the base of twelve plants on the outside rows with a screened bottom box. Seventy eight newly formed cocoons were found and twenty six cocoon cases from previous years from which the moths had emerged. These cocoons are about the size and the shape of a navy bean. It is a very well made silken structure covered with sand granules which appear to be able to withstand rather moist conditions. They were usually found singly but in two instances two were found adheded together and in one case five were found adheded together. Most of the cocoons were located within ten inches of the plant base. Generally, the cocoons occurred at a two inch depth.

Examination of several cocoons revealed the larval form. Some of the larvae that were extracted from their cocoon were placed in a vial filled partially with sand. Two days later they had all formed a new cocoon similar to the original.

The cocoons collected August 26th were placed in jars containing two inches of sand and then covered with another inch of sand. Most of the literature cited (3, 5, 7, 27) seemed to indicate that moths flew in each year to infest the fields which would tend to explain the infestation only in the bordering rows.

It is believed that the initial infestation occurs in

Cocoons of the Cranberry Fruitworm,

Mineola vaccinii Riley

this manner and the spread then progresses to the inner parts of the field. Since most of the plantings are more recent and the spread of the fruitworm has been checked in a large measure by applications of rotenone the infestation only in the bordering rows of Michigan fields seems plausible. Areas surrounding most all the fields in Michigan have uncultivated blueberries, huckleberries, and related fruits which are hosts for this moth. In spite of all control measures, such areas will serve as a reservoir for the fruitworm for years to come unless such areas are destroyed.

A few days prior to departing from South Haven in 1946 a final check was made of the codling moth cage into which the many infested berries had been placed. Several typical fruitworm cocoons were found in the soil and a few on the surface. So this cage was returned to the college intact and placed in the insectary for the winter.

Three glass jars with fruitworm cocoons were also placed in the outside insectary for the winter. One jar containing twenty five cocoons was placed in the laboratory on September 2nd. The latter jar was moistened from time to time during the winter months.

On June 1, 1947 all the cocoons collected in 1946 were examined. In all cases the larvae had dried up. It seems likely that the cocoons must be kept rather moist at all times which would be the field condition during the winter and spring in blueberry fields.

In an effort to determine the stage of the fruitworm on June 11th soil was removed from the base of sixteen plants

and placed in six screened bottomed trays measuring 2.5 x 5 ft. The soil was very moist due to the many rains during the spring and sifting was impossible without some drying of the soil. By vigorous shaking the soil was sifted through on June 12th and the following obtained:

- 5 wireworm larvae
- 12 tipulid larvae
- 1 white grub
- 1 coleoptera larva
- 2 lepidoptera pupae
- 40 old fruitworm cocoons
- 12 fruitworm cocoons with dead larvae
- 1 fruitworm cocoon with a larva (larva appeared
sickly)
- 1 cocoon with a pupa

The cocoon containing the pupa was placed in a small vial with moist sand. From this cocoon a moth emerged June 17, 1947.

In the southern-most part of the state some fruitworm larvae were found on June 14, 1947. However, in the larger growing centers the fruitworm larvae became noticeable about June 30th. This was approximately two weeks later than during 1946.

NEUROPTERA

Chrysopa oculata Say

Stink-Flies or Aphis-Lion

A common predacious insect found on blueberry plants. The peculiar egg stalk can be found frequently on blueberry leaves. It is probable that this insect helps in checking the aphid population in blueberry plantings.

Micromus subanticus Walker

No common name

A neuroptera that feeds on aphids and was occasionally observed on the bushes.

Myrmeleon immaculatus DeGeer

Ant-Lion

Some of these insects are found in blueberry fields due, most likely, to the numerous ants at times. The sand and muck are light and good pitfalls are readily constructed by the larvae which are predacious on ants.

ODONATA

The adults of odonata being predacious in habit are frequently seen in the blueberry field looking for prey. There is an abundance of small diptera and other insects in the field that attract these visitors. Fields that are near lakes or ponds usually always have many species of odonata cruising up and down the rows.

ORTHOPTERA

Most of the observations on this order of insects were made in two fields where cultivation was somewhat neglected. Quack grass, other grasses, blackberry, brake fern, meadow sweet, sedges, etc. encouraged the presence of Orthoptera, especially grasshoppers. July 15, 1946 a number of immature grasshoppers were feeding on the foliage and ripened berries. Holes were eaten out of the edges of the leaves, giving them a very ragged appearance. Small areas in the top or calyx end of the berries are eaten out of the grasshoppers. Such conditions of the berries attracts other insects as diptera and hymenoptera to feed on the pulp that is exposed. The borders of the fields which are composed of grasses and weeds are heavily populated with grasshopper nymphs. Adjacent grain fields were also infested with large numbers of nymphs. Berries that have been attacked by grasshoppers, no matter how slight, are unfit for picking. July 23, 1946 the fields were dusted with a 2.5 percent rotenone dust that was a year old. This dusting did not seem to affect the grasshoppers population but they fed very little for the next few days. The number of other insects in the field was reduced. July 27, 1946 a few nymphs of katydid were found on the blueberry bushes and several nymphs of Melanoplus differentialis Thomas. July 27, 1946 a dusting with fresh 2.5 percent rotenone dust was applied to the field for the control of the blueberry maggot. Following this dusting the grasshopper numbers dwindled slightly.

However, after this application no feeding by the nymphs or adults could be detected.

Camnula bellucida Scudder

Clear-winged Grasshopper

This is a northern grasshopper that is locally abundant in some states. They resemble *Melanoplus* and were usually taken with them in collecting.

Chorthippus curtipennis Harris

No common name

Matures about the first week in August and was one of the more common grasshoppers found in this area.

Dissosteira carolina Linn.

Carolina Grasshopper

Present in most blueberry fields but never found in numbers.

Melanoplus bivittatus Say

Two-striped Grasshopper

One of the common early locust appearing in this area.

Melanoplus differentialis Thomas

Differential Grasshopper

Matures in the latter part of the summer and is found in company with *M. femur-rubrum* DeGeer. Apparently the last of the grasshoppers to mature in this area. Nymphs were still present in numbers on August 30, 1946.

Melanoplus femur-rubrum DeGeer

Red-legged Grasshopper

This species is the most numerous of the Orthoptera in blueberry fields and is responsible for most of the damage

done by this group. It is usually found in a variety of different conditions and is particularly fond of crops of cultivated fields.

Oecanthus nigricornus quadripunctatus Beutenmuller

Four Spotted Tree Cricket

Occasionally found on the blueberry but is much more numerous along the borders of the field on the tall grasses and weeds. Any damage to the blueberry is doubtful.

Orchelimum concinnum campestre Blatchley - Meadow Grasshopper

The most common long-horned grasshopper in this area. It was taken on blueberry but its damage to this plant is doubtful.

Control of Grasshoppers in Blueberries

Sufficient cultivation will eliminate grasshoppers from the blueberry field. Should they be numerous along the borders of the field, control could be effected by using poisoned bran bait. The latter is cheap, easily applied, and effective. As already discussed the dusting program of rotenone will also serve to control the grasshoppers to some extent.

INSECT FAUNAL SURVEY

COLEOPTERA

- Family Euprestidae Agrius politus Say
1 specimen July 8, 1946.
- Family Euprestidae Agrius ruficollis Fab.
1 specimen June 24, 1946.
- Family Cantharidae Chauliognathus marginatus Fabr.
1 specimen August 26, 1946.
- Family Carabidae Agonoderus ballines Fab.
21 specimens July 15 - August 12, 1946.
Night collecting.
- Family Carabidae Calosoma scrutator Fab.
1 specimen June 17, 1946.
- Family Eurytomidae Lebia tricolor Say
1 specimen August 12, 1946.
- Family Carabidae Lebia viridis Say
1 specimen July 15, 1946.
- Family Cerambycidae Oberon nigrum Hald.
Larvae and their work identified in the
field in June and July, 1946.
- Family Chrysomelidae Anemopa laticlavata Forst.
1 specimen July 1, 1946.
- Family Chrysomelidae Callignatha similis Rogers
2 specimens August 12, 1946.
- Family Chrysomelidae Chrysochus auratus Fab.
1 specimen July 8, 1946.

Family Chrysomelidae Cryptocephalus venustus Fabr.

7 specimens July 8 - August 10, 1946.

Family Chrysomelidae Cryptocephalus venustus cinetibennis Rand.

1 specimen August 10, 1946.

Family Chrysomelidae Diabrotica 12-punctata Fab.

88 specimens June 10 - August 12, 1946.

Family Chrysomelidae Bisonycha pennsylvanica Illig.

1 specimen July 8, 1946.

Family Chrysomelidae Maltica ignita Hag.

3 specimens June 10 - August 10, 1946.

Family Chrysomelidae Labidomera clivicollis Kirby

1 specimen June 10, 1946.

Family Chrysomelidae Paria sp. resembling gellatus Horn

175 specimens July 3 - July 7, 1946.

Family Chrysomelidae Phyllobrotica limbata Fab.

1 specimen July 3, 1946.

Family Chrysomelidae Systema frontalis Fabr.

51 specimens July 3 - August 10, 1946.

Family Chrysomelidae Systema marginata Hag.

1 specimen August 20, 1946.

Family Chrysomelidae Trirhabda canadensis Kirby

3 specimens July 8, 1946.

Family Chrysomelidae Euphorus conellus pusillus Lec.

3 specimens July 15 - August 22, 1946.

Family Coccinellidae Adalia bipunctata Linn.

1 specimen June 10, 1946.

Family Coccinellidae Inatis 15-punctata Oliv.

1 specimen June 10, 1946.

- Family Coccinellidae Chilocorus bivulnerus Muls.
6 specimens July 8 - July 15, 1946.
- Family Coccinellidae Coccinella 2-notata Herst.
9 specimens July 1 - August 5, 1946.
- Family Coccinellidae Coccinella sanguinea Linn.
4 specimens June 10 - June 17, 1946.
- Family Coccinellidae Coccinella trifasciata Linn.
1 specimen June 17, 1946.
- Family Coccinellidae Hippodamia convergens Guer.
8 specimens June 17 - August 5, 1946.
- Family Coccinellidae Hippodamia variegata Say
1 specimen July 8, 1946.
- Family Coccinellidae Hippodamia 15-punctata Linn.
8 specimens July 15 - August 19, 1946.
- Family Coccinellidae Hyperaspis signata binotata Say
2 specimens June 10, 1946.
- Family Coccinellidae Macilla maculata DeGeer
5 specimens June 10 - August 19, 1946.
- Family Curculionidae Acanthoscelis curtus Say
2 specimens August 19, 1946.
- Family Curculionidae Brachyrhinus ovatus Linn.
4 specimens July 29 - August 19, 1946.
3 specimens June 10, 1947.
- Family Curculionidae Brachyrhinus rugifrons Gyll.
1 specimen August 19, 1946.
In the soil near the roots.
- Family Curculionidae Conotrachelus nenuphar Hbst.
3 specimens August 11, 1946.

- Family Curculionidae Hypera punctata Fab.
4 specimens July 1 - July 22, 1946.
- Family Curculionidae Sitona flavescens Marshm.
1 specimen July 15, 1946.
- Family Dytiscidae Metus bicarinatus Say
1 specimen July 15, 1946.
- Family Elateridae Cariphorus cinctus Erichs
5 specimens June 10 - July 8, 1946.
- Family Elateridae Otenicera pyrrhos Herbst.
1 specimen July 15, 1946.
- Family Elateridae Melonotus fissilis Say
1 specimen July 15, 1946.
- Family Erotylidae Tritoma unicolor Say
1 specimen July 1, 1946.
- Family Hydrophilidae Ceremon ocellatus Say
1 specimen July 15, 1946. Night collecting.
- Family Lampyridae Photinus pyralis Linn.
2 specimens July 3 - July 15, 1946.
- Family Lampyridae Photuris pennsylvanica DeGeer
1 specimen June 24, 1946.
- Family Lampyridae Podabrus tomentosus Say
24 specimens June 10 - July 29, 1946.
- Family Lampyridae Telephorus carolinus Fabr.
6 specimens June 17 - July 1, 1946.
- Family Lampyridae Telephorus scitulus Say
4 specimens July 15, 1946.
- Family Lycidae Calostemon reticulatum Fab.
1 specimen July 8, 1946.

- Family Meloidae Epicauta pennsylvanica DeGeer
6 specimens August 5 - August 19, 1946.
- Family Meloidae Epicauta vittata Fab.
2 specimens August 12 - August 19, 1946.
- Family Meloidae Macrobasis unicolor Kirby
1 specimen July 15, 1946.
- Family Melyridae Collops quadrimaculatis Fab.
4 specimens June 17 - August 12, 1946.
- Family Mordellidae Mordella octopunctata Fab.
1 specimen August 5, 1946.
- Family Mordellidae Mordella scutellaris Fab.
8 specimens July 22 - July 29, 1946.
- Family Scarabaeidae Anomala lucicola Fab.
5 specimens July 3 - July 15, 1946.
- Family Scarabaeidae Diplotaxis sordida Say
1 specimen July 15, 1946. Night collecting.
- Family Scarabaeidae Diplotaxis truncatula Lec.
2 specimens July 3, 1946.
- Family Scarabaeidae Hoplia trifasciata Say
1 specimen June 10, 1946.
- Family Scarabaeidae Macroductylus subspinosus Fab.
10 specimens June 10 - July 1, 1946.
- Family Scarabaeidae Phyllophaga crenulata Frohl.
2 specimens July 15, 1946. Night collecting.
- Family Scarabaeidae Phyllophaga nitida Lec.
1 specimen July 15, 1946. Night collecting.
- Family Scarabaeidae Phyllophaga rugosa Melsh.
1 specimen July 8, 1946. Night collecting.

Family Scarabaeidae Cerica vespertina Gyll.

2 specimens July 15, 1946.

Family Staphylinidae Philonthus serpentinus Horn

1 specimen July 15, 1946.

DIPTERA

- Family Agromyzidae Calycomyza artemisiae Kalf.
5 specimens August 19, 1946.
- Family Agromyzidae Cerodontha dorsalis Lw.
2 specimens August 19, 1946.
- Family Agromyzidae Liriomyza sp. var. of pusilla Meigen.
1 specimen August 19, 1946.
- Family Anthomyiidae Coenosia (Hoblogaster) nigritarsis Stein
1 specimen June 10, 1946.
- Family Anthomyiidae Coenosia (Limosia) triseta Stein
1 specimen June 10, 1946.
- Family Anthomyiidae Coenosia (Limosia) sp.
9 specimens July 22 - August 19, 1946.
- Family Anthomyiidae Helina (Spilaria) lucorum Fallen
1 specimen July 22, 1946.
- Family Anthomyiidae Hylemya cilicruva Aond.
25 specimens June 10 - August 19, 1946.
- Family Anthomyiidae Hylemya trivittata Stein
1 specimen August 12, 1946.
- Family Anthomyiidae Hylemya sp.
5 specimens July 8 - August 19, 1946.
- Family Anthomyiidae Lispa sp.
1 specimen August 19, 1946.
- Family Anthomyiidae Lispocephala erythrocera (R-D)
1 specimen August 19, 1946.
- Family Anthomyiidae Ophyra leucostoma Wd.
3 specimens June 17 - July 8, 1946.

- Family Anthomyiidae Pegomya bicolor Wied.
1 specimen July 15, 1946.
- Family Anthomyiidae Schoenomyza dorsalis Lw.
1 specimen August 19, 1946.
- Family Asilidae Asilus notatus Wied.
2 specimens June 17 - June 24, 1946.
- Family Asilidae Atomosia puella Wied.
1 specimen July 22, 1946.
- Family Asilidae Hopologon guttula Wd.
2 specimens July 15 - July 22, 1946.
- Family Asilidae Neoitanus sp.
1 specimen August 5, 1946.
- Family Asilidae Omunatius tibialis Say
1 specimen July 8, 1946.
- Family Asilidae Proctacanthus brevipennis Wd.
1 specimen August 19, 1946.
- Family Dibionidae Bibio townsi Hardy
2 specimens July 29 - August 12, 1946.
- Family Bombyliidae Anthrax albofasciatus Macq.
1 specimen June 24, 1946.
- Family Bombyliidae Phthiria sulphurea Lw.
2 specimens August 12 - August 17, 1946.
- Family Bombyliidae Villa "alternata group"
1 specimen August 12, 1946.
- Family Bombyliidae Villa lateralis Say
6 specimens June 10 - August 5, 1946.
- Family Bombyliidae Villa sinuosa Wd.
1 specimen June 17, 1946.

- Family Borboridae Leptocera sp.
5 specimens July 15 - August 19, 1946.
- Family Calliphoridae Defolucilia silvarum MG.
1 specimen June 10, 1946.
- Family Calliphoridae Calliphora erythrocephala MG.
1 specimen July 8, 1946.
- Family Calliphoridae Rhaconia sordida MG.
3 specimens June 10 - August 19, 1946.
- Family Calliphoridae Thormia regina MG.
10 specimens June 10 - July 22, 1946.
- Family Ceratopogonidae Jenkinshelca albaria Coq.
1 specimen July 22, 1946.
- Family Chironomidae Harnischia sp.
3 specimens July 15 - August 12, 1946.
- Family Chironomidae Procladius bellus Lw.
1 specimen July 15, 1946.
- Family Chironomidae Procladius chorcus MG.
1 specimen July 15, 1946.
- Family Chironomidae Stenotoma sp.
5 specimens June 10 - August 12, 1946.
- Family Chironomidae Tendipedini
14 specimens June 10 - August 12, 1946.
- Family Chironomidae Tendipes sp.
31 specimens June 10 - August 12, 1946.
- Family Chloropidae Chlorops certina Adams
1 specimen August 12, 1946.
- Family Chloropidae Eriolus sudeticus Beck.
2 specimens August 19, 1946.

- Family Chloropidae Hippelates particeps Beek.
2 specimens August 19, 1946.
- Family Chloropidae Madiza glabra Follen
3 specimens August 18 - August 19, 1946.
- Family Chloropidae Madiza nigrinalbis Mall.
2 specimens June 17 - August 19, 1946.
- Family Chloropidae Oscinella carbonaria Lw.
12 specimens August 19, 1946.
- Family Chloropidae Oscinella coxendix Fitch
2 specimens August 19, 1946.
- Family Chloropidae Oscinella frit Linn.
6 specimens August 19, 1946.
- Family Chloropidae Thaumatomyia bistriata Wlk.
1 specimen July 15, 1946.
- Family Chloropidae Thaumatomyia glabra Meigen
31 specimens July 1 - August 19, 1946.
- Family Chloropidae Thaumatomyia grata Lw.
1 specimen June 10, 1946.
- Family Cordyluridae Achaetella varipes Walker
1 specimen August 5, 1946.
- Family Culicidae Aedes condensis Theob.
1 specimen June 17, 1946.
- Family Culicidae Aedes vexans MG.
7 specimens July 15, 1946. Night collecting.
- Family Culicidae Chaoborus punctipennis Say
1 specimen July 15, 1946.
- Family Culicidae Mansonia perturbans Walker
1 specimen July 15, 1946. Night collecting.

- Family Dexidae Dinera sp.
5 specimens July 22 - August 12, 1946.
- Family Colichopodidae Condylostylus calcaratus Loew.
6 specimens June 17 - July 8, 1946.
- Family Dolichopodidae Condylostylus caudatus Vied.
1 specimen August 19, 1946.
- Family Dolichopodidae Condylostylus flavipes Ald.
12 specimens June 17 - August 19, 1946.
- Family Dolichopodidae Condylostylus (near forcipatus) Ald.
1 specimen July 15, 1946.
- Family Colichopodidae Condylostylus natibulatus Say
4 specimens July 15 - July 22, 1946.
- Family Colichopodidae Dolichopus albicoxa Ald.
2 specimens June 17 - August 19, 1946.
- Family Dolichopodidae Dolichopus bifractus Loew.
1 specimen August 15, 1946.
- Family Dolichopodidae Dolichopus conatus Loew.
1 specimen August 19, 1946.
- Family Colichopodidae Dolichopus ramifer Loew.
4 specimens August 19, 1946.
- Family Dolichopodidae Dolichopus sp.
2 specimens July 22 - August 19, 1946.
- Family Dolichopodidae Gnomontermus sp.
1 specimen June 10, 1946.
- Family Dolichopodidae Gnomontermus 4 spp.
10 specimens June 10 - August 19, 1946.
- Family Dolichopodidae Mesorrhaga sp.
1 specimen July 15, 1946.

- Family Dolichopodidae Nothostanytus sp.
1 specimen July 15, 1946.
- Family Dolichopodidae Belastoneurus vagans Loew.
1 specimen June 24, 1946.
- Family Drosophilidae Cartonotum helvum Lw.
1 specimen August 5, 1946.
- Family Ephydriidae Scutella scutellaris Fallen
1 specimen July 8, 1946.
- Family Ephydriidae Cyrtosilopa alba Lw.
1 specimen August 19, 1946.
- Family Empididae Drapetis sp.
5 specimens July 15 - July 21, 1946.
- Family Empididae Platypalpus aequalis Loew
1 specimen July 23, 1946.
- Family Empididae Rhynchomyia candicans Loew.
1 specimen June 17, 1946.
- Family Empididae Gyndras voluta Loew.
1 specimen July 15, 1946.
- Family Empididae Syneches anthus Walker
1 specimen July 15, 1946.
- Family Empididae Syneches thoracicus Say
9 specimens July 15 - July 22, 1946.
- Family Megaproscopidae Microanthus disjuncta Wd.
1 specimen July 8, 1946.
- Family Muscidae Eurellia cyanicolor Zett.
2 specimens July 8 - July 29, 1946.
- Family Muscidae Stomoxys calcitrans Linn.
4 specimens June 17 - July 22, 1946.

- Family Ctenophoridae Chamaecyba herbarum R. D.
1 specimen August 19, 1946.
- Family Ortalidae Chrysomya demissa Fab.
1 specimen August 5, 1946.
- Family Ortalidae Tetanops luridicornis Lw.
2 specimens July 1, 1946.
- Family Tasiidae Gymnocyrtus immaculatus MacG. (Cistogaster)
1 specimen July 29, 1946.
- Family Sarcophagidae Camptoproctosella sp.
1 specimen July 22, 1946.
- Family Sarcophagidae Homoneura philadelphia MG.
1 specimen July 22, 1946.
- Family Sarcophagidae Minettia lupulina F.
9 specimens July 22 - August 19, 1946.
- Family Sarcophagidae Metopia campestris Fallen
1 specimen July 15, 1946.
- Family Sarcophagidae Metopia leucocephala Rossi
4 specimens July 29 - August 19, 1946.
- Family Sarcophagidae Sarcophaga bullata Fk.
1 specimen June 10, 1946.
- Family Sarcophagidae Sarcophaga herminiere Desv.
2 specimens August 12 - August 19, 1946.
- Family Sarcophagidae Sarcophaga laticincta Fk.
1 specimen August 19, 1946.
- Family Sarcophagidae Sarcophaga busckii V. d.
9 specimens July 8 - August 19, 1946.
- Family Sarcophagidae Sarcophaga rapax Walker
1 specimen July 15, 1946.

- Family Sarcophagidae Sarcophaga reversa Ald.
3 specimens June 10 - July 29, 1946.
- Family Sarcophagidae Sarcophaga rudis Ald.
1 specimen June 10, 1946.
- Family Sarcophagidae Sarcophaga ventricosa V. d.
1 specimen July 22, 1946.
- Family Sarcophagidae Sarcophaga sp. (females)
21 specimens June 10 - August 19, 1946.
- Family Sarcophagidae Senotainia rubriventris Macq.
1 specimen July 29, 1946.
- Family Sarcophagidae Senotainia trilineata V. d. W.
22 specimens June 24 - July 29, 1946.
- Family Sciariidae Sciara sp. (female)
6 specimens June 10 - August 19, 1946.
- Family Sciomyzidae Limnia sarotogensis Fitch
1 specimen August 5, 1946.
- Family Sepsidae Saltella stagnalis Fallen
2 specimens July 15, 1946.
- Family Sepsidae Sepsis sp.
2 specimens July 29 - August 19, 1946.
- Family Stratiomyidae Euparyphus tetrapilus Lw.
1 specimen July 15, 1946.
- Family Stratiomyidae Geosargus curvatus Linn.
1 specimen June 24, 1946.
- Family Stratiomyidae Hemotelus sp.
1 specimen June 17, 1946.
- Family Stratiomyidae Odontomyia interrupta Oliv.
1 specimen June 10, 1946.

- Family Stratiomyidae Odontomyia virgo Wied.
1 specimen June 24, 1946.
- Family Stratiomyidae Oxycera picta V. d. W.
4 specimens June 24 - July 15, 1946.
- Family Stratiomyidae Stratiomys norma Wied.
1 specimen June 17, 1946.
- Family Syrphidae Cartosyrphus tristis Lw.
1 specimen July 29, 1946.
- Family Syrphidae Eristalis dimidiatus Wd.
1 specimen June 17, 1946.
- Family Syrphidae Eristalis tenax Linn.
4 specimens June 17 - August 19, 1946.
- Family Syrphidae Melanostoma obscurum Say
1 specimen June 24, 1946.
- Family Syrphidae Mesogramma marginata Say
1 specimen August 19, 1946.
- Family Syrphidae Mesogramma polita Say
1 specimen August 19, 1946.
- Family Syrphidae Metasyrphus latifasciatus MacQ.
1 specimen June 17, 1946.
- Family Syrphidae Metasyrphus wiedemanni Johns.
4 specimens June 10 - July 8, 1946.
- Family Syrphidae Pipizella pulchella Will.
3 specimens June 10 - August 5, 1946.
- Family Syrphidae Platycyberus erraticus Curr.
4 specimens June 17 - July 8, 1946.
- Family Syrphidae Platycyberus quadratus Say
1 specimen July 22, 1946.

- Family Syrphidae Sphaerophoria cylindrica Say
4 specimens June 10 - August 19, 1946.
- Family Syrphidae Sphaerophoria robusta Curr.
1 specimen June 17, 1946.
- Family Syrphidae Euritta ribens Linn.
2 specimens July 29 - August 19, 1946.
- Family Syrphidae Syrphus knabi Chan.
1 specimen July 22, 1946.
- Family Syrphidae Syrphus ribesi vittatrons Chan.
1 specimen June 22, 1946.
- Family Syrphidae Toxomerus geminatus Say
1 specimen June 17, 1946.
- Family Syrphidae Tropidea quadrata Say
1 specimen August 19, 1946.
- Family Tabanidae Chrysops montana O. S.
1 specimen July 8, 1946.
- Family Tabanidae Chrysops univittata MacQ.
1 specimen July 8, 1946.
- Family Tabanidae Chrysops vittata Wd.
2 specimens July 8 - July 15, 1946.
- Family Tabanidae Chrysops wiedenmanni Krb.
1 specimen July 15, 1946.
- Family Tabanidae Tabanus 5-vittatus Wd.
2 specimens July 29, 1946.
- Family Tabanidae Tabanus hinei Johnson
1 specimen June 17, 1946.
- Family Tabanidae Tabanus lasiophthalmus MacQ.
10 specimens June 17, 1946.

- Family Tabanidae Tabanus nivosus O. S.
1 specimen August 19, 1946.
- Family Tabanidae Tabanus sparus Whitn.
1 specimen July 1, 1946.
- Family Tachinidae Achaetoneura sp.
2 specimens June 10 - June 17, 1946.
- Family Tachinidae Acroglossa hesperidarum Will.
1 specimen August 19, 1946.
- Family Tachinidae Amodoria luctuosa Mg.
1 specimen June 17, 1946.
- Family Tachinidae Almya theclorum (?)
2 specimens July 29 - August 19, 1946.
- Family Tachinidae Belvosia borealis Ald.
1 specimen July 29, 1946.
- Family Tachinidae Belvosia unifasciata Desv.
1 specimen July 29, 1946.
- Family Tachinidae Cylindronyia doscoides Walk.
2 specimens July 29, 1946.
- Family Tachinidae Frontiniella paracilla Tns.
2 specimens June 24 - July 15, 1946.
- Family Tachinidae Guerinia simulans Mg.
4 specimens July 22 - August 5, 1946.
- Family Tachinidae Leucostoma atra Tns.
2 specimens August 5 - August 19, 1946.
- Family Tachinidae Lixophaga variabilis Coq.
1 specimen July 22, 1946.
- Family Tachinidae Lydella obconica Walker
Masicera eufitchiae Coq. and authors
1 specimen August 26, 1946.

- Family Tachinidae Lydina creos Walk.
5 specimens August 5 - August 19, 1946.
- Family Tachinidae Memoriella Florilis Fallen
1 specimen July 15, 1946.
- Family Tachinidae Meleteria apicalis Walker
1 specimen August 29, 1946.
- Family Tachinidae Pseudochaeta canadensis Brooks
1 specimen July 15, 1946.
- Family Tachinidae Voria ruralis MG.
1 specimen July 8, 1946.
- Family Tachinidae Wagneria sequax Will.
1 specimen June 10, 1946.
- Family Tachinidae Winthenia sp.
1 specimen (female) July 29, 1946.
- Family Tachinidae Xanthomelana atripennis Tns.
2 specimens July 29, 1946.
- Family Therevidae Epomyia pictipennis Wied.
2 specimens June 17 - July 22, 1946.
- Family Therevidae Epomyia rufiventris Lw.
1 specimen July 8, 1946.
- Family Therevidae Psilocephala frontalis Cole
5 specimens July 8 - July 22, 1946.
- Family Therevidae Psilocephala haemorrhoidalis Macq.
7 specimens June 17 - August 18, 1946.
- Family Tipulidae Gonomyia sp.
1 specimen July 15, 1946.
- Family Tipulidae Limnophila sp.
2 specimens June 10, 1946.

- Family Tipulidae Eales clandestina (Dtz.?)
1 specimen June 10, 1946.
- Family Tipulidae Eales ferrugineus F.
5 specimens June 10, 1946.
- Family Tipulidae Eales virescens Lw.
1 specimen July 15, 1946.
- Family Tipulidae Tipula georgiana Alex.
1 specimen June 10, 1946.
- Family Tipulidae Tipula sp.
1 specimen July 8, 1946.
- Family Trypetidae Duaresta bella Lw.
25 specimens July 15 - August 19, 1946.
- Family Trypetidae Rhagoletis pomonella Walsh.
29 specimens July 8 - August 26, 1946.
- Family Trypetidae Teterica seriata Lw.
2 specimens July 22 - August 5, 1946.

HEMIPTERA

- Family Anthocoridae Orius insidiosus Say
9 specimens August 12, 1946.
- Family Corinelaenidae Corinelaena pulicaria Germar.
2 specimens July 15 - July 19, 1946.
- Family Coriscidae Coriscus conspersus Montandon
1 specimen August 5, 1946.
- Family Coriscidae Erotenor belfragei Haglund
1 specimen July 29, 1946.
- Family Corizidae Corizus lateralis Say
11 specimens July 15 - August 12, 1946.
- Family Lygaeidae Cymus angustatus Stal.
2 specimens June 24 - July 8, 1946.
- Family Lygaeidae Horaeus plebejus Stal.
6 specimens July 15 - August 26, 1946.
- Family Lygaeidae Lygaeus kalmii Stal.
20 specimens June 10 - July 15, 1946.
- Family Lygaeidae Nysius ericae Schill.
22 specimens July 8 - August 17, 1946.
- Family Miridae Adelphocoris lineolatus Goetze
4 specimens June 10 - August 5, 1946.
- Family Miridae Adelphocoris rapidus Say
11 specimens June 17 - August 26, 1946.
- Family Miridae Chlamydatus associatus Uhler
2 specimens July 15 - August 26, 1946.
- Family Miridae Lopidea media Say
1 specimen July 15, 1946.

- Family Miridae Lixus brachialis Linn.
51 specimens June 17 - August 19, 1946.
- Family Miridae Plagiognathus politus Uhler
4 specimens June 17 - August 26, 1946.
- Family Miridae Plagiognathus politus flaveolus Knight
1 specimen August 26, 1946.
- Family Miridae Poecilocapsus lineatus Fabricius
4 specimens July 2 - July 8, 1947.
- Family Miridae Stenodema vicinior Prov.
6 specimens July 29 - August 29, 1946.
- Family Miridae Habis ferus Linn.
7 specimens July 15 - August 19, 1946.
- Family Heilidae Heides muticus Say
1 specimen July 22, 1946.
- Family Notonectidae Notonecta undulata Say
1 specimen July 8, 1946.
- Family Pentatomidae Banasa dimidata Say
2 specimens July 29, 1946.
- Family Pentatomidae Cosmopepla binnebulata Thon.
1 specimen July 29, 1946.
- Family Pentatomidae Euschistus euschistoides Vollenhoven
1 specimen August 26, 1946.
- Family Pentatomidae Euschistus tristignus luridus Say
1 specimen August 5, 1946.
- Family Pentatomidae Euschistus variolarius F. & B.
5 specimens July 22 - August 19, 1946.
- Family Pentatomidae Mormidea lugens Fabricius
1 specimen August 5, 1946.

| | |
|----------------------|--|
| Family Pentastomidae | <u>Medius maculiventris</u> Gay |
| | 5 specimens July 10 - August 26, 1946. |
| Family Pentastomidae | <u>Thyanta eustator</u> Fabricius |
| | 1 specimen August 19, 1946. |
| Family Reduviidae | <u>Sinea didona</u> Fabricius |
| | 1 specimen August 19, 1946. |

- Family Pentatomidae Podiscus maculiventris Say
3 specimens June 10 - August 26, 1946.
- Family Pentatomidae Thyanta custator Fabricius
1 specimen August 12, 1946.
- Family Reduviidae Binus discolor Fabricius
1 specimen August 12, 1946.

HOLOPTERA

- Family Cercopidae Clastoptera proteus Fitch
57 specimens July 15 - July 24, 1946.
- Family Cercopidae Philaenus leucophthalmus var. marginellus Fab.
14 specimens June 17 - August 19, 1946.
- Family Cercopidae Philaenus leucophthalmus var. squamaris Fall.
65 specimens June 10 - August 12, 1946.
- Family Cercopidae Philaenus leucophthalmus var. pallidus Zett.
56 specimens July 1 - August 5, 1946.
- Family Chermidae Tachysylla sp.
8 specimens July 15, 1946.
- Family Chermidae Triona sp.
5 specimens August 19, 1946.
- Family Cicadellidae Agallia sanguinalenta Prov.
5 specimens July 15, 1946.
- Family Cicadellidae Chorotettix unicolor Fitch
2 specimens July 15 - August 12, 1946.
- Family Cicadellidae Cicadula semnotata Fall.
45 specimens July 15 - August 12, 1946.
- Family Cicadellidae Doltocephalus inimicus Say
9 specimens July 15 - July 22, 1946.
- Family Cicadellidae Doltocephalus sayi Fitch
5 specimens July 15 - August 19, 1946.
- Family Cicadellidae Draculacephala noveboracensis Fh.
8 specimens July 15 - August 8, 1946.
- Family Cicadellidae Empoasca fabae Herr.
51 specimens July 15 - August 12, 1946.

- Family Cicadellidae Trioxys pulicaria Walsh.
12 specimens July 15 - August 12, 1946.
- Family Cicadellidae Graminella nigrifrons Forbes
1 specimen August 12, 1946.
- Family Cicadellidae Graphocorhala coccinea Forest.
1 specimen July 15, 1946.
- Family Cicadellidae Gypona octolineata Say
1 specimen August 15, 1946.
- Family Cicadellidae Phloxius sp.
5 specimens July 15, 1946.
- Family Cicadellidae Thermotettix sp.
1 specimen July 15, 1946.
- Family Coccidae Locanium corni Bouché
Specimens identified in the field.
- Family Fulgoridae Oliarus sp.
3 specimens July 15, 1946.
- Family Fulgoridae Ormenis ruinosa Say
1 specimen July 22, 1946.
- Family Fulgoridae Scolops sulcipes Say
1 specimen August 5, 1946.
- Family Membracidae Ceresa bubalus Fabr.
2 specimens August 19, 1946.
- Family Membracidae Enchenopa binotata Forst.
1 specimen August 5, 1946.

HYMENOPTERA

- Family Andrenidae Agapostemon radiatus Say
3 specimens June 10 - August 29, 1946.
- Family Andrenidae Halictus rubicundus Christ.
2 specimens July 1 - August 19, 1946.
- Family Apidae Apis mellifica Linn.
3 specimens June 10 - August 5, 1946.
Present throughout the spring and summer.
- Family Bombidae. Bremus bimaculatus Cresson
5 specimens June 10 - June 17, 1946.
- Family Bombidae Bremus impatiens Harris
9 specimens June 10 - August 19, 1946.
- Family Bombidae Bremus pennsylvanica DeGeer
1 specimen June 10, 1946.
- Family Bombidae Bremus vagans consimilis Cresson
7 specimens June 10 - August 19, 1946.
- Family Braconidae Apanteles ornigis Need
2 specimens July 25 - August 1, 1946.
- Family Braconidae Meteorus communis Cress.
1 specimen June 21, 1946.
- Family Braconidae Meteorus hyphantriae Riley
22 specimens July 1 - August 26, 1946.
- Family Braconidae Oncophanes atriceps Ashm.
10 specimens June 19 - July 2, 1946.
- Family Chalcididae Hemadas nubilipennis Ashm.
Galls collected in the field 1946 - 1947.

- Family Chalcididae Leucospis affinis Say
1 specimen July 29, 1946.
- Family Chrysididae Holopyga ventralis Say
12 specimens July 1 - August 5, 1946.
- Family Encyrtidae Oencyrtus johnsoni How.
1 specimen July 30, 1946.
- Family Eulophidae Sympiesis bimaculatipennis Gir.
1 specimen July 1, 1946.
- Family Gasteruptidae Gasteruption incertum Cross.
1 specimen August 12, 1946.
- Family Hylacidae Colletes sp.
1 specimen August 19, 1946.
- Family Ichneumonidae Amblyteles detritus Brulle
1 specimen July 29, 1946.
- Family Ichneumonidae Amblyteles stadaconensis Prov.
1 specimen July 22, 1946.
- Family Ichneumonidae Campoplex validus Cr.
1 specimen August 23, 1946.
- Family Ichneumonidae Cryptus albitarsis albitarsis Cr.
1 specimen August 23, 1946.
- Family Ichneumonidae Exochus sp. near pleuralis Cr.
1 specimen August 1, 1946.
- Family Ichneumonidae Ophion bilineatus Say
2 specimens July 15 - August 12, 1946.
- Family Pompilidae Pompilus sp.
2 specimens July 29, 1946.
- Family Scelionidae Telenomus sp.
14 specimens July 30, 1946.

- Family Scelionidae Trissoleus sp.
4 specimens July 30, 1946.
- Family Sphecidae Bombus spinolae Say
1 specimen August 19, 1946.
- Family Sphecidae Cerceris nigrescens Sm.
1 specimen August 5, 1946.
- Family Sphecidae Chlorion cyaneum Gahlbom
1 specimen July 29, 1946.
- Family Sphecidae Chlorion inchneumonae Linn.
2 specimens August 19, 1946.
- Family Sphecidae Crabo latipes Smith
1 specimen July 29, 1946.
- Family Sphecidae Crabo monticola Packard
6 specimens July 29 - August 5, 1946.
- Family Sphecidae Crabo sp.
6 specimens June 17 - July 29, 1946.
- Family Sphecidae Gorytes nigrifrons Smith
1 specimen July 29, 1946.
- Family Sphecidae Larrousis distincta Smith
2 specimens July 8 - July 29, 1946.
- Family Sphecidae Lyroda triloba Say
1 specimen August 19, 1946.
- Family Sphecidae Philanthus bilunatus Cress.
1 specimen August 12, 1946.
- Family Sphecidae Philanthus dubius Cress.
2 specimens August 5, 1946.
- Family Sphecidae Philanthus punctatus Say
1 specimen July 15, 1946.

- Family Sphecidae Philanthus solivarus Say
2 specimens August 19, 1946.
- Family Sphecidae Sphex abbreviata Fabr.
1 specimen August 19, 1946.
- Family Sphecidae Sphex luctuosa Smith
2 specimens July 8 - July 29, 1946.
- Family Sphecidae Sphex procera Klug
1 specimen August 5, 1946.
- Family Tenthredinidae Ametastegia tenor Fall.
2 specimens July 15 - July 22, 1946.
- Family Tenthredinidae Caliroa sp.
1 specimen
- Family Tenthredinidae Imbria sp.
1 specimen
- Family Tenthredinidae Priophorus sp.
1 specimen
- Family Tenthredinidae Sofus zabrieski W. and H.
10 specimens July 29 - August 29, 1946.
- Family Tenthredinidae Taxonus terminalis Say
1 specimen July 22, 1946.
- Family Tiphidae Myzine 5-cincta Fabr.
2 specimens July 29 - August 19, 1946.
- Family Tiphidae Tiphia punctata Robertson
2 specimens July 1 - July 29, 1946.
- Family Vespidae Monobia quadridens Linn.
1 specimen July 29, 1946.
- Family Vespidae Polistes fuscatus variatus Cress.
9 specimens June 10 - August 19, 1946.

LEPIDOPTERA

- Family Negeriidae Simanthedon sp.
1 specimen August 5, 1946.
- Family Arctiidae Arcyia nivalis Cru.
1 specimen July 15, 1946.
- Family Arctiidae Euphantria cunea Dru.
Several colonies seen and collected (larvae)
- Family Arctiidae Euphantria textor Harris
1 specimen July 8, 1946.
- Family Geometridae Euchlaena johnsonaria Fitch
1 specimen August 5, 1946 night collecting.
- Family Geometridae Neustocampa limbata How.
2 specimens August 8, 1946.
- Family Geometridae Synchlora aerata Fab.
1 specimen August 5, 1946 night collecting.
- Family Gracilariidae Gracilaria vacciniella Ely
6 specimens August 5 - August 30, 1946.
- Family Hesperidae Pholisora catullus Fab.
1 specimen August 5, 1946.
- Family Liparidae Hemerocampa leucostigma Abbot and Smith
6 specimens July 6 - July 14, 1946.
- Family Lycaenidae Chrysorhanus hypophlaeus Boisduval
1 specimen July 15, 1946.
- Family Noctuidae Apotele oblinita Abbot and Smith
1 specimen August 5, 1946.
- Family Noctuidae Eleptina caradrinalis Guenee
1 specimen July 8, 1946.

- Family Notodontidae Datana ministra Dru.
1 specimen August 26, 1946.
- Family Notodontidae Gluphisia septentrionalis Walker
1 specimen August 5, 1946.
- Family Notodontidae Melipotis albosigma Fitch
1 specimen August 5, 1946.
- Family Notodontidae Odontosia elegans Strecker
1 specimen July 15, 1946.
- Family Nymphalidae Aglais antione Linn.
1 specimen August 19, 1946.
- Family Nymphalidae Argynnis aphrodite Fab.
1 specimen July 29, 1946.
- Family Nymphalidae Grapta interrogationis Fab.
1 specimen June 17, 1946.
- Family Nymphalidae Satyrus neophote Kirby
1 specimen July 29, 1946.
- Family Pieridae Colias eurytheme Boisduval
1 specimen June 8, 1946.
- Family Pieridae Pieris rapae Linn.
1 specimen June 10, 1946.
- Family Pyralidae Crambus praefectellus Zeller
2 specimens June 10, 1946 night collecting.
- Family Pyralidae Herculia olinalis Guenee
1 specimen July 15, 1946.
- Family Pyralidae Mimola vaccinii Riley
No adults secured to date. Larvae, cocoons, and pupae have been collected in

the field and identified.

Family Oecophoridae

Schiffmulleria argenticinctella Clem.

1 specimen July 15, 1946.

Family Syntomidae

Scopsis fulvicollis Hubner

4 specimens July 8 - August 12, 1946.

Family Tortricidae

Peronea minuta Rob.

1 specimen August 1, 1946.

Family Tortricidae

Starganthis tyconodiana Hearf.

2 specimens August 19, 1946.

Family Tortricidae

Zonaria interrupto-lineana Fehn.

4 specimens August 5, 1946.

NEUROPTERA

- Family Chrysopidae Chrysopa oculata Say
15 specimens June 10 - August 19, 1946.
- Family Hemerobiidae Hemerobius subanticus Walker
2 specimens July 15 - July 29, 1946.
- Family Myrmeleonidae Myrmeleon immaculatus DeGeer
2 specimens August 12, 1946.

NEUROPTERA

Family Chrysopidae Chrysopa oculata Say

15 specimens June 16 - August 19, 1946.

Family Hemerobiidae Micromus subanticus Walker

2 specimens July 15 - July 29, 1946.

Family Hymenoleonidae Hymenoleon immaculatus DeGeor

2 specimens August 12, 1946.

COLEOPTERA

- Family Agrionidae Ichnura verticalis Say
9 specimens June 10 - June 24, 1946.
- Family Libellulidae Homorobius humulinus Linn.
1 specimen July 15, 1946.
- Family Libellulidae Libellula pulchella Drury
2 specimens June 10 - July 3, 1946.
- Family Libellulidae Leucorrhinia intacta Hagen
1 specimen June 10, 1946.
- Family Libellulidae Sympetrum obtrusum Hagen
1 specimen July 15, 1946.
- Family Libellulidae Sympetrum rubicundulum Say
1 specimen July 15, 1946.
- Family Libellulidae Tetraneuria cymosura Say form simulans
Muttik.
1 specimen June 17, 1946.

CERTHOLITRA

- Family Acrididae Cannula bellucida Scudder
1 specimen July 22, 1946.
- Family Acrididae Chorthippus curt-bonnis Harris
5 specimens August 5 - August 12, 1946.
- Family Acrididae Chorthippa viridifasciata DeGeer
1 specimen July 8, 1946.
- Family Acrididae Dissosteira carolina Linn.
7 specimens July 22 - August 12, 1946.
- Family Acrididae Melanoplus bivittatus Say
2 specimens July 22, 1946.
- Family Acrididae Melanoplus differentialis Thomas
3 specimens August 19, 1946.
- Family Acrididae Melanoplus femur-ribum DeGeer
53 specimens July 15 - August 23, 1946.
- Family Acrididae Spharagemon bolli Scudder
3 specimens July 15 - August 12, 1946.
- Family Acrididae Spharagemon wyomingianum Thomas
1 specimen July 29, 1946.
- Family Gryllidae Gryllus assimilis luctuosus Serville
2 specimens July 15 - August 26, 1946.
- Family Gryllidae Oecanthus nigricornis F. Walker
1 specimen August 26, 1946.
- Family Gryllidae Oecanthus nigricornis quadripunctatus Beut.
15 specimens August 12 - August 19, 1946.
- Family Tettigidae Nototettix cristatus compressus Morse
1 specimen August 19, 1946.

Family Tettigonidae Orchelimum concinnum campestre Blatchley
6 specimens July 22 - August 26, 1946.

Family Tettigonidae Ceudonia furecata Brunner
1 specimen August 26, 1946.

SUMMARY AND CONCLUSIONS

From 500 acres of cultivated blueberries the following table represents the specimens collected for the most part in 1946:

| Orders | Families | Species |
|-------------|----------|---------|
| Coleoptera | 13 | 63 |
| Diptera | 33 | 175 |
| Hemiptera | 11 | 30 |
| Homoptera | 6 | 25 |
| Hymenoptera | 17 | 54 |
| Lepidoptera | 15 | 30 |
| Neuroptera | 3 | 3 |
| Odonata | 2 | 7 |
| Orthoptera | 4 | 15 |
| Total | 9 | 407 |

It is likely that many insects could be added to this tabulation. With only two seasons of collecting it is possible that some insects of importance from time to time have been omitted. Several of the included species could probably be dismissed but have been recorded as there is always some significance to their presence. The surrounding environment of water, woods, or other vegetation greatly influences the number and species of insects that sometimes inhabit blueberry plantings.

Potentially, the blueberry maggot is one of the two

more serious pests of blueberries in Michigan. However, the present methods of control by use of rotenone dust has reduced losses to a negligible amount. The spread of the maggot must be followed and a dusting program set up by the owners as soon as any sign of the maggot is in evidence.

At present the fruitworm is the number one insect to be considered. Not too much is known of its habits to date and it has been difficult to control. The present dusting with one percent rotenone holds it in check for the time being. With more knowledge concerning its life history and habits it is felt that better control measures will be forthcoming. In rearing the fruitworm it is believed that approximating the natural conditions more closely will give better results.

The dusting program followed by the blueberry growers consisting of two fruitworm dustings with one percent rotenone and two dustings for the blueberry maggot with 2.5 percent rotenone serves to control other insects such as the datana worm, spittle bug, webworms, and others.

Effectiveness of rotenone is lessened greatly when kept from one year to another. Year old dust was applied to two fields by ground machinery for the control of blueberry maggot. This dusting was very thorough but had little, if any, effect on the flies present in the field. A few days later fresh rotenone dust was applied to these same fields. For the ten following days no flies were trapped nor were any seen by field observations. It seems imperative that fresh dust be used each year.

PREFACE

This bibliography includes references to literature pertaining to insects occurring on blueberries. Literature concerning insects of the cultivated highbush blueberries is limited due to two facts; first, blueberry cultivation is recent; second, propagation is difficult in comparison with other fruits.

For the most part publications are from a few states which have had some success in blueberry growing.

The arrangement is alphabetical and where more than one entry of an author or authors occurs a chronological arrangement has been used.

- (1) Bailey, J. S. and Franklin, M. J. Blueberry Culture in Massachusetts. Mass. Agr. Exp. Sta. Bul. No. 317. 1945.
- (2) Bailey, J. S., Franklin, M. J. and Kelly, J. L. Blueberry Culture in Massachusetts. Mass. Agr. Exp. Sta. Bul. No. 358. 1939.
- (3) Beckwith, C. S. Blueberry Culture. New Jersey Agr. Exp. Sta. Cir. 170. 1924.
- (4) Beckwith, C. S. Insects Attacking Blueberry Fruit. New Jersey Agr. Exp. Sta. Cir. Bul. 472. 1945.
- (5) Beckwith, C. S. and Coville, F. V. Blueberry Culture. New Jersey Agr. Exp. Sta. Cir. No. 200. 1927.
- (6) Beckwith, C. S., Coville, F. V. and Doehlert, C. A. Blueberry Culture. New Jersey Agr. Exp. Sta. Cir. 229. 1937.
- (7) Beckwith, C. S. and Doehlert, C. A. Cranberry and Blueberry Investigations. Biennial Report. New Jersey Agr. Exp. Sta. 1932-33.
- (8) Chandler, F. B. Low Bush Blueberries. Maine Agr. Exp. Sta. Bul. 423. 1945.
- (9) Chandler, F. B. Composition and Uses of Blueberries. Maine Agr. Exp. Sta. Bul. 428. 1944.
- (10) Chandler, F. B. and Hyland. Botanical and Economic Distribution of Vaccinium L. in Maine. Maine Agr. Exp. Sta. Reprint. 1944.
- (11) Chandler, F. B. and Mason. Blueberry Investigations. Report of Progress. Maine Agr. Exp. Sta. Bul. 330. 1935.
- (12) Chandler, F. B. and Mason. The Effect of Mulch on Soil

- Moisture, Soil Temperature and Growth of Blueberry Plants. Maine Agr. Exp. Sta. Reprint. 1942.
- (13) Chapman, E. J. and Hammer, C. H. A Study of Apple Maggot Control Measures. N. Y. State Agr. Exp. Sta. Geneva, N. Y. Bul. No. 644. 1934.
- (14) Colby, A. S. Possibilities of Growing Blueberries in Illinois. Dept. of Hort. Ill. University Reprint. 1943.
- (15) Comstock, J. H. An Introduction to Entomology. Comstock Publishing Co., Inc. Ithaca, N. Y. Edition 3. 1936.
- (16) Coveille, F. V. Experiments in Blueberry Culture. Wash. Govt. Print. Off. Bul. No. 195. 1910.
- (17) Coveille, F. V. Directions for Blueberry Culture. U. S. Dept. Agr. Bul. 974. 1921.
- (18) Crowley, D. J. Blueberry Promised Well in Coast Countries. Better Fruits. 20:7. 1935.
- (19) Crowley, D. J. Blueberry Growing. A New Industry in Washington, Wash. Agr. Exp. Sta. Pop. Bul. 144. 1933.
- (20) Crowley, D. J. Observations and Experiments with Blueberries in Western Washington. State Coll. of Wash. Agr. Exp. Sta. Bul. No. 276. 1933.
- (21) Darrow, G. M. Managing Cranberry Fields. U. S. Dept. Agr. Farmers Bul. 1401. 1935.
- (22) Darrow, G. M. The Atlantic, Pemberton and Burlington Blueberries. U. S. Dept. Agr. Cir. No. 539. 1940.
- (23) Darrow, G. M. Blueberries. U. S. Dept. Agr. Leaflet. 201. 1940.
- (24) Darrow, G. M. Blueberry Growing. U. S. Dept. Agr. Farmers Bul. No. 1951. 734-38. 1944.

- (25) Dean, R. W. The Alimentary Canal of the Apple Maggot.
Ann. Ent. Soc. Amer. 1:210-213. 1932.
- (26) DeLongoree and Wilcox. Blueberry Cane Canker. U. S. Dept.
Agr. Bur. Plant Ind. Sta. Beltsville, Md. Reprint.
- (27) Doehlert, C. A. Condensed Reports of New Jersey Blue-
berry Research Laboratory. New Jersey Agr. Exp. Sta.
Pemberton, N. J. 1944.
- (28) Driggers, B. F. Galls on Stems of Cultivated Blueberry
(*Vaccinium Corymbosum*) Caused by a Chalcidoid, Hemades
nubilipennis Ashm. New Jersey Agr. Exp. Sta. Report. 1937.
- (29) Driggers, B. F. Notes on the Life History and Habits of
the Blueberry Stem Borer, *Oncophanes* Held., on Cultivated
Blueberries. New Jersey Agr. Exp. Sta. Dept. of Ent. Re-
print. 1939.
- (30) Eaton, Mildt, Pickett and Hockey. The Blueberry Dominion
of Canada - Dept. of Agr. Farmers Bul. 130. 1943.
- (31) Fall, H. C. The Blueberry Leaf Beetle and Some of Its
Relatives. Maine Agr. Exp. Sta. Bul. No. 319. 1934.
- (32) Franklin, H. J. Cape Cod Cranberry Insects. Mass. Agr.
Exp. Sta. Bul. 259:54-62. 1933.
- (33) Gurnea, P. Notes on Breeding the Apple Maggot, Rhagoletis
pomonella, 456-7. Culture Methods for Invertebrate Ani-
mals. Comstock Publishing Co. Inc., Ithaca, N. Y. 1937.
- (34) Gurnea, P. Control of Apple Maggot with Rotenone Dusts.
Conn. Agr. Exp. Sta. Bul. 474. 1943.
- (35) Gourley, J. H. The Blueberry in New Hampshire. New Hamp-
shire College. Cir. No. 13. 1917.
- (36) Hanson, A. J. and Webster, R. L. Insects of the Blackberry,

- Raspberry, Strawberry, Currant and Gooseberry. State Coll. of Wash. Agr. Exp. Sta. Popular Bul. No. 155. 1938.
- (37) Hutson, R. Controlling the Fruitworm on Blueberries. Art. 26-48. Reprint. Mich. Agr. Exp. Sta. Quar. Bul. 26:4. 1944.
- (38) Hutson, R. Making and Using Blueberry Maggot Traps. Mich. Agr. Coll. Exp. Sta. Ext. Folder. 1945.
- (39) Johnston, S. The Cultivation of Highbush Blueberry. Mich. Agr. Exp. Sta. Spec. Bul. 252. 1934.
- (40) Johnston, S. Essentials of Blueberry Culture. Mich. Agr. Exp. Sta. Circ. Bul. 188. 1944.
- (41) Johnston, S. Observations on the 1944 Blueberry Season. So. Haven. Exp. Sta. Mich. State Coll. Folder. 1944.
- (42) Lathrop, F. H. and McAllister, L. C., Jr. The Blueberry Maggot and Its Control in Eastern Maine. U. S. Dept. Agr. Circ. No. 196. 1931.
- (43) Lathrop, F. H. and Nickels, C. E. A Comparative Study of Dusting by Means of Airplane and Ground Machine for the Control of the Blueberry Maggot. U. S. Dept. Agr. Circ. No. 123. 1930.
- (44) Lathrop, F. H. and Nickels, C. E. The Biology and Control of the Blueberry Maggot in Wash. County Maine. U. S. Dept. Agr. Tech. But. No. 275. 1932.
- (45) Merrill, T. A. Pollination of the Highbush Blueberry. Mich. Agr. Exp. Sta. Tech. Bul. No. 151. 1936.
- (46) Metcalf, C. L. and Flint, W. P. Destructive and Useful Insects. McGraw-Hill Book Co., Inc. N. Y. and London. Second Edition. 1939.

- (47) Mowry, H. and Camp, A. F. Blueberry Culture in Florida. Fla. Agr. Exp. Sta. Bul. 194. 1938.
- (48) Patch, E. N. and Woods, W. C. The Blueberry Maggot. Maine Agr. Exp. Sta. Bul. 308. 1922.
- (49) Phillips, V. T. A Revision of the Trypetidae of Northeastern America. Jour. N. Y. Ent. Soc. 31:119-155. 1923.
- (50) Phipps, C. R. The Black Army Cutworm. Maine Agr. Exp. Sta. Bul. No. 340. 1927.
- (51) Phipps, C. R. The Chain Dotted Measuring Worm. Maine Agr. Exp. Sta. Bul. 345. 1928.
- (52) Phipps, C. R. Blueberry and Huckleberry Insects. Maine Agr. Exp. Sta. Bul. 356. 1930.
- (53) Schammel, H. B. Cranberry Insect Problems and Suggestions for Solving Them. U. S. Dept. Agr. Farm Bul. 860. 1917.
- (54) Slate and Collison The Blueberry in New York. N. Y. State Agr. Exp. Sta. Geneva, N. Y. Circ. 189. 1942.
- (55) Slingerland, M. V. and Crosby, C. R. Manual of Fruit Insects. MacMillanCo., N. Y. 1922.
- (56) Stene, A. E. Highbush Blueberry Culture in Rhode Island. R. I. Agr. Exp. Sta. Misc. Pub/ No/ 8. 1940.
- (57) Weiss, H. B. The Cultivated Blueberry Industry in New Jersey. 1939 including a report The Insects of the Cultivated Blueberry. New Jersey Dept. Agr. Circ. 356. 1940.
- (58) Woods, W. C. A Note on Rhagoletis pomonella in Blueberries. Jour. Econ. Ent. 7:398-400. 1914.
- (59) Woods, W. C. Blueberry Insects in Maine. Maine Agr. Exp. Sta. Bul. 244. 1915.

ROOM USE ONLY