453

Later, June 4th, leaves mostly immature were inoculated in In our examination of the diseased willow leaves and twigs we Petri dishes with spores from these same cultures. The spores have not paid especial attention to the other fungi that occurred were sprayed over the leaves and four days later, while the leaves on the dead tissues. We have, however, noted species present were still entirely green and showing no signs of injury, they were belonging to the following genera: Coniothyrium, Cladosporium fixed and later sections made of them. Careful search of Alternaria, Fusarium, Cryptostictis, Monochætia, Pestalozzia these sectioned leaves occasionally revealed germinating spores Gloosporium and Physalospora. next the epidermal cells with rarely an indication that a germ tube We have considered only the Gloeosporium and the Physaloshad pushed in the wall between two adjacent cells. Mycelium similar to that of the Fusicladium was found sparingly in certain sections between the cuticle and epidermal cells and between and under the latter. In no case, however, were we able to actually con-

pora, of the other fungi observed by us, as possible parasites. A culture of each from twigs was obtained by the junior author. The latter fungus seems to agree with the Physalospora described by Nattrass. Likewise it approaches Glomerella cingulata the common bitter rot fungus that is often a serious parasite on various hosts in the United States, but preliminary inoculations of apples with it (with one exception) and with the Gloeosporium from the willows failed to take while those made at the same time with cultures of the bitter rot fungus were all successful. Further study is needed before we can definitely state their identity. We have as yet, made no inoculations with cultures of these fungi on willows so judge of their parasitism merely from their appearance in nature, especially on twig cankers. However, if we consider the results of our infection experiments with pure cultures of Fusicladium saliciperdum, recorded here later, both, if involved, are secondary parasites in causing the willow disease in this country.

It is interesting to note that the three writers mentioned here, as well as ourselves, have all found a species of Physalospora (or by some it might be considered Glomerella) associated with the willow trouble. It is possibly the same fungus in all cases, although each of the writers noted gives a different specific name to it.

INFECTION EXPERIMENTS

Apparently in Europe not much has been done dealing with artificial cultures of the willow scab, or inoculating willows with such cultures. Nattrass (42, 43) of England, however, has recently obtained cultures of the fungus but reports failures from his inoculations. The writers, therefore, have made special efforts along these lines. The junior author, in 1927, obtained cultures of the Fusicladium stage of the fungus from material collected at Norfolk. The chief difficulty in isolating these cultures is to avoid the common and saprophytic species of Cladosporium which is frequent on the dead willow leaves.

Infection experiments with these pure cultures were carried on at the Station laboratory at New Haven in the spring of 1928 on cuttings of various willows kept in water in battery jars. These did not prove very effective. While the leaves of the inoculated shoots died sooner, in most cases, and the contrast in the early period with the checks was usually evident and sometimes marked, the fungus did not fruit on the inoculated shoots possibly because of unfavorable conditions not yet determined.

were. Other experiments, however, carried on at about the same time at the Mt. Carmel farm of this Station, on growing basket willow shoots in an isolated place (Plate XVI, foreground of inset) where the disease is unknown for many miles, proved very conclusively that the scab fungus isolated from the Norfolk willows was responsible for the injury. Seven inoculations (April 13, April 27, May 7, June 4, June 14, June 20 and July 11) were made on these willows, beginning before the leaf buds were open on some of them, just as they were opening on others, on various stages of leaf growth and ending with the fully grown leaves. These inoculations were made usually in the afternoon on cloudy days or just before rains. With an atomizer containing water in which was an abundance of spores from the cultures, the sprouts were sprayed from the top to bottom with a fine mist. Then with a medicine dropper additional material was dropped on the leaves and buds here and there.

nect the germinating spores on the outside with mycelium within

the tissues. We do not, therefore, assert that these inoculations

were successful although the results seem to indicate that they

The typical disease appeared as the result of all these inoculations, except the last, killing the young leaves and finally the young stems, spotting the more mature leaves, producing cankers at the base of the infected leaves and finally fruiting in normal manner on the leaves and occasionally on the dead shoots. Uninoculated shoots at the further end of the inoculated rows remained free from the disease. There were five different varieties of basket willows in the experiment. These had been received from the U. S. Dept. of Agric., several years before, and were labeled Purple No. 2 (S. purpurea), American Green (S. cordata?), American (S. cordata), Common Purple (S. purpurea) and Lemley (S. lucida?). At the time of the first inoculation on April 13, the condition of the buds on the different varieties was as follows: Purple No. 2, leaf buds out the most of any; American Green, catkins only out; American and Common Purple, leaf buds out a little; Lemley, leaf buds not out at all.

From the tables that follow it appears that the American willow, Salix cordata (Plates XIII, b, and XVI) was by far the most sus-

455

ceptible and the American Green and Lemley moderately susceptible, while the purple varieties were only slightly susceptible. Not all of the inoculations took equally well, those made April 27 and May 7, after the buds were open but before the leaves were fully developed, were the best. With Salix cordata, however, the earliest inoculation of April 13 was also very successful since the leaf buds were somewhat open on that date. The last inoculations, made on July 11, apparently were not successful in any case.

CONNECTICUT EXPERIMENT STATION

TABLE 1.—Showing Number of Twig Infections (First Figure) and LEAF INFECTIONS (SECOND FIGURE) ON JUNE 4.

West of the state								
Variety.		Date of Inoculations and Results.						
		April 13	April 27	May 7				
Purple No. 2	Row 1	14-?*	?-11	0-1				
American Green	Row 2 Row 3	$\begin{array}{c} 0-0 \\ 2-4 \end{array}$	2-24 4-21	$\begin{array}{c} 2-13 \\ 0-6 \end{array}$				
American	Row 4 Row 5	5-244 4-60	19-130 20-73	0-31 0-76				
Common Purple	Row 6	3–8	4-2	0-3				
Lemley	Row 7 Row 8 Row 9	3-1 0-4 0-0	14-21 6-8 1-2	4-6 8-16 5-35				

^{*}Tip of twigs with very young leaves all killed.

TABLE 2.—Showing Number of Infections (First Figure) on Number OF INOCULATED WILLOW SPROUTS (SECOND FIGURE) TAKEN ON THE 27 *

			ON JU	NE ZI					
Variet	у.	April 13	Date April 27	s of inoo May 7	ulations June 4	and res June 14	sults. June 20‡	July 1	Av. inf. per 1* sprout
Purple No. 2	Row 1		13 on 12		2 on 5	0 on 5	0 on 6	0	6
American	Row 2	2 3 on	59 on	29 on	27 on	9 on	0 on	0	
Green	Row 3	3 18 on 4	58 on 7	54 on 11	21 on 7	6 on 4	0 on 6	0	3.5
American	Row 4	245 on 16	143 on	79 on	70 on	26 on	12 on	?	
22morroun	Row 5		112 on 7		46 on 7	21 on 6	5 15 on 5	3	10.7
Common Purple	Row 6	3 13 on 32	11 on 13	4 on 10	1 on 7	3 on 6	1 on 6	0	.5
	Row 7	36 on 13	42 on	13 on	36 on	2 on	9 on	0	
Lemley	Row 8		18 on	28 on	18 on	11 on 5	5 7 on	0	3.3
	Row 9		2 on 6	44 on 7	66 on 8	7 on 7	5 17 on 5	0	

The earlier inoculations were much more favorable for infection than the later ones. Omitting the last inoculation which seems to have been too late for any infection, if we take the results of all of

the first-three inoculations and compare them with all of those of the second-three, we find that the former showed 1205 infections on 244 rods or an average of 4.9 infection per rod as compared with 433 infections on 161 rods or 2.6 infections per rod on the latter. This would indicate that infection in nature takes place much more readily on very young or scarcely mature leaves than on the fully grown leaves which agrees with our observations made at Norfolk.

It was not easy to determine the exact number of infections that resulted from these inoculations; for instance, several infections may have occurred on the same leaf and run together, or the tip of the twig, with its adhering leaves, may have been killed as the result of several rather than one infection. Consequently the number of infections that took place as recorded here is probably under rather than over estimated. There were over 1600 separate infections of which over 100 showed in dead blackened twigs two to six inches in length or in cankers on the young stems at the base of an infected leaf. In Table 1 there is given the number of infections resulting from the first three inoculations, as shown from the examination of Tune 4. The first figure in the table indicates the number of twig infections that were found, while the second the number of isolated leaf infections. In the second table data are given for all the inoculations from an examination made on June 27, except for the last inoculation which was examined on Sept. 27th.

SPRAYING EXPERIMENTS

In order to determine if this disease could be controlled by spraying, treatments were made on four large willows at Norfolk which had been seriously injured the two previous seasons by this fungus. The power sprayer shown in Plate XIV, a, was used and thorough treatments were given by the operator climbing the trees (Plate XIV, b). Five treatments were made on the following dates: April 18, May 4, May 18, May 25, and June 6. Two of the trees did not receive the first treatment which was made with Bordeaux mixture only. This was intended as the dormant treatment before the leaf buds began to open, but as the spring at Norfolk was very slow in developing the second treatment on all four trees was practically a dormant treatment also. The third and fourth treatments were made on the growing leaves when about one-third and two-thirds grown, and the fifth on the leaves just after they had reached full size. Because of the very wet weather after the last treatment if it had been succeeded by another, say the second which took place at the same stage as the first, the treatments would have been better placed and probably more effective. After the first treatment two of the trees were sprayed with home-made 4-4-50 Bordeaux mixture and the other two with commercial dry lime sulphur, three pounds to fifty gallons of water.

^{*} Except counts of inoculations made on July 11 were taken on Sept. 27.
‡ Counts for this inoculation were probably made too soon to get all the infections.

Considering that these trees had suffered severely from this disease the two pervious years at least and that about 50% of the young twigs and a number of the large branches were dead before the treatments were started, the results of the spraying were very encouraging. When examined on June 5th, as the disease was just beginning to show serious headway, there were comparatively few dead leaves on them when judged by the two adjacent unsprayed trees whose foliage was badly infected. See Plate XIV, c, d, for one each of the sprayed and unsprayed trees, photographed in August. Seen last late in September, while there were some dead leaves showing infection had taken place, there was considerable healthy foliage on the living twigs and all four sprayed trees had by far the best foliage of any of the trees of this variety in the village, since all the unsprayed trees were very largely or completely defoliated.

There was not much difference between the two trees sprayed with Bordeaux mixture and the two with lime-sulphur. No injury was noticed from any of these treatments. As the Bordeaux stuck much better, we are inclined to favor this fungicide so far. We believe where thorough and timely treatments are given and the trees are not too far gone with the disease, it can be checked and in time satisfactorily controlled by four or five sprayings made each year as follows: 1st, on the dormant trees just before the buds begin to open; 2nd, on the very young leaves emerging from the buds; 3rd, on the young leaves one-third to two-thirds grown; 4th, on the leaves just as they reach full size; 5th, if necessary in wet seasons, a week or ten days after the 4th treatment.

ADDITIONAL NOTE.

March 31st, 1929. Since this paper was written (a summary of which was given before the Canadian Mycologists at their meeting in December, 1928) we have received a letter that raised the question whether Fusicladium saliciperdum or Physalospora Miyabeana was the principal cause of the disease in North America and Europe, citing the work by Nattrass in England, as well as observations made in Canada, as reason for believing that the latter fungus was the responsible agent.

We have, therefore, repeated our indoor infections with pure cultures of Fusicladium saliciperdum. We can now state more certainly than we did before that our indoor infections of willow rods in battery jars and of leaves in Petri dishes, previously reported, were due to the Fusicladium saliciperdum spores sprayed on them. Apparently this fungus does not fruit, at least readily, under these conditions. However, we secured all the types of infection before noted in this second test. While the fungus has not as yet fruited on the dead tissues, by washing infected pieces in sterile water, corrosive sublimate and again in sterile water, we were always able to recover the fungus in fruiting condition when these tissues

were placed in Petri dishes in nutrient agar and in no case did the fungus Physalospora contaminate the cultures.

We have also tried a few infection experiments with pure cultures of our so-called *Physalospora Miyabeana* and apparently got somewhat similar results with it. However, we need to repeat these inoculation experiments a number of times before we can say just what kind of infection results. We can state very positively, however, that it is not necessary for this fungus to be present to secure serious injury to willows from inoculations with *Fusicladium saliciperdum*, such as is characteristic in nature on their very young leaves in the spring. We are inclined to believe that *Physalospora Miyabeana* is more likely to be responsible for the less serious injury to the mature tissues later in the year, as we have found a disease on the mature leaves, with concentric lines of growth, that we think was caused by it.

In any case we believe Nattrass was wrong when he states that Fusicladium saliciperdum "is in no way responsible for the symptoms of the disease on the leaves". Just why Nattrass failed to obtain infection with Fusicladium saliciperdum on willow leaves we do not know. We are inclined to believe, however, if he used pure cultures of this fungus, it was either due to failure to inoculate young tissues, or to lack of continued favorable moisture conditions. It is very essential that these conditions prevail and their absence is apparently the chief reason why the disease is not serious in most years.

PART II. EUROPEAN HISTORY

In the preceding part we have dealt with the willow scab as it occurs in America, based chiefly on our own work. In the present part we aim to treat of it briefly in a historical way, dealing with the investigations made in Europe where both the saprophytic and parasitic stages were first discovered. From these investigations there has resulted a somewhat extended bibliography, a duplication of names resulting in a limited synonomy, the issuing of dried specimens in various exsiccati and much of our knowledge relating to the hosts and distribution of the fungus. We shall treat of these separately.

SYNONOMY

- Venturia chlorospora (Ces.) Karst. Fung. Fenn. Exs. No. 957. 1870.
- Sphaeria chlorospora Ces. in Rabh. Fung. Eur. No. 48. 30 My. 1859.
- Sphaerella chlorospora Ces. et De Not. Comm. Soc. Critt. Ital. 14: 237. Ja. 1863.

Sphaerella ditricha Awd. p. p. in Rab. Fung. Eur. No. 943

(1) ? Sphaerella canescens Karst. Fung. Fenn. Exs. No. 895

Venturia chlorospora (Ces.) Karst. Fung. Fenn. Exs. No. 957 1870.

Venturia chlorospora Karst. p. p. Myc. Fenn. 2: 189. 1873.

(1) ? Venturia chlorospora var. canescens Karst. Myc. Fenn. 2: 190. 1873.

Venturia chlorospora Wint. in litt. in de Thüm. Myc. Uni. No.

Fusicladium ramulosum Rostr. p. p. in Müll. Tidsskr. Skovs. 6: 294. 1883.

Venturia chlorospora Wint. p. p. Rab. Krypt. Fl. 12: 436. 1887. Septoglæum saliciperdum All. & Tub. in All. et Schn. Fung. Bav. No. 485. 1895.

Venturia chlorospora Aderh. in Hedw. 36: 82. Ap. 1897.

Fusicladium saliciperdum Tub. in Arb. Biol. Abt. Land-Forstw. Kaiserl. Gesundh. 2: 567-70. 1902.

Fusicladium saliciperdum Lind in Ann. Myc. 3: 430. 1905.

The preceding names indicate the synonomy as we have found it in the literature. We have had to depend for this information partly on the opinion of others as we have not critically examined the specimens listed in the exsiccati, though we have seen all of them and almost all of the references to literature reported here. Those we have failed to see are indicated by a star (*) before the

It appears from our investigations that Cesati was the first to describe this fungus, under the name Sphaeria chlorospora, in 1859 from specimens of the asco stage on species of willow (Salix triandra, S. alba) collected at Vercelli, Italy. A few years later in 1863, he and De Notaris changed the name to Sphaerella chlorospora. In 1866 Auserwald used the name Sphaerella ditricha to include this species as well as others now considered distinct on Betula, Salix, Sorbus and Fraxinus.

In 1869 Karsten described Sphaerella canescens from Finland and later, in 1873, named it as a variety of Venturia chlorospora, namely var. canescens, distinguishing it by very slight differences in the spores. Aderhold (2, p. 82), however, gives it as a synonym of Venturia chlorospora. We include it here not because we doubt its varietal difference but because we believe that all of the specimens collected on Salix need to be gone over thoroughly to determine what if any varietal or specific differences there are. Karsten, also, was the first to place the fungus under the

proper genus, Venturia, as he issued specimens on willow (Fung. Fenn. Exs. No. 957) in 1870 as Venturia chlorospora. Therefore he is quoted by us as the second authority for the specific name. Karsten, however, in 1873 used the name Venturia chlorospora not only for this fungus but also included with it the species on poplar which is now considered distinct.

Winter, likewise, as early as 1876 issued specimens of the asco stage, in de Thümen's exsiccati on Salix sps. under the name Venturia chlorospora with Wint. in litt. as the authority. In 1887 he (72) showed that he also included other hosts with it.

Ordinarily the mature stage is cited as Venturia chlorospora (Ces.) Aderh. This is because Aderhold (2) in 1897, brought together the two stages on the willow for the first time under this name and limited the species to Salix as a host. So much for the asco stage.

The parasitic stage was first called Septoglæum saliciperdum in 1895 by Allescher and Tubeuf (7) but in 1902 the latter (70) renamed it Fusicladium saliciperdum, three years before this name was applied to it by Lind. This would make the proper

combination for this stage Fusicladium saliciperdum (All. & Tub.) Tub. Tubeuf in his article states that Dr. Merck first called his attention to the willow disease in 1884. Rostrup (47), apparently the first to recognize the disease in 1883, used an older name, applied only to the scab of poplar Cladosporium ramulosum by Desmazier (or by Roberge according to Rostrup and Tubeuf), to include both these species under the name Fusicladium ramulosum. Aderhold (2) used the name Fusicladium ramulosum Rostr. for the conidial stage of the willow scab only but recognized that the fungi on the willow and poplar were distinct, calling that on the

EXSICCATI

Both stages have been issued in various exsiccati. Such as we have been able to find are given in the following lists.

Venturia Stage:

poplar Fusicladium Tremulae Fr.

Sphaeria chlorospora Ces. Mspt. et herb. Rabh. Fung. Eur. No. 48. 30 My. 1859.

Sphaeria chlorospora Ces. Erb. Critt. Ital. No. 296. D. 1859. ?Sphaerella canescens Karst. Fung. Fenn. Exs. No. 895, 1869. Venturia chlorospora (Ces.) Karst. Fung. Fenn. Exs. No. 957.

Venturia chlorospora Wint. in litt. de Thüm. Myc.Uni. No. 560. 1876.

? Venturia chlorospora (Ces.) Karst. f. canescens Karst. Rehm Asc. No. 840. (1884, date of coll.).

⁽¹⁾ Said to have differently tinted and narrower spores.

Venturia chlorospora (Ces.) Karst. Roum. Fung. Sel. Exs. No. 5838. (My. 1891, date of coll.).

Venturia chlorospora (Ces.) Aderhold. Krieger Fung. Sax. No. 1428. 1899.

Venturia chlorospora (Ces.) Karst. Sacc. Myc. Ital. No. 486, 1900.

Venturia chlorospora (Ces.) Aderhold. Rehm Asco. No. 1340. 1900.

Venturia chlorospora (Ces.) Aderh. Jaap Fung. Sel. Exs. No. 425. S. 1910.

? Venturia chlorospora (Ces.) Karst. var. canescens Karst. Tranz. et Ser. Myc. Ross. Exs. No. 122. 1911.

Venturia chlorospora (Ces.) Karst. Petrak Fl. Boh. et Mor. Ex., II, 1, No. 782. O. 1913.

Venturia chlorospora (Ces.) Aderh. Syd. Myc. Germ. No. 1565. (5 Jl. 1919, date of coll).

Fusicladium Stage:

Septoglæum saliciperdum All. & Tub. All. et Schn. Fung. Bav. No. 485. 1895.

Fusicladium saliciperdum (All. et Tub.) Lind. Krieger Fung. Sax. No. 2090. 1909.

Fusicladium saliciperdum (All. et Tub.) Lind. Kabát et Bŭbák Fung. Imp. Exs. No. 642. 10 D. 1910.

Fusicladium saliciperdum (All. et Tub.) Lind. Tranz. et Ser. Myc. Ross. Exs. No. 146. 1911.

Fusicladium saliciperdum (All. et Tub.) Ld. Petrak Fl. Boh. et Mor. Exs. II, No. 925. 1914.

Hosts and Distribution

Some of the names of the willows included here are probably synonyms. Because of the geographical changes in Europe in recent years, it is sometimes difficult to determine the distribution of the fungus in the countries as they exist today. According to the information gained we find that the Venturia and Fusicladium stages, with the authority for the same, have been reported as follows:

Venturia Stage:

Salix alba: Italy (Cesati); Europe (Rostrup).

S. [alba var.] vitellina: Italy (Saccardo).

S. aurita: Finland (Karsten); Germany (Aderhold).

S. Caprea: Denmark (Lind); Finland (Karsten); France (F. Fautrey); Germany (Aderhold, Henkel, Krieger, Schroeder); Moravia (Petrak).

- S. cinerea: Germany (Aderhold, Schroeder); Saxony (G. Winter).
- S. cuspidata: Europe (Rostrup).
- S. fragilis: Europe (Rostrup). S. glauca: Iceland (Rostrup).
- S. herbacea: Iceland (Rostrup); Spitzbergen and Bear Isl. (Lind).
- S. herbacea x polaris: Spitzbergen and Bear Isl. (Lind).
- S. lanata: Iceland (Rostrup).
- S. mollissima: Europe (Rostrup).
- S. polaris: Spitzbergen and Bear Isl. (Lind). S. reticulata: Spitzbergen and Bear Isl. (Lind).
- S. triandra: Italy (Cesati).
- S. viminea: Ungarn (Rehm).

Salix sp.: Brandenburg (H. Sydow); Finland (Karsten); Italy (Saccardo); Waldschlucht (Rehm).

Fusicladium Stage:

Salix alba: Bohemia (Kabát et Bŭbák); Denmark (Lind); Germany (Tubeuf, Lindau); Kursk, Russia (Potebnia).

S. alba var. vitellina: Scotland (Alcock).

S. alba var. vitellina pendula: Holland (Schwarz.). Bad.

- S. americana: Germany (Janson, Appen); Silesia (Pape). Very susceptible. [Possibly our S. cordata.]
- S. amvgdalina: Saxony (Krieger).
- S. aurita: Europe (Lind); Germany (Aderhold, Lindau).
- S. babylonica: Germany (Tubeuf, Janson).
- S. Caprea: Europe (Lind); Germany (Aderhold, Lindau).
- S. cinerea: Europe (Lind); Germany (Aderhold, Lindau).
- S. cuspidata: Europe (Lind); Germany (Tubeuf, Lindau).
- S. fragilis: Europe (Lind); Germany (Tubeuf, Lindau).
- S. fragilis x pentandra: Denmark (Lind).
- S. japonica pendula: Denmark (Lind).
- S; laurina: Bavaria (Allescher & Tubeuf).
- S. mollissima: Denmark (Lind); Germany (Lindau).
- S. nigricans: Germany (Tubeuf).
- S. pentandra: Germany (Tubeuf).
- S. purpurea: Germany (Appen, Janson). Not very susceptible.
- S. viminalis: Germany (Appen, Janson). Not very susceptible. Salix sps.: Bavaria (Tubeuf); Bohemia (Petrak); England (Nattrass).

463

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No doubt there are other references to this fungus than those recorded here, but these include all we have been able to locate in the time and facilities at our disposal. Those we have not been able to verify in the original we have indicated by a star (*) before the author's name. Exsiccati references are not usually given.

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Calls attention to investigations previous to his by Goethe-Geisenheim and Brefeld suggesting connection of Fusicladium on apple and pear to Venturia chlorospora in its broad conception

2. Aderhold, R. Revision der Species Venturia chlorospora, inæqualis und ditricha autorum. Hedw. 36: 67-83. Ap. 1897.

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- 10. Anon. Review. Rev. Appl. Myc. 4: 199. Ap. 1925. Reviews Mrs. N. L. Alcock's article (q. v. 4), Trans. Roy. Scott. Arb. Soc. 38: 128-30.

- 11. Anon. Review. Rev. Appl. Myc. 4: 644. N. 1925. Reviews articles by Pape (q. v. 44) who reported Fusicladium saliciperdum on willow rods, Salix americana, from Silesia where it was extremely destructive and gave directions for control. Pape thinks further investigation is needed to prove Venturia chlorospora the mature stage.
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- 13. Anon. Review. Rev. Appl. Myc. 7: 127. F. 1928. Reviews article by Janson (q. v. 28) on Fusicladium saliciperdum which was bad in neighborhood of Berlin on soil deficient in potash. Salix americana was especially susceptible while crosses of S. viminalis with S. purpurea, S. daphnoides, S. triandra appeared to be immune; gives method of control by nosprasen.
- 14. Anon. Review. Rev. Appl. Myc. 7: 129. Mr. 1928. Reviews article by unannounced author (q. v. 78) which states there were complaints from all parts of Germany concerning a dieback of American willows, Salix americana, largely due to Fusicladium saliciperdum; carried on cuttings; gives means for control; says S. purpurea, S. triandra, S. viminalis appear to be immune.
- 15. Appen, A. V. Weidenschorf (Fusicladium saliciperdum). Ill. Landw. Zeit. 47: 67-8. 4 F. 1927. Notes very serious injury to basket willow (Salix americana) in the flood season of 1926 and less so in 1925; describes character of injury; S. viminalis and S. purpurea were also somewhat infected; worst in soil rich in nitrogen; gives suggestions for control. Gives references to articles on this disease by Dr. Max Wolff (No. 77), and Drs. S. Ludwigs and M. Schmidt (No. 75). See review by Anon. No. 12.
- 16. Auerswald, B. Sphaerella ditricha Awd. Rab. Fung. Eur. No. 943. Issues it as "Sphaerella ditricha Awd. in litt. et Mspt."; gives synonomy and notes differences on different hosts among which are Betula, Salix, Sorbus and Fraxinus. He makes the species to include more than is recognized today and the specimen issued with the note being on Fraxinus excludes it from the exsiccati of Venturia chlorospora as understood by us.
- 17. Cesati, V. Sphaeria chlorospora Ces. Mspt. et herb. Rab. Fung. Eur. 1, No. 48. My. 1859. Describes and figures the asco stage on leaves of Salix triandra and S. alba from Vercelli, Italy.
- 18. Cesati, V. Sphaeria chlorospora Ces. Erb. Critt. Ital. No. 296. D. 1859. Issued specimens of the above; said to be on Salix alba and S. triandra from Vercelli, Italy.
- 19. Cesati, V. et De Notaris, G. Schema di classificazione degli Sferiacei Italici Aschigeri. Comm. Soc. Critt. Ital. 14: 237. Ja. 1863. Place Sphaeria chlorospora Ces. under the genus Sphaerella.

20. Clinton, G. P. A New Disease of Willows appears in Connecticut. U. S. Pl. Dis. Rep. 11: 87. Au. 1927. Reports trouble caused by Fusicladium saliciperdum and the editor adds note. This is the first report of the disease in North America.

21. Clinton, G. P. Willow Scab (Fusicladium saliciperdum). U. S. Pl. Dis. Rep. 12: 82. 15 Au. 1928.

Reports above from Conn., N. Y., Mass., N. H. and Me.; found on six species of willows in nine towns in northwestern Conn.; defoliated all trees of S. alba var. vitellina at Norfolk, Conn., except the sprayed.

22. Clinton, G. P. and McCormick, F. A. Fusicladium saliciperdum (Leaf Rot) on Willow. U. S. Pl. Dis. Rep. 12: 54-5. 15 Jl. 1928. Report this new American disease on willows from Conn., Mass., N. H., N. Y. in the United States and from Nova Scotia and New Brunswick in Canada; list hosts as Salix nigra, S. alba var. vitellina, S. cordata and possibly S. sericea; obtained culture of fungus and proved by inoculation experiments its parasitic nature; got results from four treatments with Bordeaux mixture and lime-sulphur.

23. Dearness, J. The Fungi of the Arctic Coast of America West of the 100th Meridian. Rept. Can. Arc. Exp. 1913-18, 4C: 12C. Je. 1923.

Lists Venturia chlorospora as reported on Salix arctica from Ellesmere Island.

24. De Notaris, G. 97. Sphaerella chlorospora. Sfer. Ital. 1²: 86-7, Tav. 97. 1863.

Gives synonomy, describes and figures fungus under above name. No setae shown on perithecia.

25. Ellis, J. B. and Everhart, B. M. Venturia chlorospora (Ces.). N. A. Pyrenomycetes: 138. 1892.

Give synonyms, exsiccati, scientific description of above and list on Salix herbacea and S. glauca from Greenland.

26. Farlow, W. G. and Seymour, A. B. Venturia chlorospora (Ces.)

Karst. Host Index Fungi U. S.: 131-2. 1888.

List on Salix glauca and S. herbacea. (The revised Index will give hosts as Salix arctica, S. arctica var. Brownei, S. glauca, S. grænlandica, S. herbacea and S. reticulata).

27. Henkel, A. Neues und Bemerkenswertes der Pilzflora Thüringens. Ann. Myc. 21: 146. 28 F. 1923. Lists Venturia chlorospora on old leaves of Salix Caprea from Thüringia, Germany.

28. Janson, A. Ueber den Schorf und andere Korbweidenschädlinge. Nachr. ü. Schädl. 2, 3: 161-4. Au. 1927. Notes injury to basket willows in Germany, especially on ground poor in potash, by Fusicladium saliciperdum during warm wet weath-

Notes injury to basket willows in Germany, especially on ground poor in potash, by Fusicladium saliciperdum during warm wet weather of 1927; describes character of injury to the growing rods and contrasts with frost and hail injury; reports injury in past on Salix bab(i)lonica and other ornamental willows but especially bad now on American willow used for basket work while crosses of S. viminalis with purple Caspian and almond willows were less susceptible; thinks cutting rods in April rather than in winter may lessen the disease; gives methods of control by clean culture, spraying, etc. Also see review by Anon. no. 13.

29. Karsten, P. A. Sphaerella canescens Karst. Karst. Fung. Fenn. Exs. No. 895. 1869.
Gives description of above and lists on Salix acutifolia.

30. Karsten, P. A. Venturia chlorospora (Ces.). Fung. Fenn. Exs. No. 957. 1870.

Issues above on Salix from Finland.

Karsten, P. A. Venturia chlorospora (Ces.) Karst. Myc. Fenn. 2:

189. 1873.

Describes above, gives synonyms and lists on Salix Caprea, S. aurita and Pyrus malus; describes as variety canescens (Sphaerella canescens Karst.) on Salix acutifolia which differs in slight spore characters (p. 190).

32. Lind, J. Über einige neue und bekannte Pilze. Ann. Myc. 3: 427-32. 10 D. 1905.

Distinguishes (pp. 429-31) between the two species of Fusicladium on Salix and Populus, giving their correct names as Fusicladium saliciperdum (All. & Tub.) Lind and F. radiosum (Lib.) Lind (F. Tremulae), with the proper names for their asco stages as Venturia chlorospora (Ces.) Ad. and V. Tremulae Aderh. and lists F. saliciperdum on Salix alba, S. aurita, S. Caprea, S. cinerea, S. cuspidata, S. fragilis and S. mollissima. Does not

33. Lind, J. Systematic List of Fungi (Micromycetes) from North-East Greenland. Danmark-Eksped. til Groenl. Nord. 1906-08, 3: 153. 1910.
 Lists Venturia chlorospora (Ces.) Karst. on Salix arctica from Greenland. This is a separate from Medd. om Grφnl. XLIII.

separate Napicladium from Fusicladium as a distinct genus.

34. Lind, J. Fungi (Micromycetes) collected in Arctic North America. Reprint from Vid. Selsk. Skrifter, I Math.-Nat. Klasse 1909: 7, 17.

Lists above fungus on Salix arctica var. Brownei and S. reticulata from Greenland.

35. Lind, J. 922. Venturia chlorospora (Ces.) Karsten. Danish Fungi in Herb. E. Rostrup: 212. 3071. Fusicladium saliciperdum (All. & Tub.). Ibid.: 520. 1913.

Lists V. chlorospora on Salix Caprea and F. saliciperdum on Salix alba, S. fragilis x pentandra, S. japonica pendula, S. mollissima and gives references to collectors and literature.

36. Lind, J. The Micromycetes of Svalbard. Det. Kongl. Dep. f. Hand. Sjøf. Ind. Händv. og Fisk. 1928: 21. 1928.

Lists Venturia chlorospora on Salix herbacea, S. herbacea x polaris, S. polaris, S. reticulata from Spitzbergen and Bear Island.

37. Lindau, G. Venturia Ces. et de Not. Engler u. Prantl Nat. Pflanz. 1¹: 431. 1897. Septoglœum Sacc. *Ibid.* 1^{1**} 407-8. 1900. Describes genus Venturia and includes several species under Venturia chlorospora (Ces.) Karst.; describes genus Septoglœum and states that Septoglœum saliciperdum Allesch. et Tub. causes serious injury to Salix laurina in South Bavaria.

Lindau, G. Fusicladium saliciperdum (All. et Tub.). Rab. Krypt. Fl.
 18: 776. 16 My. 1907.
 Describes, gives synonomy and lists above on Salix alba, S.

aurita, S. Caprea, S. cinerea, S. cuspidata, S. fragilis, S. mollissima, in Denmark on the authority of Rostrup. Gives Venturia chlorospora as asco stage. States Rostrup wrongly included both the species on Salix and Populus under F. ramulosum, the proper name for the latter.

Lindau, G. F. saliciperdum (All. et Tub.) Lind (Septoglæum saliciperdum All. et Tub.). Sorauer Handb. Pflanzenkr. 2: 444. 1908.
 Lists above on Salix sps. as conidial stage of Venturia chlorospora.

- 40. Martin, G. H. Fusicladium saliciperdum (All. & Tub.) Lind. U. S. Pl. Dis. Rep. Suppl. 42: 341. 15 S. 1925.

 Merely gives reference to Alcock's paper no. 4.
- 41. Müller, P. E. Bot. Centralb. 15: 151-2. 1883.

 Reviews briefly Rostrup's article (q. v. 47) on Fusicladium ramulo [r] um which occurs as a parasite on species of willow and poplar, giving description of injury and character of fungus.
- 42. Nattrass, R. M. Economic Mycology. Ann. Rep. Agr. Hort. Res. Sta. Uni. Bristol 1927: 209, 211, 212. 1927?

 Notes presence of Fusicladium saliciperdum on willow at Long Ashton; cultures were obtained. Worked with this fungus and Physalospora Miyabeana in relation to willow disease.
- 43. Nattrass, R. M. The Physalospora Disease of the Basket Willow. Trans. Brit. Myc. Soc. 13: 286-306. 26 O. 1928.

 Describes P. Miyabeana and its attack on Salix alba vars. vitellina and cardinalis and S. americana; gives culture characteristics and successful inoculation experiments; compares with Physalospora gregaria Sacc. and P. Salicis Fuckel and notes relationship to Glomerella cingulata (Stonem.) Spauld. & v. Schr.; credits it rather than Fusicladium saliciperdum as primarily responsible for the disease of basket willows in England.
- 44. Pape, H. Der Pilz Fusicladium saliciperdum (All. et Tub.) Lind als Korbweidenschädling. Deutsche Obst- und Gemüsebau-Zeitung 71: 326-29. 12 Je. 1925.

 Gives a short historical account and comprehensive description of the macroscopic appearance of diseased specimens sent him in February, 1925, from Brieg in Schlesien, where much injury had been caused to basket willows, especially Salix americana; notes appearance of disease similar to frost injury for which it may be mistaken; disease worst in very wet years and in situations with abundant nitrogenous matter in the soil; indicates control by clean culture, spraying and cutting rods in late spring rather than in winter or fall; holds above fungus fully responsible for the disease but questions whether connection with Venturia stage has been fully proven as yet. See also review by Anon. No. 11.
- 45. Petrak, F. Beiträge zur Pilzflora von Sternberg in Mähren. Ann. Myc. 25: 344-88. 1927.
 Lists Fusicladium saliciperdum (All. et Tub.) Lind, page 384, on living leaves and tips of twigs of Salix sp. on the banks of streams in low ground.
- 46. Potebnia, A. Beiträge zur Micromycetenflora Mittel-Russlands. Ann. Myc. 8: 42-93. 1910.

 States on page 90 that Fusicladium saliciperdum (All. et Tub.) Lind on Salix alba at Kursk, Russia, badly injured the leaves in June, 1909.

47. Rostrup, E. Fusicladium ramulosum. Fortsatte, Undersøgelser over

Snyltesvampes Angreb paa Skovtræerne. [Separate from Müller's Tidsskr. f. Skovbrug 6: 199-300. 1883.]

Treats on pages 294-6 of above fungus which he recognizes as a parasite; pictures spores and gives measurements; gives reference to Cladosporium ramulosum on Populus alba and credits Roberge rather than Desmazier as the authority as given by Saccardo and others, but uses Fusicladium ramulosum as proper name and includes as hosts Populus alba, P. canescens, P. tremula, Salix alba, S. fragilis and S. cuspidata, thus not distinguishing the two species as now recognized. See also review by Müller, No. 41.

Rostrup, E. Fungi Grœnlandiae. Separate from Medd. om Grφnl.
3: 556. 1888.
Lists Venturia chlorospora (Ces.) Karst. on Salix herbacea and S. glauca from Greenland.

BIBLIOGRAPHY

- 49. Rostrup, E. Ost-Grønlands Svampe. Separate from Medd. om Grønl. 18: 22. 1894.

 Lists Venturia chlorospora (Ces.) Karst. on Salix grænlandica from East Greenland.
- 50. Rostrup, E. Pileskurv. Venturia chlorospora (Ces.) Aderh. Rostrup's Plantepatologi: 464. 1902.

 Has note on above and lists on Salix alba, S. fragilis, S. cuspidata and S. mollissima.
- 51. Rostrup, E. Islands Svampe. Separate from Bot. Tidsskr. 25: 303. 1903.

 Lists Salix herbacea, S. lanata, S. glauca, from Iceland, as hosts of Venturia chlorospora.
- 52. Rostrup, E. Fungi collected by H. G. Simmons on the 2d Norwegian Polar Expedition, 1898-1902. Rept. Sec. Nor. Arct. Exp. Fram, 1898-1902, No. 9: 7. 1906.

 Lists Venturia chlorospora on Salix arctica from E. Bedford, Pim Island. Hayes Sound.
- 53. Saccardo, P. A. Venturia chlorospora (Ces.) Karst. Fungi Ital. No. 349. S. 1878.

 Pictures perithecia, asci and ascospores on Salix vitellina from Italy.
- 54. Saccardo, P. A. Venturia chlorospora (Ces.) Karst. Sacc. Syll. Fung.

 1: 586-7. Venturia inaequalis (Cooke) Wint. Ibid.: 587-8. 1882.

 Describes Venturia chlorospora and lists the hosts as Quercus, Salix, Pyrus, Prunus, Sorbus and Crataegus, but follows with short description of vars. of which var. Salicis vitellina is one. Describes as distinct Venturia inaqualis (Cooke) Wint. and lists as hosts Pyrus Aria, P. communis, P. Malus but not Crataegus, Salix, Fraxinus, etc.
- 55. Saccardo, P. A. Venturia chlorospora (Ces.) Karst. var. canescens Karst. Sacc. Syll. Fung. 9: 687-8. 1891. Venturia macrospora Rostr. Ibid. 11: 306. 1895.

 States variety differs from V. chlorospora by differently tinted and narrower spores; reported on Salix acutifolia from Finland. Describes V. macrospora on S. grænlandica from Greenland. It has much wider and longer asci and ascospores than V. chlorospora.
- 56. Saccardo, P. A. et Sydow, P. Septogælum saliciperdum Allesch. et Tubeuf. Sacc. Syll. Fung. 14: 1031. 1899. Describes and lists host as Salix laurina from Bavaria.
- 57. Saccardo, P. A. et Traverso, J. B. Venturia chlorospora (Ces.)
 Karst. Sacc. Syll. Fung. 20: 1123. 1911.
 Give reference to illustrations of above fungus.
- 58. Saccardo, P. A. et Trotter, A. Fusicladium saliciperda (All. et Tub.)
 J. Lind. Sacc. Syll. Fung. 22: 1376. 1913.
 Give Venturia chlorospora (Ces.) Karst. as asco stage of above and Septoglæum saliciperdum as synonym. Notice spelling of saliciperdum.

59. Schroeter, J. Venturia chlorospora (Cesati). Krypt. Fl. Schl. 32:

Describes genus and species. In the latter includes as hosts Crataegus, Apple and Pear (now considered as distinct from that on Salix) with Salix Caprea and S. cinerea, from Germany.

 Schwarz, Marie Beatrice. Das Zweigsterben der Ulmen, Trauerweiden und Pfirsichbäume. Med. Phytopath. Lab. Willie Commelin Scholten, Baarn, V: 1-73. D. 1922.

Discusses on pages 33-49 "Das Triebsterben und der Rindenbrand der Trauerweide" caused by Fusicladium saliciperdum (All. et Tub.) Tub. on Salix alba var. vitellina pendula in Holland. Describes in detail effect on host and names saprophytes and parasites that follow on the weakened willows. Failed to get cultures and made no inoculations and not sure about the so-called asco stage.

- 61. Stevens, F. L. Fusicladium saliciperdum (All. & Tub.) Lind. The Fungi which cause Plant Dis.: 606. 1913.

 Lists above as stage of Venturia chlorospora on Salix.
- 62. Stevenson, J. A. Foreign Plant Diseases. U. S. Dept. Agr.: 163. 1926.

 Under Salix gives Fusicladium saliciperdum as a disease attacking S. alba, S. aurita, S. Caprea, S. cinerea, S. cuspidata, S. fragilis, S. mollissima, S. nigricans, S. pentandra; reported from Scotland, Russia, Denmark, Holland and Germany with Venturia chlorospora as perfect stage.
- 63. Sydow, P. Venturia chlorospora (Ces.) Karst. Sacc. Syll. Fung. 13: 1078-1102. 1898. Venturia chlorospora (Ces.) Karst. var. canescens Karst. Ibid. Venturia inæqualis (Cke.) Wint. Ibid. Venturia macrospora Rostr. Ibid. Septoglæum saliciperdum Allesch. et Tub. Ibid.

 Gives following willows as hosts of Venturia chlorospora, Salix sp., S. Caprea, S. cinerea, S. glauca, S. herbacea; for var. canescens gives S. acutifolia; for Venturia inæqualis gives Salix sp.; for V. macrospora gives S. grænlandica; for Septoglæum saliciperdum gives S. laurina.
- 64. Sydow, P. Pilze. Just's Bot. Jahr. 37, I: 159. 1912.

 Notes Krieger, Fung. Sax. No. 2090, issued specimens of Fusicladium saliciperdum in 1909.
- 65. Sydow, P. Pilze. Just's Bot. Jahr. 38, I: 147. 1913. Notes Jaap issued Venturia chlorospora, No. 425 in Fung. Sel. Exs. in 1910.
- 66. Sydow, P. Pilze. Just's Bot. Jahr. 38, I: 148. 1913. Notes that Fusicladium saliciperdum was issued as No. 642 of Kabát et Bubák's Fung. Imp. Exs. in 1910.
- 67. Sydow, P. Pilze. Just's Bot. Jahr. 39, I: 206. 1913.

 Notes Tranzschel and Serebrianikow issued Venturia chlorospora (Ces.) Karst. var. canescens Karst, No. 122, and Fusicladium saliciperdum (All. et Tub.) Lind, No. 146, in Myc. Ross. Exs. in 1911.
- 68. Sydow, P. Pilze. Just's Bot. Jahr. 41, I: 200. 1919.

 Notes Petrak issued specimens of *Venturia chlorospora*, Fl. Boh. et Mor. Exs. II, 1, No. 782, in 1913.
- 69. Sydow, P. Pilze. Just's Bot. Jahr. 42, I: 175. 1921. Notes Petrak issued Fusicladium saliciperdum, Fl. Boh. et Mor. Exs. II, 1, No. 925, in 1914.

 Tubeuf, C. Das Triebsterben der Weiden. Arb. Biol. Abth. Land. u. Forstw. Kaiserl. Gesundh. 2: 567-70. 1902.

States the willow disease was first called to his attention in 1884 by Dr. Merck; gives description of the injury and discusses similarity to frost injury which Frank thought the fungus followed; copies original description of Septoglæum saliciperdum; discusses historical relationship to similar fungus on poplars and notes their differences and the right of the poplar fungus to the name Fusicladium ramulosum; renames the willow fungus Fusicladium saliciperdum Tub.; pictures spores of both species, the injured tips of willow twigs, as well as a cross section of a conidial sorus on Salix pentandra; reports S. babylonica and "other willows" as hosts; gives Ludwigs "Lehrbuch der niederen Kryptogamen" as reference for serious outbreak on willows in Burgundy reported by Vuillemin.

- 71. Winter, G. Venturia chlorospora Wint. in litt. de Thüm. Myc. Uni-No. 560. 1876.

 Under above name issues specimens collected in Saxony on Salix cinerea in 1874; gives Sphaeria chlorospora Ces. and Sphaerella chlorospora Ces. et De Not. as synonyms.
- 72. Winter, G. Venturia chlorospora (Cesati). Rab. Krypt. Fl. 12: 436. 1887.

 Gives synonomy, exsiccati, specific description and hosts but agrees with Rehm that under above name should be included what are now considered distinct species on Salix, Sorbus, Fraxinus, Pyrus, Ulmus, etc.
- 73. *Fabricius, L. Krankheiten der Nutzhölzer. Hollrung's Jahresb' Neuer. Leist. Geb. Pflanzenkr. 5: 279-302. 1904 or 2? According to Lind (No. 35, p. 520, 562) Fabricius treats of Fusicladium saliciperdum in this article on page 281.
- 74. *Ludwigs. Lehrbuck der niederen Kryptogamen.

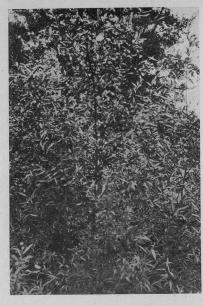
 According to Tubeuf (No. 70, p. 570) Ludwigs gives reference to a serious outbreak on willow in Burgundy reported by Vuillemin.
- 75. *Ludwigs u. Schmidt, M. Biol. Reichs. Land-Forstw., Flugblatt No. 81.
 According to Appen (No. 15, p. 67) they state Fusicladium saliciperdum injures willow trees.
- 76. *Salmon, E. S. Rept. S. E. Agr. Coll., Wye, Economic Myc. 1907: 17?

 Given here on authority of Mrs. Allcock (q. v. No. 5), but we have been unable to verify from reference given by her.
- 77. *Wolff, M. Abt. Pflanzenkr. Kais. Wilh. Inst. Landw. Bromb., Flugblatt No. 15.

 According to Appen (No. 15, p. 67) Wolff states that Fusicladium saliciperdum injures willow trees.
- 78. *Undet. Author. Abbauerscheinungen bei der amerikanischen Weide.
 Der Deutsche Korbweidenzüchter 1927: 75-76. 1927.
 See Review given under Anon. No. 14.



a. Salix alba; no disease.



b. Salix sp.; no disease.



e. Salix sp.; little disease.



d. S. alba var. vitellina; mod. disease.

WILLOWS WITH LITTLE OR NO DISEASED FOLIAGE.



a. Salix alba var. vitellina. Lawn trees, Norfolk.

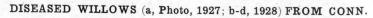
c. Salix cordata. Bushes in swamp, Goshen.



b. Salix alba var. vitellina. Street trees, Norfolk.



d. Salix alba var. vitellina. Trees along stream, Norfolk.





a. Street tree, Weymouth.



b. Pasture tree, Stewiacke.



c. Lighthouse Road, Digby.



d. Margaree, C. Breton.

DISEASED Salix alba var. vitellina FROM NOVA SCOTIA. (a, c, Photos, 1927; b, d, 1928.)



a. New Haven, P. Edw. Isl.



b. Moncton, N. Brunswick.



c. Harrington, Me.



d. Salisbury Cove, Me.

DISEASED Salix alba var. vitellina FROM CANADA AND MAINE, 1928.



a. Salix alba var. vitellina, natural infection.



b. Salix cordata, artificially infected.

WILLOW LEAVES AND TWIGS SHOWING INJURY.

a. Spray apparatus.



b. Spraying top of tree.



c. Sprayed tree.



d. Check, unsprayed tree.

SPRAYING EXPERIMENTS AT NORFOLK, CONN., 1928.



a. Characteristic fruiting pustules on veins.

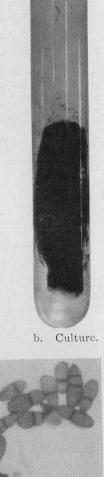
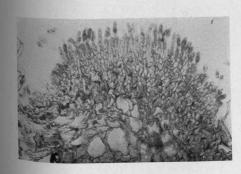
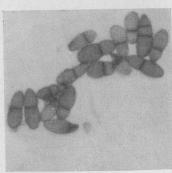


PLATE XV.



c. Fruiting pustule.



d. Spores.

DETAILS OF, Fusicladium saliciperdum, SCAB FUNGUS.

(a, slightly; c, d, highly magnified).

Connecticut Agricultural Experiment Station New Haven, Connecticut

REPORT ON INSPECTION OF COMMERCIAL FEEDING STUFFS 1928

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.



Inset, experimental plot.

Main photo, details of one infection.

ARTIFICIAL INFECTION OF BASKET WILLOWS AT MT. CARMEL.

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Entomology.	N. E. BRITTON, PHD., Entomologist in Charge: State Entomologist. B. H. WALDEN, B.AGR. M. P. ZAPPE, B.S. PHILIP GARMAN, PH.D. ROGER B. FRIEND, PH.D., Graduate Assistant. JOHN T. ASHWORTH, Deputy in Charge of Gipsy Moth Work. R. C. BOTSFORD, Deputy in Charge of Mosquito Elimination. J. P. JOHNSON, B.S., Deputy in Charge of Asiatic and Japanese Beetle Quarantines. MRS. GLADYS BROOKE, B.A., Secretary.
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Plant Breeding.	DONALD F. JONES, S.D., Geneticist in Charge. W. R. SINGLETON, S.M., Assistant Geneticist. H. R. Murray, B.S., Graduate Assistant. Mrs. R. A. Hunter, Secretary.
Soil research.	M. F. Morgan, M.S., Agronomist. H. G. M. Jacobson, M.S., Assistant Agronomist. Herbeet A. Lunt, M.S., Assistant in Forest Soils. Dwight B. Downs, General Assistant.
Tobacco Sub-station at Windsor.	PAUL J. ANDERSON, Ph.D., Pathologist in Charge. T. R. SWANBACK, M.S., Scientific Assistant. MISS DOROTHY LENARD, Secretary.

CONTENTS.	
	PAGE
The Feed Law	477
Explanation of Terms Used in an Analysis	478
Registrations	479
nspection	499
analyses of Official Samples	502
analyses of Miscellaneous Samples	576
ndev	

BULLETIN 303

REGISTRATION

479

Affixing tags. The use of wire or any metal in affixing tags to

feed packages is prohibited by law.

Registration and registration fee. The law requires an annual registration of all concentrated feeds sold or offered for sale in this State. Registrations are to be made with the Connecticut Agricultural Experiment Station and beginning January 1st, 1928, the registration period is for the duration of the calendar year. The registration fee is fifteen dollars (\$15.00), for each brand, a distinct brand name or a distinct analysis constituting a distinct brand.

Duties of manufacturers, jobbers and dealers. All concentrated commercial feeding stuffs must be registered annually on January

1st, or before they are offered for sale.

Manufacturers, jobbers or individuals shipping feeds into Connecticut will be expected to register their brands and pay the necessary fees thereon. Connecticut dealers should assure themselves that the brands they handle are properly registered and labelled. In case the manufacturer or jobber outside the State neglects or refuses to register, the dealer who handles such feeds will be held responsible for such registrations, registration fees and other legal requirements.

Dealers within the State who mix their own brands are responsi-

ble for the registration and proper labelling thereof.

Cottonseed meal. Cottonseed meal sold as a fertilizer is required to be registered under the terms of the fertilizer law; if sold also as a feeding stuff it is required also to be registered under the provisions of the feed law; if sold exclusively for one or the other of these purposes, it may be registered only under that law which applies.

EXPLANATION OF TERMS USED IN AN ANALYSIS OF FEEDING STUFF.

In registering feeding stuffs the law requires that the minimum percentages of crude protein and crude fat, and the maximum percentage of crude fiber, shall be given; that is, the registrant must guarantee that the feeds registered will contain not less than the stated percentages of crude protein and of crude fat and not more than the stated percentage of crude fiber.

The term crude protein denotes those nutrients which contain nitrogen, and is obtained by multiplying the percentage of total

nitrogen in the feed by the factor 6.25.

The term *crude fat* denotes those substances which are soluble in ether and includes, besides fat, such non-fatty materials as chlorophyll and coloring matter.

The term *crude fiber* denotes the coarse, woody tissues characteristic of all forms of roughage and which are present in the outer coats of cereal and other fodder grains.

While the law requires only a statement of the three nutrients just defined, no objection is taken to more complete statements of composition, but such further statements, if given, must be correct. Thus, tags sometimes bear guaranties for nitrogen-free-extract and for carbohydrates.

The term nitrogen-free-extract denotes those nutrients of the starch and the sugar types. This group is never determined directly but is obtained by subtracting from 100 per cent the sum of the percentages of moisture, ash, crude protein, crude fiber and crude fat.

The term carbohydrates denotes the combined percentages of

crude fiber and nitrogen-free-extract.

REGISTRATIONS.

(Late Registrations for the period 1926-27.)

To the brands registered for 1926-27 in our last report should be added:

Beacon Milling Co., Inc., Cayuga, N. Y.

Beacon Broiler Feed

Chapin & Company, Chicago, Ill.

Ajax Horse Feed Centaur Feed

Hennepin Mill Company, Minneapolis, Minn.

Ben Hur Pure Hard Wheat Red Dog

Ben Hur Hard Wheat Bran and Wheat Screenings

Ben Hur Hard Wheat Standard Middlings and Wheat Screenings

Ben Hur Hard Wheat Flour Middlings and Wheat Screenings

Ben Hur Fancy Mixed Feed

N. E. By-Products Corp., Lawrence, Mass.

Sterilized Feeding Bone Flour

Ralston Purina Company, St. Louis, Missouri.

Blue Checker Cow Chow Purina Lamb Chow Purina Sheep Fatena Cubes

St. Albans Grain Company, St. Albans, Vt.

Hygrade Sweetened Milk Ration

Syracuse Milling Company, Syracuse, N. Y.

Syragold Laying Mash with Buttermilk

(For the period January 1st, 1928 to December 31st, 1928)

One hundred and seventy-three firms and individuals have registered 828 brands of feeding stuffs. As required by Statute these registrations are listed as follows:

C. L. Adams Co., Woodbury, Conn.

Claco

Advance Milling Company, 309 South La Salle St., Chicago, Ill. Advance Hominy Feed

E. T. Allen Company, Atlanta, Ga.

Atlas-Standard Cotton Seed Meal

American Agricultural Chemical Company, New Haven Sales Dept., New Haven, Conn.

"Protox Meat and Bone Scrap"
"Capital Meat and Bone Scrap"

American Linseed Company, 297 Fourth Ave., New York City.

Alinco Old Process Linseed Meal Old Process Flaxseed Screenings Oil Feed

American Maize-Products Co., 41 East 42d St., New York City.

Cream of Corn Gluten Feed

American Milling Co., Peoria, Ill.

Amco Chick Grains
Amco Corn Feed Meal
Amco Egg Mash
Amco Egg Mash with Dried Buttermilk
Amco Horse Feed
Amco Intermediate Scratch Grains
Amco June Pasture Alfalfa & Molasses
Amco Scratch Grains (No. 1 Formula)
Amco Scratch Grains (No. 2 Formula)
Amco 12% Fitting Ration
Amco 20% Batch Mix
Amco 24% Batch Mix
Amco 24% Dairy Ration (Flexible Formula)
Amco 24% Dairy Ration (Flexible Formula)
Amco 24% Universal Dairy Ration

Arcady Farms Mfg. Co., 223 W. Jackson Blvd., Chicago, Ill.

Advanced Registry Dairy Feed Arcady Besbet Laying Mash Arcady Scratch Grains Arco 24% Dairy Ration Milkers Ready Ration Peerless Milk Ration Producer's 20% Ready Ration Sweet 16 Dairy Feed Wonder Dairy Ration Wonder Horse & Mule Feed

Archer-Daniels Midland Co., Minneapolis, Minn.

Pure Old Process Linseed Meal 32% Pure Old Process Linseed Meal 34%

Atlan Mfg. Co., 142 Logan Ave., Jersey City, N. J.

Diamond Pick Meat and Bone Scrap

Atlantic Coast Fisheries Corporation of N. Y., Groton, Conn. "Atco"

E. W. Bailey & Co., Montpelier, Vt.

Capital Dairy Ration Favorite Dairy Ration Pennant Brand Stock Feed

Bay State Milling Co., Winona, Minn.

Wingold Diamond G Pure Hard Wheat Reddog Wingold Fancy Pure Hard Wheat Mixed Wheat Feed Wingold Pure Hard Wheat Bran Wingold Pure Hard Wheat Fancy White Flour Middlings Wingold Rye Middlings and Rye Screenings Wingold Standard Hard Wheat Middlings and Wheat Screenings

REGISTRATION

Beach Soap Company, Lawrence, Mass.

Beach's Star Brand Beef Scraps

Beacon Milling Co., Inc., Cayuga, N. Y.

Auburn Dairy Feed Auburn Scratch Feed Beacon Broiler Feed Beacon Calf Meal Beacon Chick Feed Beacon Dairy Ration Beacon Developer Feed Beacon Duck Breeders Mash Beacon Duck Fattener Beacon Duck Growing Mash Beacon Duck Starter Beacon Egg Mash with Buttermilk Beacon Fleshing Mash with Buttermilk Beacon Growing Mash Beacon Hog Feed Beacon Horse Feed Beacon Laving Mash Beacon Scratch Grains Beacon Special Scratch Grains Beacon Starting Mash Beacon Sweet 24 Beacon "20"
Beacon Turkey Growing Feed Cayuga Growing Mash Cayuga Laying Mash with Buttermilk Cayuga Stock Feed Chariot Chick Feed Chariot Developer Feed Chariot Horse Feed

Belle Isle Creamery Company, Detroit, Michigan.

"Belle Isle Brand"

Ira W. Beers, Hamden, Conn.

Beers' Laying Mash Beers' Scratch Feed

Blatchford Calf Meal Company, Waukegan, Ill.

Blatchford's Calf Meal Blatchford's Chick Mash with Buttermilk

Amos D. Bridges' Sons, Inc., Hazardville, Conn.

Success Dairy Ration

The Bristol Grain & Supply Co., Bristol, Conn.

Bristol Laying Mash Bristol Scratch Feed

CONNECTICUT EXPERIMENT STATION

F. W. Brode Corp., Memphis, Tenn.

Owl Brand 36% Prime Cotton Seed Meal Owl Brand 41% Prime Cotton Seed Meal Owl Brand 43% Prime Cotton Seed Meal

C. Buckingham & Co., Inc., Southport, Conn.

C. B. Dairy Feed C. B. Growing Mash C. B. Mash

C. E. Buell, Inc., Boston, Mass.

"Buell-Boston" Dried Skim Milk

C. W. Burckhalter, Inc., 233 Broadway, New York City

Burck Brand Powdered Skim Milk

C. W. Campbell Co., Stonington, Conn.

Campbell Horse Feed Egg-O Dry Mash Egg-O Scratch No-Botheration Dairy Ration Provender

The Canada Linseed Oil Mills, Limited, Montreal, Canada "Maple Leaf"

Chapin & Company, Chicago, Ill.

Ajax Dairy Ration 16% Ajax Dairy Ration 20% Ajax Dairy Ration 24% Ajax Horse Feed Centaur Fitting Ration Chapin Kernels Egg Mash Chapin Grow All Chapin Kernels Lay All Chapin Kernels Start All Green Diamond Brand Cottonseed Meal Unicorn Chick Starter Unicorn Coarse Chick Unicorn Dairy Ration Unicorn Egg Mash with Buttermilk Unicorn Fine Chick Unicorn Growing Mash with Buttermilk Unicorn Horse Feed Unicorn Pig Meal Unicorn Scratch Feed

Clinton Corn Syrup Refining Company, Clinton, Iowa.

Clinton Corn Gluten Feed

The Coles Company, Middletown, Conn.

Fortune Egg Mash with Dried Buttermilk Fortune Growing Feed Fortune Scratch Feed Fortune Stock Feed Fortune 20% Molasses Dairy Feed Fortune 24% Molasses Dairy Feed

Collis Products Company, Clinton, Iowa

Collis Process Pure Dried Buttermilk

The G. E. Conkey Co., Cleveland, Ohio

Conkey's All Grain Horse and Mule Feed (with Molasses) Conkey's Chick Grains Conkey's Diamond Horse Feed

Conkey's Fattening Mash without Buttermilk

Conkey's Growing Grains

Conkey's (The Original) Growing Mash with Buttermilk

Conkey's Gecco Chick Grains Conkey's Gecco Egg Mash

Conkey's Gecco Growing Grains

Conkey's Geccofat with Buttermilk and Y-O Cod Liver Oil, Yeast, Sov-bean Oil Meal, Wheat Middlings

Conkey's Gecco Growing Mash

Conkey's Gecco Scratch Grains Conkey's Gecco 20% Dairy Ration Conkey's Horse Feed with Alfalfa and Molasses

Conkey's (The Original) Laying Mash with Buttermilk

Conkey's Scratch Grains

Conkey's (The Original) Starting Feed with Buttermilk

Red Seal Scratch Grains Red Seal 16% Dairy Ration Superior Scratch

Conkey's 24% Dairy Ration

The Conn. Fat Rendering & Fertilizer Corp., West Haven, Conn.

Conn. Fat Rend. & Fertz. Corp. Meat and Bone

Consolidated Rendering Company, Boston, Mass.

Corenco Bone Meal, An All Animal Feed For Cattle, Hogs and Poultry

Copeland Flour Mills Limited, Midland, Ontario, Canada

Dandy Bran Dandy Shorts

Corn Products Refining Company, 17 Battery Place, New York City

Buffalo Corn Gluten Feed Co-Pro-Co Horse and Mule Feed Diamond Corn Gluten Meal

C. A. Cowles, Plantsville, Conn.

C. A. Blue Seal Laying Mash Cowles Dairy Ration Cowles Scratch Feed

Chas. M. Cox Co., Boston, Mass.

Lakewoods Wheat Bran

Crosby Milling Company, Brattleboro, Vt.

Crosby's Balanced Ration Crosby's Egg Mash Crosby's Mixed Feed Crosby's Ready Ration Crosby's Scratch Feed Crosby's Stock Feed Crosby's 22% Dairy Feed

R. G. Davis & Sons, New Haven, Conn.

Basic Dairy Ration Davis Horse Feed Davis Scratch Feed Davis Stock Feed 20% Open Formula Dairy Ration

Decatur Milling Company, Decatur, Ill.

Homco Brand Hominy Feed

Delaware Mills, Inc., Deposit, N. Y.

Delaware Chick Grains Delaware Chick Starting Mash (With Dried Buttermilk) Delaware Dairy Feed Delaware Growing Mash (with Dried Buttermilk)
Delaware Laying Mash (with Dried Buttermilk)
Delaware Scratch Grains Delaware Stock Feed Delco 20% Dairy Feed Indian Laying Mash (with Dried Buttermilk) Indian Scratch Grains

The Denver Alfalfa Milling & Products Co., Lamar, Colorado

Alfalfa Meal

The Devon Coal & Ice Company, Devon, Conn.

Devon Dairy Ration Devon Laying Mash Devon Sweet Stock Feed

The Dewey Bros. Co., Blanchester, Ohio

Corn Distillers Dried Grains

The Dominion Flour Mills, Limited, Montreal, Canada

Wheat Bran Wheat Shorts

Dry Milk Company, 15 Park Row, New York City

Chikora

Duluth-Superior Milling Co., Duluth, Minn.

Duluth Imperial Wheat Bran Boston Mixed Feed

Eastern Grain Co., Bridgewater, Mass.

Dried Skim Milk Powder

East Coast Trading Company, Baltimore, Md.

E-C Pure Fish Meal

Eastern States Farmers' Exchange, 33 Lyman St., Springfield, Mass.

Eastern States Cottonseed Meal 41% Eastern States Egg Mash Open Formula Eastern States Fitting Ration Open Formula Eastern States Fitting Ration Open Formula
Eastern States Horse Feed Open Formula
Eastern States Milk Egg Mash Open Formula
Eastern States Milkmore Dairy Ration Open Formula Eastern States Scratch Grains Open Formula (1927 Formula) Eastern States Scratch Grains Open Formula (Old Formula)

S. T. Edwards & Co., Inc., 110 So. Dearborn St., Chicago, Ill. Butterfly Dry Skim Milk

REGISTRATION

Elmore Milling Company, Inc., Oneonta, N. Y.

Chixsaver Elmore Egg Mash Elmore Growing Mash Elmore's Hog Ration Elmore Horse Feed with Molasses Elmore (Storrs' Formula) Laying Mash Elmore's Makemgrow Little Pig Ration Elmore Milk Grains Elmore Scratch Feed Elmore Stock Feed Elmore "Three Point" Calf Meal Elmore-Waldorf Formula Elmore's "Xtragood" Wheat Feed with Ground Screenings Emco Feed Otsego Economy Ration

John W. Eshelman & Sons, Lancaster, Pa.

Eshelman's Baby Chick Starter Eshelman's Chick Feed Eshelman's Conestoga 18 Dairy Feed Eshelman's Fattening Mash Eshelman's Golden Rod 25 Dairy Feed Eshelman's Growing Mash Eshelman's Lancaster 60 Horse Feed Eshelman's Lancaster Stock Feed Eshelman's Lancaster 20 Dairy Feed Eshelman's Laying Mash Eshelman's Open Formula 20 Dairy Feed Eshelman's Pennsy 16 Dairy Feed Eshelman's Red Rose 85 Horse Feed Eshelman's Red Rose 24 Dairy Feed Eshelman's Scratch Feed Eshelman's Stock Feed Eshelman's Thorobred Horse Feed Eshelman's Wheat Flour Middlings Eshelman's Wheat Red Dog Eshelman's Susquehanna Dairy Feed Imperial Scratch Feed Lancaster Scratch Feed Liberty Horse Feed Pennsy Scratch Feed

Evans Milling Company, Indianapolis, Indiana

Emco Hominy Feed

Fairchild Milling Company, Cleveland, Ohio

Wheat Bran Standard Middlings Special Fine Wheat Middlings

The Fairfax Milling Company, Minn.

Red Wing Special Reddog

The Fairmont Creamery Company, Omaha, Neb.

Fairmont's Better Pure Flake Buttermilk

Farmers Feed Company, 532 East 76th St., New York City "Bull Brand" Dried Brewers Grains

Flory Milling Co., Inc., Bangor, Pa.

Blue Mountain Horse Feed Corn Feed Meal Cream-O-Milk Dairy Feed Flory's Baby Chick Feed Flory's Chick Starter Flory's Dairy Feed Flory's Egg Mash Flory's Growing Mash Flory's Horse Feed Flory's Intermediate Chick Feed Flory's Scratch Feed Flory's Wheat Mixed Feed Golden Egg Scratch Feed

A. W. Forbes, East Haven, Conn.

Chic Mash Dairy Ration R-Own Laying Mash Scratch Feed

National Cow Feed

Special Stock Feed

Vio Horse Feed

Sunray Scratch Feed

The L. T. Frisbie Company, New Haven, Conn.

Frisbie's Poultry Feed 45% Frisbie's Poultry Feed 55%

Grain Belt Mills Company, So. St. Joseph. Mo.

Bronco Horse and Mule Feed Hunter Horse and Mule Feed

D. H. Grandin Milling Company, Jamestown, N. Y.

Grandin's Baby Chick Starter with Buttermilk Grandin's Growing Feed Grandin's Laving Mash with Buttermilk Grandin's Screened Scratch Feed Grandin's 24% Balanced Dairy Ration

Hales & Hunter Company, 327 So. La Salle St., Chicago, Ill.

College Horse Feed H & H Dairy Feed Kingfalfa Horse Feed Pioneer Hog Feed Red Comb Chick Starter Red Comb Egg Mash Red Comb Growing Mash Red Comb Scratch Feed, No Grit

William Hamilton & Son, Inc., Honeoye Falls, N. Y.

Wheat Bran Wheat Middlings

The Hecker H-O Company, Inc., Buffalo, N. Y.

Algrane Steam-Cooked Chick Feed Re-Ground Oat Feed

Hecker-Jones-Jewell Milling Co., 40 Corlears St., New York City

REGISTRATION

Choice Wheat Bran H Wheat Middlings Red Dog Flour (Buffalo Mill) Choice Wheat Bran Wheat Flour Middlings Wheat Red Dog Flour Wheat Standard Midds Extra Heavy Wheat Mixed Feed

Hennepin Mill Company, 200 Chamber of Commerce, Minneapolis, Minn.

Ben Hur Fancy Mixed Feed Ben Hur Hard Wheat Bran and Wheat Screenings Ben Hur Hard Wheat Flour Middlings and Wheat Screenings Ben Hur Hard Wheat Standard Middlings and Wheat Screenings Ben Hur Pure Hard Wheat Red Dog

The J. C. Hubinger Bros. Co., Keokuk, Iowa

Ke OK uK Corn Gluten Feed

L. W. Hudson, Windsor, Conn.

Hudson's Cow Feed Hudson's Developing Mash Hudson's Laving Mash

Humphreys-Godwin Company, Memphis, Tenn.

Bull Brand Cottonseed Meal Danish Brand Cottonseed Feed Dixie Brand Cottonseed Meal

Imperial Grain & Milling Co., Toledo, Ohio

Imperial Steam Cooked Feed

International Agricultural Corp., Columbus, Ga.

Zenith 41% Cotton Seed Meal

International Milling Company, Minneapolis, Minn.

Blackhawk Pure Wheat Bran Blackhawk Wheat Flour Middlings Blackhawk Wheat Low Grade Flour Blackhawk Wheat Standard Middlings

The Kansas Flour Mills Corporation, Kansas City, Missouri Big Flake Pure Wheat Bran

Kasco Mills. Inc., Waverly, N. Y.

Apex Milk Maker Beatsall Milk Grains

Kellogg Company, Battle Creek, Michigan

White Hominy Feed

Kelloggs & Miller, Inc., Amsterdam, N. Y.

Pure Old Process Linseed Oil Meal

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.

Kellogg's Pure Old Process Linseed Meal 32 % Kellogg's Pure Old Process Linseed Meal 34%

H. H. King Flour Mills Co., Minneapolis, Minn. "Gold Mine" Feed

King Midas Mill Company, Minneapolis, Minn.

Wheat Standard Middlings and Ground Wheat Screenings

Chas. A. Krause Milling Co., Milwaukee, Wis.

Badger Horse and Mule Feed Badger 16½%Sweet Dairy Badger White Hominy Feed Blue Top Chick Feed, No Grit Blue Top Egg Mash Blue Top Scratch Feed, No Grit Cream City Scratch Feed, No Grit

S. F. Labieniec, Kensington, Conn.

Dry Mash

The Larrabee Flour Mills Company, Kansas City, Missouri

Wheat Bran and Wheat Screenings

The Larrowe Milling Company, Detroit, Michigan

Dried Beet Pulp
Dried Molasses-Beet Pulp
Larro Brand Choice Cottonseed Meal
Larro Chick Grains
Larro Chick Starter
Larro Egg Mash
Larro Growing Grains
Darro Growing Mash
Larro Hog Feed
Larro Scratch Grains
Larro—The Ready Ration for Dairy Cows

C. W. Lines Co., New Britain, Conn.

Homestead Dry Mash Homestead Scratch Feed Mill Pride Fancy Scratch Feed Mill Pride Dairy Ration Mill Pride Milk Mash

Litchfield County Co-Operative Association, Torrington, Conn.

Common Sense Dairy Ration Common Sense Growing Mash Common Sense Laying Mash Common Sense Scratch Feed

Long Hill Feed Store, Long Hill, Conn.

Square Deal Buttermilk Laying Mash Square Deal Dairy Ration

Louisville Milling Co., Inc., Louisville, Ky.

Sonny South Hominy Feed

L. B. Lovitt & Company, Memphis, Tenn.

"Lovit Brand" 36% Cottonseed Meal "Lovit Brand" 41% Cottonseed Meal "Lovit Brand" 43% Cottonseed Meal

E. Manchester & Sons, Winsted, Conn.

Buttermilk Mash Red Star Dairy Feed Red Star Egg Mash Red Star Flour Middlings Red Star Mixed Feed Red Star Scratch Feed

The Mann Bros. Cc., Buffalo, N. Y.

33% Protein Pure Old Process Linseed Meal

Maritime Milling Co., Inc., Buffalo, N. Y.

Bull Brand Chick Feed
Bull Brand Chick Starter (with Dried Buttermilk)
Bull Brand Chop Feed
Bull Brand Dairy Ration
Bull Brand Dairy Ration (Sweetened)
Bull Brand Developing Feed
Bull Brand Growing Mash (with Dried Buttermilk)
Bull Brand Heavy Mixed Feed
Bull Brand Horse Feed (with Molasses)
Bull Brand Laying Mash (with Dried Buttermilk)
Bull Brand Scratch Feed
Bull Brand Stock Feed
Bull Brand Stock Feed
Bull Brand Wheat Flour Middlings
Daisy Scratch Feed
Hi-Test Dairy Feed (Sweetened)
Hi-Test Stock Feed (Sweetened)
Jersey Dry Mash (with Dried Buttermilk)
Marmico Dairy Feed (with Molasses)
Red-E-Mixt Dairy Feed (Sweetened)
Red-E-Mixt Dairy Feed (Sweetened)

A. G. Markham & Company, Springfield, Mass.

Cooked Meat and Bone Scrap Special Cooked Meat and Bone Scrap

The George E. Marsh Company, Lynn, Mass.

Marsh's Pure Ground Scraps for Poultry

E. J. Martenis Grain Co., L-3 Produce Exchange, New York City

Alco Dried Distillers Grains Alco Dried Brewers Grains

Meech & Stoddard, Inc., Middletown, Conn.

Red Wing Dairy Ration
Red Wing Mixed Feed
Red Wing Molasses Horse Feed
Red Wing Scratch Feed
Red Wing Special Buttermilk Chick Starter
Red Wing Special Buttermilk Growing Feed
Red Wing Special Buttermilk Laying Mash
Red Wing Special Chick Feed
Red Wing Special Dairy Feed
Red Wing Special Intermediate Chick Feed
Red Wing Stock Feed

Memphis Cottonseed Products Company, Memphis, Tenn.

Durham Brand Thirtysix Cottonseed Meal Durham Brand Fortyone Cottonseed Meal Durham Brand Fortythree Cottonseed Meal

Middleport Flour Mills, Inc., Middleport, N. Y.

Angelus Wheat Bran Angelus Wheat Middlings

Miner-Hillard Milling Co., Wilkes-Barre, Pa.

No. 1 Scratch Feed Rye Middlings "1795" Steam Cooked Corn and Oats Steam Cooked Hominy Feed

Minneapolis Milling Company, Minneapolis, Minn.

Wheat Bran with Ground Screenings

Geo. Q. Moon & Co., Inc., Binghamton, N. Y.

Moon's Developing Grains
Moon's Fresh Ground Mixed Feed
Moon's Fresh Ground White Middlings
Moon's Growing Mash
Moon's Hominy Feed
Moon's Laying Mash with Dried Buttermilk
Moon's 24% Dairy Ration
Moon's Stratch Feed
Moon's Stock Feed
Moon's Wheat Bran
Moon's X Dairy Ration

Moran-Patton Co., 234 Cedar St., New Haven, Conn.

C-B Mash

Fred C. Morse, Guilford, Conn.

Old Mill Buttermilk Laying Mash Old Mill Dairy Ration Old Mill Growing Mash with Milk Old Mill Laying Mash Old Mill Provender Old Mill Scratch Feed

Jas. F. Morse & Co., Somerville, Mass.

Morse's Meat Scraps for Poultry 40% Morse's Meat Scraps for Poultry 50%

The National Milling Co., Toledo, Ohio

National Feed Osota Feed Pure Wheat Bran (extra broad)

Nebraska Consolidated Mills Co., 627-630 Grain Exchange Building, Omaha, Nebraska

Pure Flour Middlings Pure Wheat Bran Pure Winter Wheat Shorts

New England By-Products Corp., 20 West St., Lawrence, Mass.

Blue Seal Meat Scraps Gold Seal Dried Skim Milk White Seal Meat Scraps

Newman Bros. Grain Co., Rochester, N. Y.

Corn Feed Meal Lay She Will Egg Mash with Buttermilk Mystic Laying Mash Mystic Milk Maker Mystic Scratch Grains Newman's Best Dairy Feed

Newsome Feed & Grain Company, Pittsburgh, Pa.

Palmo Midds

Newton Feed Company, Milwaukee, Wisconsin

Institutional 20% Sweet Dairy Feed Institutional 24% Sweet Dairy Feed Newtrio Growing & Fitting Ration Newtrio 16% Dairy Ration Newtrio 20% Dairy Ration Newtrio 24% Dairy Ration

Niagara Falls Milling Company, Niagara Falls, N. Y.

Niagara Choice Wheat Bran Niagara Choice Wheat Middlings

N. W. Consolidated Milling Company, Minneapolis, Minn.

Planet Feed
Pure Wheat Bran
Wheat Flour Midds with Ground Screenings N. E. M. R.
Wheat Mixed Feed and Ground Screenings N. E. M. R.
Wheat Standard Midds, with Ground Screenings not exceeding
Run
X X X Comet

REGISTRATION

Norton Tallow Co., Somerville, Mass.

Norton's High Grade Meat and Bone Poultry Food

Nowak Milling Corporation, Hammond, Indiana

Cream O Lene Dairy Feed Domino Baby Chick Starter with Buttermilk Domino Butterine Dairy Feed Domino Chick Feed Domino Developing Feed Domino Growing Mash with Buttermilk Domino Hog Feed Domino Horse Feed with Alfalfa Domino Laying Mash with Buttermilk Domino Pep-O-Lene Horse Feed Domino Scratch Feed Domino 32% Protein Mixed Dairy Feed Domino 24½% Dairy Feed Domino Vim O Lene Horse Feed Export Scratch Feed Fidelity Dairy Feed Fidelity Scratch Feed Fidelity Stock Feed Hammond Dairy Feed Marathon All Mash Chick Starter Marathon Chick Feed Marathon Dairy Feed Marathon Horse Feed Marathon Laying Mash with Buttermilk Marathon Scratch Feed Union Dairy Feed

Ogilvie Flour Mills Co. Ltd., Montreal, Canada

Ogilvie's Oat Feed Ogilvie's Wheat Bran Ogilvie's Wheat Shorts

Ontario Milling Company, Inc., Oswego, N. Y.

Aunt Mary's Chick Starting Mash with Dried Buttermilk Aunt Mary's Egg Mash with Dried Buttermilk Aunt Mary's Scratch Feed Big Value Dairy Feed Oswego Egg Mash with Meat and Bone Oswego Scratch Feed Uncle John's Stock Feed Uncle John's 24% Cream Pot Ration

S. V. Osborn Estate, Branford, Conn.

Osborn Mash Osborn Provender Osborn Scratch

Park & Pollard Co., Buffalo, N. Y.

Arlington Horse Feed Baby Buster Chick Feed Belmont Horse Feed Bet-R-Milk 20% Ration Bidwell Dry-Mash (Black Rock Milling Corp.) Bidwell Scratch Feed (Black Rock Milling Corp.) Bonnie Booster Chelsea Horse Feed Corn and Oats 1/2 and 1/2 Feed Meal Go Tu It Hog Ration Growing Feed Herdhelth 16% Ration Intermediate Chick Feed Lay or Bust Dry-Mash Leghorn Special Dry-Mash Milkade Calf Meal Milk-Maid 24% Sweetened Dairy Ration Overall 24% Dairy Ration Over the Top Scratch Red Ribbon Chick Feed Red Ribbon Scratch Feed The Park & Pollard Co. Stock Feed Top Notch 16% Ration Wheat Flour Middlings

Pecos Valley Alfalfa Mill Co., Hagerman, New Mexico

Alfalfa Leaf Meal

Pillsbury Flour Mills Company, Minneapolis, Minn.

Palisade Chick Feed, No Grit Palisade Scratch Feed, No Grit Pillsbury's Chick Grains, No Grit Pillsbury's Dairy Ration Pillsbury's Durum Wheat Bran and Screenings Pillsbury's Egg Mash with Buttermilk Pillsbury's Fancy Mixed Feed and Screenings Pillsbury's Growing Mash with Buttermilk 16% Pillsbury's Growing Mash with Buttermilk 17% Pillsbury's Hard Wheat A Middlings and Screenings

Pillsbury's Hard Wheat Bran and Screenings Pillsbury's Hard Wheat Standard B Middlings and Screenings
Pillsbury's Rye Middlings and Screenings
Pillsbury's Scratch Grains
Pillsbury's Starting Feed with Buttermilk
Pillsbury's Wheat Bran and Screenings
Pillsbury's Wheat Gray Shorts

REGISTRATION

Pillsbury's X X Daisy

Pittsburgh Plate Glass Co., Newark, N. J.

Red Wing Linseed Meal 32% Red Wing Linseed Meal 34%

The Frank S. Platt Co., 450 State St., New Haven, Conn.

Platco Laving Mash Platco Perfection Grain Mixture

Postum, Inc., Battle Creek, Michigan

Burt's Dairy Feed Burt's Hominy Feed

W. N. Potter & Sons, Inc., Greenfield, Mass.

A. D. P. 24% Dairy Ration Puritan Dry Mash Puritan Growing Feed Puritan Scratch Feed

Pratt Food Co., Hammond, Indiana

Armour's 24% Dairy Feed Cak Cak Laying Mash with Buttermilk, Oat Meal, Fish, Meat, etc. Iroquois Poultry Mash Iroquois Scratching Grains
Pratt's Baby Chick Food with Buttermilk
Pratt's Circle A Chick Scratch Feed Pratt's Circle A Chick Scratch Feed
Pratt's Circle A Large Scratch Feed
Pratt's Supreme Chick Scratch Feed
Pratt's Supreme Dairy Ration
Pratt's Supreme Fattening Mash with Buttermilk
Pratt's Supreme Intermediate Scratch Feed
Pratt's Supreme Intermediate Scratch Feed Pratt's Supreme Laying Mash with Buttermilk Pratt's Supreme Stock Feed Pratt's Sweet 24% Dairy Ration Pratt's Utility Horse Feed Pratt's Utility Large Scratch Feed Pratt's Victory Chick Scratch Feed Pratt's Victory Intermediate Scratch Feed. Pratt's Victory Large Scratch Feed Pratt's Victory Laying Mash with Buttermilk

H. C. Puffer Company, Springfield, Mass.

Egg-Em-On Growing Feed Egg-Em-On Laying Mash Egg-Em-On Laying Mash Producer Dairy Feed

Pratt's White Hominy Feed

The Quaker Oats Company, 80 East Jackson St., Chicago, Ill.

Banner Feed Bell Cow Bran Bell Cow Shorts Big Egg Scratch Grains, No Grit Buckeye Feed Hominy Feed (Aunt Jemima Mills Branch) Horse Power Feed Quaker Big "Q" 20% Protein Dairy Ration Quaker Boss 24% Protein Dairy Ration Quaker Ful-O-Pep Chick Starter Quaker Ful-O-Pep Chick Starter Quaker Ful-O-Pep Coarse Chick Feed Quaker Ful-O-Pep Egg Mash Quaker Ful-O-Pep Fine Chick Feed Quaker Ful-O-Pep Growing Mash Quaker Ful-O-Pep Scratch Grains Quaker Green Cross Horse Feed Quaker Pig-N-Hog Meal Quaker Schumacher Feed Quaker 16% Protein Dairy Ration Quaker Sugared Schumacher Feed Richford Provender Richford White Diamond Stock Feed Schumacher Calf Meal Schumacher Little Chick Feed, No Grit Schumacher Scratch Grains, No Grit Sugared Vim Feed Vim Feed White Hominy Feed White Star Stock Feed, Fine White Star Stock Feed, Coarse Yellow Hominy Feed

Ralston Purina Company, St. Louis, Mo.

Purina Intermediate Hen Chow Feed

Purina Orange Checker Cow Chow Purina Pig Chow Feed containing Charcoal

Purina Omolene Feed

Purina Lamb Chow Feed containing Charcoal

Buffalo Purina Bulky Las Feed Corn Feed Meal Fine Ground Green Poultry Alfalfa Meal Protena Dairy Feed Purina Baby Chick Chow Feed
Purina Blue Checker Cow Chow Feed
Purina Buffalo Green Checker 24% Cow Chow Feed Purina Calf Chow Feed Purina Chicken Chowder Feed containing Charcoal and Mineral Purina Chicken Fat Chow Feed Purina Chicken Fatena Feed Purina Chick Grow Chow Feed Containing Bone Meal and Lime Stone Purina Chick Growena Feed containing Charcoal and Mineral Purina Chick Startena Feed containing Charcoal and Mineral Purina Cow Chow Feed Purina Grainola Feed Purina Hen Chow Feed Purina Hog Fatena Feed containing Charcoal

Purina Red Checker 34% Cow Chow Feed Purina Rolled Oats for Feeding Purposes (steam cooked) Purina Special Steer Fatena Feed containing Charcoal Winner Scratch Feed

REGISTRATION

John Reardon & Sons Company, Cambridge, Mass.

Register Brand 55% Register Brand 45%

Red Wing Milling Company, Red Wing, Minn.

Red Wing Special Wheat Bran

Robin Hood Mills Limited, Moose Jaw and Calgary, Canada

Superior Pure Wheat Bran Superior Pure Wheat Shorts

Rockville Grain & Coal Company, Rockville, Conn.

Diamond Chick Feed Diamond Laying Mash Diamond 85% Horse Feed Diamond Scratch Feed Diamond 24% Dairy Ration

The Rogers & Hubbard Company, Portland, Conn.

Rogers & Hubbard's Edible Bone Flour for Cattle and Poultry

Fred H. Rolf, Inc., Guilford, Conn.

Hubbard's Egg Producer Rolf's Chic Grains Rolf's Chie Mash Rolf's Scratch Grains

Royal Milling Company, Great Falls, Montana

Dependable Rex Hard Wheat Mixed Feed and Wheat Screenings

Russell-Miller Milling Co., Minneapolis, Minn.

Alta Hard Wheat Middlings Hard Wheat Occident Bran Hard Wheat Occident Mixed Feed

Russia Cement Co., Gloucester, Mass.

Chic-Chuk, "The Ideal Concentrated Poultry Food"

Chas. Schaefer & Son, 304 Meserole St., Brooklyn, N. Y.

Honeysuckle Horsefeed

Seymour Grain & Coal Co., Seymour, Conn.

See More Egg Mash Buttermilk See More Egg Scratch Feed See More Milk Dairy Feed

The Shelton Feed Co., Inc., Shelton, Conn.

Nelson's Laying Mash Nelson's Mixed Chicken Feed

Winchell Smith, Inc., Farmington, Conn.

Mill Streams "Boomerang" Dairy Feed Mill Streams "Fortune Hunter" Scratch Grains Mill Streams "Lightnin" Laying Mash Mill Streams "Twenty Percent" Dairy Ration

Southwestern Milling Co., Inc., Kansas City, Missouri Red Turkey Pure Wheat Bran

Spratt's Patent (Am.) Limited, Newark, N. J. Spratt's Chicgrain

Spratt's Mash Food with Buttermilk

Springfield Rendering Company, Springfield, Mass.

Springfield Ground Meat Scraps

Standard Milling Company of Canada Limited, Toronto, Ontario, Canada

Bran Shorts

A. E. Staley Manufacturing Company, Decatur, Ill.

Staley's Corn Gluten Feed

John T. Stanley Co., Inc., 642 West 30th St., New York City

Stanley's Meat and Bone Scrap

D. A. Stickell & Sons, Inc., Hagerstown, Md.

Blue Ridge Egg Mash Blue Ridge Scratch Grains Victor Scratch Grains

David Stott Flour Mills, Inc., Detroit, Mich.

Pennant Middlings and Wheat Screenings

Chas. M. Struven & Co., Baltimore, Md.

Struven's Fish Meal

St. Lawrence Flour Mills Co., Montreal, Que., Canada

St. Albans Grain Company, St. Albans, Vt.

Brewers' Dried Grains Charlestock Hygrade Sweetened 16 Milk Ration Hygrade Sweetened Milk Ration King Baby Chick Food containing Buttermilk King Chick Feed King Dairy Feed with Beet Pulp King Growing Feed containing Dried Buttermilk and Beef Scraps King Intermediate Chick Feed King Mash Feed containing Buttermilk, Fish and Meat Scraps King Scratch Feed King Stock Feed King 22% Protein Milk Ration Sweetened Paragon Dairy Feed Paragon Dairy Feed Sweetened Paragon Hominy Feed Paragon Scratch Feed Wirthmore All Grain Chick Feed (Fine Chick Scratch) Wirthmore Buttermilk Baby Chick Food Wirthmore Certified Scratch Feed Wirthmore Dairy Feed with Beet Pulp

Wirthmore Flour Middlings Wirthmore Growing Feed with Dried Buttermilk and Beef Scraps Wirthmore Hog Feed Wirthmore Horse Feed Wirthmore Intermediate Chick Feed (Coarse Chick Scratch) Wirthmore Laving Mash with Buttermilk Wirthmore Laying Mash with Butternin Wirthmore Pig Feed Wirthmore Poultry Green Wirthmore Scratch Feed Wirthmore 16% Dairy Feed Sweetened Wirthmore Stock Feed

REGISTRATION

Wirthmore Dairy Feed with Beet Pulp Sweetened

Wirthmore 20% Dairy Feed
Wirthmore 20% Dairy Feed Sweetened
Wirthmore 25% Balanced Ration Sweetened
Wirthmore 25% Protein Balanced Ration

Wirthmore Wheat Feed Wirthmore Wheat Reddog

Syracuse Milling Company, Syracuse, N. Y.

Jordan Horse Feed with Molasses Onondaga Dairy Feed Onondaga Scratch Grains Symco Scratch Grains Syragold Chick Starter Syragold Cnick Starter
Syragold Dairy Feed
Syragold Egg Mash
Syragold Feed Meal
Syragold Flour Middlings Syragold Ground Corn and Oat Feed Syragold Growing Mash Syragold Horse Feed with Molasses Syragold Laying Mash with Buttermilk Syragold Milk Ration Syragold Scratch Grains Syragold Stock Feed

D. L. Talcott, Torrington, Conn.

Talcott's Economy Dairy Ration

Thomaston Supply Co., Thomaston, Conn.

Thomaston Scratch Grains Thomaston Dairy Ration Thomaston Egg Mash

Tioga-Empire Feed Mills, Inc., Waverly, N. Y.

Chicatine Derby Corn and Oat Feed Derby Meal Derby Scratch Feed Egatine E-Gee Dairy Feed E-Gee Laying Mash E-Gee Stock Feed Neverfail Horse Feed Neverfail Scratch Grains Red Brand Tioga Dairy Feed Tioga-Bran and Molasses

BULLETIN 303

INSPECTION

499

Tioga Calf Food Tioga Chick Grains Tioga Growing Grains Tioga Growing Mash Tioga Laying Food Tioga Poultry Grains Waverly Flour Wheat Middlings White Brand Tioga Dairy Feed

Traders Feed & Grain Company, Inc., Buffalo, N. Y.

Bonny Hard Wheat Bran and Screenings

Ubiko Milling Company, Cincinnati, Ohio

Ubiko Union Grains 20% Sweet Dairy Ration Ubiko Union Grains 24% Sweet Dairy Ration Union Grains Ubiko Biles Ready Dairy Ration

Union Sales Corporation, Columbus, Indiana

Union Corn Gluten Feed

Upper Hudson Rye Flour Mills, Inc., Troy, N. Y.

Rye Feed

Van Iderstine Company, Railroad and Greenpoint Aves., Long Island City, N. Y.

Vico High Protein Meat Scrap for Poultry

Vitality Mills, Inc., Chicago, Ill.

Advance Dairy Feed
Advance Scratch, No Grit
"77" Scratch Feed, No Grit
"77" Stock Feed
Special Rosebro Horse Feed
Vitality Chick Starter
Vitality Coarse Chick Scratch
Vitality Egg Mash
Vitality Fine Chick Scratch
Vitality Growing Mash
Vitality Growing Mash
Vitality Scratch Feed, No Grit
Vitality 24% Dairy Feed with Molasses
Will-Pay Dairy Ration

Wadsworth Feed Company, Warren, Ohio

Wadfeeco Dairy Ration Wadsworth's Special Dairy Ration

Washburn Crosby Company, Minneapolis, Minn.

Gold Medal Corn and Oat Feed No. 2
Gold Medal Hominy Feed
North Star Scratch Feed—No Grit
Washburn's Gold Medal Chick Feed—No Grit
Washburn's Gold Medal Chick Starter (with Dried Buttermilk)
Washburn's Gold Medal Developing Feed—No Grit
Washburn's Gold Medal Fancy Mixed Feed
Washburn's Gold Medal Growing Mash (with Dried Buttermilk)
Washburn's Gold Medal Hard Wheat Bran and Wheat Screenings
Washburn's Gold Medal Hard Wheat Flour Middlings and Wheat
Screenings

Washburn's Gold Medal Hard Wheat Standard Middlings and Wheat Screenings Washburn's Gold Medal Pure Hard Wheat Adrian Red Dog

Washburn's Gold Medal Scratch Feed, No Grit

Washburn's Gold Medal Vitamin Dairy Ration, containing Wheat Germ (Embryo)

Washburn's Gold Medal Vitamin Dairy Ration (24% Protein) Washburn's Gold Medal Vitamin Egg Mash, containing Wheat Germ (Embryo)

Wolverton Flour Mills Co., Limited, St. Marys, Ontario, Canada

Wolmacs Bran Wolmacs Shorts

Worcester Rendering Co., Auburn, Mass.

P. W. Meat Scrap

P. W. Special Meat Scrap

Yantic Grain & Products Company, Norwich, Conn.

Abington Dairy Feed
Big (Y) Dairy Ration
Big (Y) Flour Middlings
Big (Y) Growing Feed
Big (Y) Laying Mash
Big (Y) Mixed Feed
Gingh'm Gal Scratch Feed
Perfection Dairy Feed
Uncas Dairy Feed
Uncas Scratch Feed
Uncas Stock Feed

INSPECTION.

This inspection covers the year 1928 and includes the period from September 1st to December 31st in 1927.

The Station inspector visited about 150 dealers in 100 towns in the State and collected 779 samples, which number includes all of the registered brands which were found on sale.

During the year 812 samples of commercial feeding stuffs and other fodder materials were analyzed. Of this number 716 were official inspection samples, 57 were silage and similar materials examined for the Storrs station, and the remaining 39 were submitted by individuals. Only those samples examined for official inspection purposes and those analyzed for individuals are included in this report.

Analyses of official samples are given in Table I and those of unofficial samples in Table II. Results, as soon as available, are reported to manufacturers, jobbers or dealers, and purchasers. In case of deficient brands second samples are drawn and analyzed if they can be obtained.

SUMMARY OF INSPECTION.

			D	eficiencie	es in	
Feed	Samples	Samples	Protein	Fat	Fiber	Total deficiencies
Cottonseed Meal. Linseed Meal. Wheat Bran. Wheat Middlings. Wheat Red Dog. Wheat Feed (Mixed Feed) Corn Gluten Feed. Hominy Feed. Rye Products. Brewers' & Distillers' Grains.	16 11 27 33 10 17 8 16 2 7	1 4 2 1 1 3 0 2 0 4	1 1 2 1 1 3 0 0 0 0 3	0 1 0 0 0 0 0 0	1 2 0 0 1 0 0 2 0 1	2 4 2 1 2 3 0 2 0 4
Dried Beet Pulp Horse Feeds, etc Dairy Feeds Stock Feeds Calf Feed, etc Poultry Feeds Beef Scrap, etc	$\begin{array}{c} 2 \\ 73 \\ 161 \\ 25 \\ 14 \\ 252 \\ 42 \end{array}$	1 16 59 5 3 40 14	$egin{array}{c} 1 \\ 2 \\ 19 \\ 0 \\ 0 \\ 9 \\ 12 \\ \end{array}$	$\begin{array}{c} 0 \\ 7 \\ 48 \\ 3 \\ 3 \\ 28 \\ 3 \end{array}$	0 8 8 2 0 6 0	1 17 75 5 3 43 15
Totals	716	156	55	93	31	179

In the tabulated summary of the inspection deficiencies of 0.75 per cent or less in protein and in fiber and 0.25 per cent or less in fat are not included. From this summary it appears that 22 per cent of the samples examined failed to meet their guaranties in one or more particulars. Of the 2,148 guaranties made, there being 3 for each sample, 179 or 8 per cent, were not met; in other words, 92 per cent of guaranties made were substantially equalled or exceeded. These figures are about the same as found for the past two years, except that this year the proportion of samples equalling guaranties is somewhat (about 5 per cent), less.

It is illegal in this State to attach tags by means of wire or other metallic device. Only two instances of violation of this provision were found.

Samples have been examined microscopically for foreign or deleterious substances and to check the ingredients found with those declared by statements on labels or in registrations as filed with the Station. No samples were found this year which contained weed seeds in conspicuous amounts and no instances of the substitution of inferior materials were detected. The checking of claimed ingredients is often complicated by revisions of formulas which may be filed by manufacturers subsequent to their original registrations. However, so far as could be determined ingredients as stated were in the main substantiated by our examinations.

Pounds per Hundred

ANALYSES

503

		THE HE WOLL TO THE TRUE OF THE TANK OF THE TOTAL CONTROL TO THE TANK OF THE TRUE OF THE TANK OF THE TRUE OF THE	6 6 7 4 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5										
					Protein (N x 6.25)		Fi	ber	extract etc.)		ıt		
Manufacturer and Brand ON HO		Retail Dealer		Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than		
	Oil Seed Products. Cottonseed Meal.		%	%	%	%	%	%	%	%	%		
3711	Atlas Standard. E. T. Allen Co., Atlanta, Ga	Hazardville: A. D. Bridges' Sons	4.25	5.94	36.19	36.00	14.63	14.00	33.59	5.40	5.50		
414	Atlas Standard. E. T. Allen Co., Atlanta, Ga	Farmington: Winchell Smith	4.08	6.52	36.00	36.00	14.30	14.00	32.20	6.90	5.50		
848	Helmet. Ashcraft-Wilkinson Co., Atlanta, Ga	Guilford: Fred C. Morse & Son	6.25	6.36	40.63	41.00	8.78	10.00	29.23	8.75	6.00		
786	Owl 36%. F. W. Brode Corp., Memphis, Tenn	Plantsville: C. A. Cowles	8.30	6.08	35.50	36.00	12.83	14.00	30.36	6.93	5.00		
815	Owl 41%. F. W. Brode Corp., Memphis, Tenn	Simsbury: Woods Chandler Co.	6.70	6.33	41.44	41.00	9.75	10.00	28.28	7.50	5.00		
285	Owl 41%. F. W. Brode Corp., Memphis, Tenn	Guilford: Fred C. Morse & Son	6.43	7.25	42.69	41.00	8.40	10.00	27.87	7.36	5.00		
7590	Buckeye Prime 41%. Buckeye Cotton Oil Co., Cincinnati, Ohio	Bethel: Morrison & Dunham	7.68	6.65	42.25	41.00	8.42	10.00	28.19	6.81	6.50		
923	Eastern States 41%. Eastern States Farmers' Exchange, Springfield, Mass	New Milford: W. E. Bostwick.	7.55	6.51	40.63	41.00	10.43	10.00	28.48	6.40	6.00		

		I			1	1		1	1	1	_
8673	Danish. Humphreys-Godwin		0.05								
8725	Co., Memphis, Tenn Bull. Humphreys-Godwin Co.,	East Wallingford: D. W. Ives	3.25	5.43	36.38	36.00	12.63	15.00	35.41	6.90	5.00
3794	Memphis, Tenn	Plantsville: C. A. Cowles	4.70	6.35	43.00	43.00	6.85	10.00	30.80	8.30	5.00
	Co., Memphis, Tenn	Thomaston: Thomaston Supply Co	4.98	5.83	39.75	41.12	10.93	10.00	31.71	6.80	5.00
277	Larro. Larrowe Milling Co.,	м									
552	Detroit, Mich	Branford: S. V. Osborn, Est	5.15	7.44	43.88	43.00	6.90	10.00	29.55	7.08	6.00
238	Memphis, Tenn	Bristol: Bristol Grain & Supply Torrington: Litchfield County	4.28	7.17	43.13	41.00	7.10	10.00	31.07	7.25	6.00
400	Memphis, Tenn	Co-op	6.60	6.07	35.63	36.00	13.15	15.00	32.35	6.20	5.00
7926	tonseed Products Co., Memphis, Tenn: National Cottonseed Products	Farmington: Winchell Smith	6.95	7.40	42.00	43.00	6.83	10.00	29.29	7.53	6.00
020	Corp., Memphis, Tenn	Devon: Devon Coal & Ice Co			41.06	41.00	9.03				
		=									
626	Linseed Meal.										
721	Alinco Old Process. American Linseed Co., Buffalo, N. Y Old Process. Archer-Daniels-	Guilford: Fred H. Rolf	4.45	4.91	34.00	34.00	8.55	9.00	41.84	6.25	5.00
	Midland Co., Minneapolis,	Middletown: Meech & Stod-									
989	Minn Archer-Daniels-	dard, Inc	6.45	5.30	35.38	34.00	8.20	9.00	39.77	4.90	5.00
050	Midland Co., Minneapolis,	Southbury: H. R. Stone	9.20	5.43	35.00	32.00	7.83	9.00	37.38	5.16	5.00
950	Maple Leaf Oilcake Meal. Can- ada Linseed Oil Meal Co.,	Seymour: Seymour Grain and									
627	Montreal, Canada	Coal Co	10.00	5.50	34.56	34.00	7.70	7.00	37.09	5.15	5.00
	seed Oil Mills, Montreal, Canada	Seymour: Seymour Grain and Coal Co.	4.85	5.23	35.88	35.00	7.80	7.00	40.84	5.40	5.00

Pounds per Hundred

Found

%

7.98

7.73

7.58

8.03

8.20

7.98

Fiber

Guaranteed, not more than

%

10.00

10.00

10.00

10.00

9.00

7.00 36.58

39.06

35.36

38.74

36.09

36.35

Protein (N x 6.25)

Found

%

35.25

33.69

32.00

33.81

5.03 35.13

5.30 34.69

%

5.11

6.66

5.01

5.94

less 1

Gua

%

35.00

34.00

32.00

33.00

33.00

32.00

extract etc.)

Nitrogen-free (starch, gum,

Fat

Guaranteed, not less than

%

5.68

6.35

6.46

5.65

7.48

5.64

%

9.40

6.70

10.61

7.23

11.22

Retail Dealer

Simsbury: Woods-Chandler Co.

Plainville: W. S. Eaton..... Middletown: Meech & Stoddard,

Middlefield: Middlefield Grain

Seymour: Seymour Grain &

Coal Co.....

Seymour Grain &

& Coal.....

Inc..

Seymour: Coal Co.

Manufacturer and Brand

OIL SEED PRODUCTS-Concluded. Linseed Meal-Concluded.

Maple Leaf 35%. Canada Linseed Oil Mills, Montreal,

Kellogg's Pure Old Process.

Spencer Kellogg & Sons, Buffalo, N. Y........... Mann Bros. Co., Buffalo, N. Y.

33% Old Process. Mann Bros.
Co., Buffalo, N. Y.......
33% Old Process. Mann Bros.
Co., Buffalo, N. Y.......
Red Wing. Pittsburg Plate
Glass Co., Newark, N. J....

Canada.

Station No.

355

8556

7841

8700

9974

9972

6.00

5.00

	WHEAT PRODUCTS.				1						3
	Wheat Bran.					4			15 4 15		
15	Dandy. Copeland Flour Mills,									- Fare	
	Midland, Canada	Shelton: Wolf Savitsky	11.33	5.72	13.50	15.00	10.25	11.50	53.88	5.32	3.50
54	Dominion Flour Mills, Mon-	7 1 7 1 6		- 00	10.00		40.05				0.50
)4	treal, Canada	Derby: Peterson-Hendee Co	11.15	5.60	13.88	15.00	10.05	11.50	53.85	5.47	3.50
4	Cleveland, Ohio	Highwood: T. C. Hadden & Co.	11 40	6.07	15.19	14 00	9 23	12.00	53 08	5.03	3.50
9	Choice. Hecker-Jones-Jewell	West Cheshire: Cheshire Grain		0.01	10.10	11.00	0.20	12.00	00.00	0.00	0.00
	Milling Co., Buffalo, N. Y		10.87	6.31	15.50	13.50	10.00	14.00	53.61	3.71	3.50
	Choice. Hecker-Jones-Jewell	Middlefield: Middlefield Grain	- 00	- 00	11.00	11 00	10.00	11.00	-0.00	4.05	0 70
	Milling Co., N. Y Ben Hur. Hennepin Mill Co.,	& Coal Co	5.60	5.89	14.00	14.00	10.00	14.00	59.66	4.85	3.50
	Minneapolis, Minn	Southbury: H. R. Stone	12 10	5 46	13.88	14 00	9 75	12.00	53 50	5.31	4.00
	Black Hawk. International	boundary. 11. 1c. Stolle	12.10	0.10	10.00	111.00	3.10	12.00	00.00	0.01	1.00
	Milling Co., Minneapolis,										7
	Minn	Guilford: Fred C. Morse & Son		6.69	15.38	15.00	10.03	12.00	52.69	4.85	3.20
	Big Flake. Kansas Flour Mills	Thompsonville: Geo. S. Phelps		7 99	15.94	15 00	0 10	11.00	59 20	4.15	3.50
	Corp., Kansas City, Mo Lakewoods. Chas. M. Cox.	& Co	10.00	7.55	15.94	15.00	9.40	11.00	32.30	4.15	5.50
	Boston, Mass	Plantsville: C. A. Cowles	11.40	6.05	12.75	15.00	10.90	11.00	53.45	5.45	3.50
'	Larrabee Flour Mills Co.,						300				7 3
	Kansas City, Mo	Canton: Canton Creamery	10.40	7.39	15.63	15.00	10.35	10.00	51.83	4.40	3.50
3	Minneapolis Milling Co., Min-	Ansonia: Ansonia Flour & Feed		C 10	15 91	14 50	11.30	19 00	EG 19	5.43	5.00
	neapolis, Minn	. Co	5.05	0.18	10.51	14.00	11.50	12.00	30.15	0.40	5.00
	Binghamton, N. Y	Stratford: Z. C. Ingersol	10.68	4.75	13.00	13.00	8.38	10.00	57.78	5.41	3.00
	Pure (extra broad). National										
	Milling Co., Toledo, Ohio	Granby. E. H. Rollins	7.01	6.53	15.69	14.00	9.15	10.00	57.12	4.50	3.00
	Pure. National Milling Co.,	Istanan Darlanan Casia Co	10 65	7 07	17.00	14 00	0 00	10.00	E9 20	4.38	3.00
	Toledo, Ohio	Lebanon: Berkman Grain Co East Winsted: Leonard Grain	10.05	7.07	17.00	14.00	8.00	10.00	34.50	4.58	5.00
	Mills Co., Omaha, Neb	Co	10.13	6.41	16.13	15.50	8.93	11.00	54.07	4.33	3.50

			Pounds per Hundred										
		Retail Dealer		Ash	Protein (N x 6.25)		F	iber	extract etc.)	F	at		
Manufacturer and Brand ON Horizontal	Manufacturer and Brand				Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, et	Found	Guaranteed, not less than		
	WHEAT PRODUCTS—Continued.		%	%	%	%	%	%	%	%	%		
	Wheat Bran—Concluded.												
3805 3659 3204 9 3771 7923	Niagara Choice. Niagara Falls Milling Co., Niagara Falls, N. Y Pure. Northwestern Consolidated Milling Co., Minneapolis, Minn. Ogilvie. Ogilvie Flour Mills Co., Montreal, Canada Pillsbury's. Pillsbury's Flour Mills, Minneapolis, Minn Bell Cow. Quaker Oats Co., Chicago, Ill Superior. Robin Hood Mills, Calgary, Canada Occident. Russell Miller Milling Co., Minneapolis, Minn.	Derby: Peterson-Hendee Co Wallingford: A. E. Hall Hamden: I. W. Beers Plainville: W. S. Easton Waterbury: Spencer Grain Co Shelton: Wolf Savitsky Waterbury: Spencer Grain Co	8.75 10.50 10.05 10.11	5.13 6.16 5.82 7.33 5.39 5.04 6.09	16.69 15.00 14.94 15.13	13.50 15.00 14.00 15,00	8.53 9.60 6.85 9.53 10.12	11.00 12.00 11.50 12.00 10.00 11.50	53.74 55.25 55.39 54.42 52.14	5.45 5.08 5.58 4.99 5.48 5.65 6.18	3.50 4.00 3.50 4.00 3.50 3.50 4.00		

	CONTRACTOR OF THE PROPERTY OF	* *								
118	Red Turkey. Southwestern Milling Co., Kansas City, Mo. St. Lawrence Milling Co., Montreal, Canada	Seymour: Seymour Grain &		15.94 14.50			11.00 11.50		4.18	3.50
102	Standard Milling Co., Toronto, Canada	Farmington: Winchell Smith. 12.03	5 16	14.25	15 00	0.75	11.50	52 00	5.43	3.50
9991	Tioga. Tioga Empire Feed		0.40	14.20	15.00	9.10	11.50	35.08	3.45	3.30
8312	Mills, Waverly, N. Y Gold Medal. Washburn-Crosby	Plantsville: C. A. Cowles 11.33	6.24	12.88	13.00	7.85	10.00	57.61	4.09	3.00
0012	Co., Minneapolis, Minn	Branford: S. V. Osborn, Est 6.95	5.66	14.38	14.00	9.63	12.00	58.03	5.35	4.00
	Wheat Middlings, etc.							7:		2,00
114	Dandy Shorts. Copeland Flour						2 2			
045	Mills, Midland, Canada	Shelton: Wolf Savitsky 11.18	4.16	16.50	16.00	6.58	8.00	56.04	5.54	5.00
315	Wheat Shorts. Dominion Flour Mills, Montreal, Canada	Branford: S. V. Osborn, Est 5.95	1.20	16.63	16 00	7.34	8 00	59.69	6.10	5.00
818	Elmore Snow Middlings. E1-		1.20	10.00	10.00	1.04	8.00	09.09	0.10	3.00
594	more Milling Co., Oneonta, N. Y	Thompsonville: Geo. S. Phelps & Co	3.88	16.38	16.00	5.73	7.00	58.46	4.65	4.25
183	Son, Lancaster, Pa	Devon: Devon Coal & Ice Co 5.70	3.40	15.81	16.00	5.43	6.00	65.11	4.55	4.00
727	Ohio	Highwood: T. C. Hadden & Co. 9.40	4.54	16.50	15.00	6.65	9.00	57.81	5.10	4.00
Kat	Jones-Jewell Milling Co., New York City	Southington: Southington Lumber Co	4.64	16.56	15.00	7.93	9.50	57.64	5.43	5.00
022	Ben Hur Hard Wheat Flour. Hennepin Mill Co., Minne-	Thomaston: Thomaston Supply		FE				EST		
	apolis, Minn	Co	4.01	15.81	16.00	4.10	6.00	60.52	5.35	4.00

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						Pound	s per Hu	ndred			
		Retail Dealer		Ash	Protein (N x 6.25)				extract etc.)	F	at
Station No.	Manufacturer and Brand		Water		Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e	Found	Guaranteed, not less than
	WHEAT PRODUCTS—Continued. Wheat Middlings, etc.—Cont.		%	%	%	%	%	%	%	%	%
8024	Ben Hur Hard Wheat Standard. Hennepin Mill Co., Minneapolis, Minn	Thomaston: Thomaston Supply	10.25	4.60	16.25	15.00	7.95	9.50	55.42	5.53	4.00
8475 8486	Ben Hur Middlings. Hennepin Mill Co., Minneapolis, Minn. Black Hawk Flour. Interna-	West Cheshire: Cheshire Grain & Coal Co	6.43	4.49	16.63	15.00	7.71	9.50	58.84	5.90	4.00
9934	tional Milling Co., Minneapolis, Minn	Plantsville: C. A. Cowles	9.40	2.44	16.13	15.00	2.73	4.50	65.10	4.20	3.50
155	dlings. International Milling Co., Minneapolis, Minn Standard Middlings. King	Stratford: Z. C. Ingersoll	10.91	4.73	16.31	15.00	7.28	8.50	55.45	5.32	4.50
7931	Midas Mill Co., Minneapolis, Minn	Wallingford: Laden Bros	1	4.53	16.00		7.20		55.84	5.75	4.00
243	ter & Sons, Winsted	Winsted: E. Manchester & Sons Winsted: E. Manchester & Sons		3.70 3.54	16.25 16.56	15.00 15.00	6.03 5.43		59.13 60.14	4.48	4.00

288	Moon's Fresh Ground White.							Line			
	Geo. Q. Moon & Co., Bing-			100	A Figure						
	hamton, N. Y	Norfolk: Aug. P. Curtis	8.98	2.14	15.00	15.00	2.18	3.50	67.92	3.78	3.50
358	Pure Flour. Nebraska Consoli-	East Winsted: Leonard Grain	9.65	1 99	17.38	16 00	5.18	5 50	58.56	5.00	4.50
8495	dated Mills, Omaha, Neb Palmo Midds. Newsome Feed	Co	9.00	4.40	17.30	10.00	0.10	3.30	30.30	3.00	4.50
0430	& Grain Co., Pittsburg, Pa.	Plantsville: Mehmel & Sarvi	6.45	4.90	15.63	16.00	5.83	9.00	56.49	10.70	7.00
8804	Niagara Choice. Niagara Falls										
	Milling Co., Niagara Falls,							-			
	N. Y	Derby: Peterson-Hendee Co	8.45	4.52	16.25	15.50	7.55	9.50	57.28	5.95	4.00
8641	Flour. Northwestern Consoli-			110			1	1			og n
	dated Mill Co., Minneapolis,	37 77 777 701	- 0-	0 70	10 00	15 00	- 00	0.00	00 04	0.05	1 00
374	Minn	No. Haven: W. L. Thorpe	5.35	3.70	16.00	15.00	5.90	0.00	62.94	6.05	4.00
314	Consolidated Milling Co.,	Bloomfield: Bloomfield Farmers'							6.5-1		
	Co., Minneapolis, Minn.	Exchange	9.55	4 78	16 69	15.00	8.08	9 50	55.25	5.65	4.00
8203	Ogilvie's Wheat Shorts. Ogilvie	Zhononge	0.00		20.00	10.00	0.00		00.20		
	Flour Mills Co., Montreal,										
	Canada	Hamden: I. W. Beers	8.25	5.11	15.75	16.00	7.45	8.00	57.71	5.73	5.00
9953	Flour. Park & Pollard Co.,			0.05	10.00	10.00	4 00	0.00	00 00	1	1 00
	Buffalo, N. Y	Derby: Peterson-Hendee Co	11.46	3.25	16.00	16.00	4.83	6.00	60.22	4.24	4.00
8	Pillsbury's Hard Wheat A.										555
	Pillsbury Flour Mills, Minneapolis, Minn	Plainville: W. S. Eaton	10.00	3 81	17 75	16.00	4.50	6 00	58.06	4.98	4.00
10	Pillsbury's Hard Wheat Stand-	Tidinville. W. S. Edion	10.90	0.01	11.10	10.00	1,00	0.00	00.00	1.00	1.00
10	ard B. Pillsbury Flour Mills.						151.45				
	Minneapolis, Minn	Plainville: W. S. Eaton	10.78	4.73	17.31	15.00	6.80	9.50	55.14	5.24	4.00
7801	Superior Wheat Shorts. 'Robin							1 2 2 3			
	Hood Mills, Ltd., Calgary,						-				-
405	Canada	Plantsville: C. A. Cowles	10.73	4.02	18.75	17.00	7.80	8.00	53.38	5.32	5.00
135	Wirthmore Flour. St. Albans	Pugufand, C V Oaham Est	10 00	1 26	15 44	15.00	5.58	6 00	58.84	4.80	4.00
103	Gain Co., St. Albans, Vt Shorts. Standard Milling Co.,	Branford: S. V. Osborn Est Bloomfield: Bloomfield Farmers'	10.98	4.00	10.44	15.00	0.08	0.00	00.04	4.00	4.00
103	Toronto, Canada	Exchange	10 98	4 65	16 75	16.00	6.85	8 00	55.12	5.65	5.00
	101011to, Canada		10.00	1.00	10.10	20.00	3.00	5.00	00.12	0.00	3.00

CONNECTICUT EXPERIMENT STATION

BULLETIN 303

			Pounds per Hundred										
			Ash		otein 6.25)	Fiber		extract etc.)	F	`at			
Station No.	Manufacturer and Brand	Retail Dealer		Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free ex (starch, gum, et	Found	Guaranteed, not less than			
0500	WHEAT PRODUCTS—Continued Wheat Middlings, etc.—Concl.		%	%	%	%	%	%	%	%	%		
8790 8197	Pennant. David Stott Flour Mills, Detroit, Mich Syragold Flour. Syracuse Mill-	Waterbury: Spencer Grain Co.	7.30	4.96	15.13	15.00	7.61	9.00	59.90	5.10	4.00		
411	ing Co., Syracuse, N. Y Syragold Flour. Syracuse Mill-	Litchfield: Wadhams Co	6.20	3.86	17.13	15.00	5.88	6.00	62.05	4.88	4.00		
7952	ing Co., Syracuse, N. Y Angelus. Thompson Milling	Colchester: P. Cutler Inc		3.01	15.44	15.00	3.83	6.00	62.81	4.43	4.00		
9999	Co., Lockport, N. Y	Waterbury: Spencer Grain Co	22.41	4.48	19.00	15.50	6.40	7.00	41.89	5.82	4.50		
315	lis, Minn	Plantsville: C. A. Cowles	10.98	4.73	16.81	15.00	7.08	9.50	55.45	4.95	4.00		
	tic Grain & Products Co., Norwich	Mystic: Mystic Grain Co	10.95	3.80	15.38	17.00	6.45	6.00	58.62	4.80	5.00		
7943	Wheat Red Dog, etc. Wingold Diamond G. Bay State Milling Co., Winona, Minn.	Danbury: F. C. Benjamin	11.90	2.70	17.00	17.00	2.38	$2.5\mathring{0}$	61.64	4.38	3.50		

8275	Eshelman's. John W. Eshel-	Thompsonville: Geo. S. Phelps						S. 55			
8729	man & Sons, Lancaster, Pa. The Fairfax Milling Co., Fair-	& Co	7.48	2.92	16.50	16.00	3.35	4.00	65.75	4.00	4.00
0.20	fax, Minn	New Haven: Moran-Patton Co.	5.68	2.60	16.75	14.50	2.60	4.00	68.99	3.38	3.00
8766	Red Wing Special. The Fairfax Milling Co., Red Wing,			,							
	Minn	Plantsville: C. A. Cowles	9.80	2.63	16.50	14.50	2.75	4.00	64.54	3.78	3.00
7850	Hecker - Jones - Jewell Milling	Higganum: F. A. Petrofsky	10 20	9 10	18.44	15 75	3.30	1 00	59.23	5.55	4.50
8490	Co., New York City Black Hawk Wheat Low Grade	Higganum: F. A. Fetiolsky	10.50	0.10	10.44	15.75	3.30	4.00	09.20	0.00	4.00
0100	Flour. International Milling							100			
	Co., Minneapolis, Minn	Plantsville: C. A. Cowles	10.70	1.13	14.50	14.00	0.83	1.50	70.26	2.58	1.80
8013	Modoc Low Grade Flour. H. H.	7 77''' T TI''I TS 1	V 25 7			M SEC	12 / Let	7.794	2.5	14.7	
	King Flour Mills, Minneapolis, Minn		10.06	3.48	19.44	16 00	4.15	4.00	57.82	5.05	4.00
937	Maritime Milling Co., Buffalo,		10.00	0.40	19.44	10.00	4.10	4.00	01.02	0.00	4.00
	N. Y	New Milford: Geo. E. Ackley & Co	10.85	3.38	16.75	16.00	3.65	4.00	61.17	4.20	4.00
138	Wirthmore. St. Albans Grain	New Haven: R. G. Davis &				7.35					
445	Co., St. Albans, Vt	Sons	11.03	2.21	15.06	16.00	2.28	4.00	66.14	3.28	4.00
145	Washburn's Gold Medal Adrian. Washburn-Crosby Co., Min-	Manchester: Manchester Grain							1	E-May 1	
	neapolis, Minn	& Coal Co	10 60	2 20	15.50	16.00	1.90	4 00	66.28	3.52	3.50
	iicapons, minir	a Coar Co	10.00	2.20	10.00	10.00	1.50	1.00	00.20	0.02	0.00
					1.77	Lay of					
000	Wheat Feed (Mixed Feed).										
263	Crosby's. Crosby Milling Co., Brattleboro, Vt	Kent: Kent Grain & Coal Co.	10 10	F 16	15 00	15.00	6.98	0 50	57.82	4.55	4.50
023	Ben Hur Fancy Mixed. Henne-	Kent: Kent Gram & Coar Co.	10.49	5.10	15.00	15.00	0.90	9.50	31.82	4.00	4.00
020	pin Milling Co., Minneapo-	Thomaston: Thomaston Supply									
	lis, Minn	Co	10.87	4.18	14.81	16.00	6.13	7.50	59.56	4.45	4.00
676	Gold Mine. H. H. King Flour		- 0-		40.00		0 10	0.00	F0 10	F 00	4 50
242	Mills, Minneapolis, Minn	Kensington: S. F. Labieniec	5.35	5.03	16.00	15.00	8.40	9.50	59.42	5.80	4.50
442	Red Star. E. Manchester & Sons, Winsted	Winsted: E. Manchester & Sons	9 78	4.71	16.31	15 00	6.78	7 50	57.74	4.68	4.00
	Solis, Willisted	William Chester & Dolls	0.10	2.11	10.01	10.00	0.10	1.00	01.11	1.00	1.00

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						Pound	ls per Hu	indred			
	Manufacturer and Brand	Retail Dealer				Protein (N x 6.25)		iber	extract etc.)	F	at
Station No.			Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	WHEAT PRODUCTS—Continued. Wheat Feed (Mixed Feed)— Concluded.		%	%	%	%	%	%	%.	%	%
295 119	Bull. Maritime Milling Co., Buffalo, N. Y. Red Wing. Meech & Stoddard,	New Milford: Geo. E. Ackley & Co	9.85	4.27	14.25	15.00	7.43	8.00	59.75	4.45	4.00
120	Inc., Middletown, Conn Moon's. Geo. Q. Moon & Co.,	East Hartford: Meech Grain Co.	10.40	4.30	15.13	15.00	6.55	10.00	58.92	4.70	4.50
50	Binghamton, N. Y	Manchester: I. P. Campbell		5.82	15.50			10.00		4.85	4.00
640	Toledo, Ohio	Simsbury: Woods-Chandler Co	10.15	5.24	16.75	15.00	7.65	10.00	55.75	4.46	4.50
402	Minneapolis, Minn	No. Haven: W. L. Thorpe	5.30	3.03	18.13	16.00	2.58	4.00	65.06	5.90	4.00
795	Minn	Farmington: Winchell Smith	10.28	5.41	16.38	15.00	7.80	8.50	54.68	5.45	4.00
	bury Flour Mills, Minneapolis, Minn	Thomaston: Thomaston Supply Co	8.10	2.28	17.50	16.00	1.43	4.00	66.01	4.68	4.00

183	Pillsbury's Fancy Mixed. Pillsbury Flour Mills, Minneapo-										
8563	lis, Minn			3.75	17.50	15.00	4.10	8.50	59.17	5.25	4.00
136	Co., Minneapolis, Minn Wirthmore. St. Albans Grain	Co	7.68	4.43.	16.06	15.00	7.10	9.50	58.95	5.78	4.50
260	Co., St. Albans, Vt Washburn's Gold Medal. Washburn Crosby Co., Minneapo-	Branford: S. V. Osborn Est	10.83	4.46	14.13	15.00	7.18	.8.00	58.82	4.58	4.50
442	lis, Minn . Washburn's Gold Medal. Washburn Crosby Co., Minneapo-	Torrington: D. L. Talcott	10.00	4.10	14.63	16.00	6.63	7.50	60.04	4.60	4.00
362	lis, Minn	New Milford: Geo. T. Soule		4.14	16.00	16.00	5.45	7.50	58.88	4.53	4.00
	Products Co., Norwich	Abington: Weeks Bros	10.25	4.39	15.31	16.00	7.58	8.00	57.24	5.23	4.50
	MAIZE PRODUCTS. Corn Gluten Feed.										
8709	American Maize Products Co., New York City			4 =0	00.00						
8580	Amco. American Milling Co.,	Inc	7.20		28.06		7.63	8.50	50.03	2.35	2.00
8566	Peoria, Ill				10.00		3.43	5.00	73.00	4.95	4.00
8184	Refining Co., Clinton, Iowa. Buffalo. Corn Products Refin-	Coal Co	6.63	5.83	27.06	23.00	6.83	8.50	50.65	3.00	2.00
9985	ing Co., New York City Diamond. Corn Products Re-	Highwood: T. C. Hadden & Co.	7.50	6.41	24.25	23.00	7.55	8.50	52.01	2.28	2.00
157	fining Co., New York City Keokuk. J. C. Hubinger Bros.	Southbury: H. R. Stone	8.35	1.25	39.56	40.00	2.88	4.00	44.21	3.75	1.00
8476	Co., Keokuk, Iowa	Norwalk: Frank Libner & Sons West Cheshire: Cheshire Grain	9.58	4.00	28.25	23.00	7.18	8.50	48.86	2.13	2.00
8677	Decatur, Ill	& Coal Co	6.45	5.96	25.25	23.00	5.50	8.00	54.09	2.75	1.00
3011	Columbus, Ind	Kensington: S. F. Labieniec	7.15	7.52	26.81	23.00	7.30	8.00	49.24	1.98	1.00

						Pounds per Hundred						
		Retail Dealer			Protein (N x 6.25)		Fib	oer	extract etc.)	Fa	t	
Station No.	Manufacturer and Brand		Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e	Found	Guaranteed, not less than	
	MAIZE PRODUCTS—Continued.		%	%	%	%	%	%	%	%	%	
8644 8559 8767 356 352 49 9933 8792	Hominy Feed. Advance. Advance Milling Co., Chicago, Ill	Manchester: Little & McKinney Bloomfield: Bloomfield Farmers' Exchange Stratford: Z. C. Ingersoll Thomaston: Thomaston Supply	8.80 10.33 8.41	8.27 2.22 2.17	10.94	10.00	3.95 4.60 3.65 4.95 5.48 3.25 5.98 4.65	6.00 5.00 5.00 6.00 5.00 6.00	70.40 68.54 67.94 63.76 60.06 69.64 66.10 65.13	7.00 7.25 6.70 6.63 5.83 3.93 6.40 7.50	7.00 7.00 6.00 6.00 7.00 4.00 5.00 7.00	

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8672	Patent Cereal Co., Geneva,	East Wallingford: D. W. Ives	5 95	9 51	10.88	10.00	3.83	5.00	73.43	4.10	5.0
8492	N. Y							TEAT			
8629	Battle Creek, Mich Pratt's White, Pratt Food Co.,	Plantsville: Mehmel & Sarvi	10.65	1.82	10.00	10.00	2.73	5.00	65.10	9.70	6.0
	Buffalo, N. Y	Norwalk: Frank Libner & Son	5.60	2.65	11.25	10.00	4.23	6.00	71.12	5.15	4.0
792	White. Quaker Oats Co., Chicago, Ill	Highwood: T. C. Hadden & Co.	11.16	1.86	9.50	10.50	4.69	6.00	67.73	5.06	5.0
674	Quaker Oats Co., Chicago, Ill.	Wallingford: Laden Bros	6.30	2.11	10.56		4.18	8.00	71.70	5.15	5.0
148	Yellow. Quaker Oats Co., Chicago, Ill	Long Hill: Long Hill Feed Store	10.55	2.38	11.25	10.50	3.88	6.00	67.59	4.35	5.0
L88	White. Quaker Oats Co., Chicago, Ill	Danbury: C. S. Barnum & Son	8 85	2 15	10 00	10.50	5.18	6.00	68.42	5.40	5.0
581	Paragon. St. Albans Grain Co.,										V
	St. Albans, Vt	Newington: Thos. Holt	6.20	3.25	10.63	10.00	4.48	7.00	67.99	7.45	6.
101	Rye Products.										
661	Miner-Hillard Milling Co., Wilkes-Barre, Pa	Wallingford: A. E. Hall	7.90	3.53	15.63	12.00	4.20	5.00	65.31	3.43	2.
83	Upper Hudson Rye Flour Mills, Troy, N Y		7.88	3 62	14.88	13 50	4.33	6 00	66.29	3.00	3.
		Troducts Co	1.00	5.02	14.00	10.00	4.00	0.00	00.23	3.00	0.
	Brewers' AND DISTILLERS' GRAINS.							1752			
17	Dewey's Distillers Dried Grains.				125					157	
	Dewey Bros. Co., Blanchester, Ohio	Norwich: Yantic Grain Co	7.70	4.70	28.44	30.00	9.40	13.00	39.36	10.40	10.
09	Dewey's Distillers Dried Grains. Dewey Bros., Blanchester,	Norwich: Yantic Grain &						P 3.5			
	Ohio	Products Co	7.48	4.70	28.50	30.00	8.63	13.00	40.49	10.20	10.
25	Bull Brand Dried Brewers Grains. Farmers' Feed Co.,	Long Hill: Long Hill Feed									
	Buffalo, N. Y	Store	5.95	3.75	23.44	22.00	16.43	15.00	43.38	7.05	6.

Pounds per Hundred

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		Retail Dealer			Protein (N x 6.25)		Fiber		extract etc.)	F	'at
Station No.	Manufacturer and Brand		Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	Brewers' AND DISTILLERS' GRAINS—Continued.										
106 976	Bull Brand Dried Grains. Far- mers' Feed Co., York City Alco Dried Brewers' Grains.	New Haven: R. G. Davis & Sons	6.00	3.50	24.38	22.00	15.35	15.00	43.92	6.85	6.00
146	C. J. Martenis Grain Co., New York City	Seymour: Seymour Grain & Coal Co	8.20	3.86	21.06	21.00	13.85	20.00	46.59	6.44	6.00
216	C. J. Martenis Grain Co., New York City	Guilford: Fred C. Morse	7.50	1.89	27.75	30.00	10.98	15.00	43.33	8.55	8.00
	bans Grain Co., St. Albans, Vt	Danbury: F. C. Benjamin	8.78	3.95	20.81	21.00	13.38	15.00	46.80	6.28	5.00
191	DRIED BEET PULP. The Larrowe Milling Co., Detroit, Mich.	Hamden: I. W. Beers	5.51	3.21	9.38	8.00	18.33	22.00	62.82	0.75	0.50
961	Molasses Beet Pulp. The Larrowe Milling Co., Detroit, Mich	Ansonia: Ansonia Flour & Feed Co	11.08	4.98	7.06	8.00	13.83	20.00	62.49	0.56	0.50

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	PROPRIETARY MIXED FEEDS. Horse Feed, etc.				SO VE					
7902	Amco. American Milling Co., Peoria, Ill.	Middletown: Charles Dragoo 8.70	10.80	13.19	10.00	17 13	21 00	40 33	0.85	0.50
7933	Amco. American Milling Co.,								3.60	2.50
8577	Peoria, Ill	Falls Village: H. E. Dean 10.48			9.00	7.46		65.71		
8579	Peoria, Ill	Newington: Thos. Holt 7.23	3.15	9.38	9.00	6.83	9.00	68.53	4.88	3.50
379	Molasses. American Milling Co., Peoria, III	Newington: Thos. Holt 6.85	10.41	12.38	10.00	18.53	21.00	51.15	0.68	0.50
7010	oria, Ill	Gildersleeve: John H. Fay 10.48	2.50	11.31	10.00	6.03	10.00	65.35	4.33	4.00
7912	Wonder. Arcady Farms Milling Co., Chicago, Ill	Putnam: Dayville Grain Co 6.90	4.58	10.00	10.50	9.08	10.00	65.61	3.83	3.00
8279	Chariot. Beacon Milling Co., Cayuga, N. Y	Danbury: C. S. Barnum & Son 5.50	5.16	10.00	8.00	7.59	10.00	69.35	2.40	2.00
8280	Beacon Hog Feed Beacon Milling Co., Cayuga, N. Y.	Bethlehem: A. T. Minor 6.95	7.59	19.81	18.00	6.50	7 00	53.55	5.60	5.00
149	Beacon. Beacon Milling Co.,				9.00		11.00		3.20	2.50
7853	Cayuga, N. Y					1				
310	R. I	Westerly: C. W. Campbell Co 12.01		11.38		6.68		59.78	4.05	
311	Stonington, Conn	Mystic: C. W. Campbell Co. 10.28	2.82	10.63	10.00	7.25	10.00	63.74	5.28	4.00
36	ton, Conn	Groton: C. W. Campbell Co 10.98 Collinsville: Rourke-Robotham	4.14	10.13	10.00	9.05	12.00	62.50	3.20	4.00
	Ajax. Chapin & Co., Chicago,	Co 9.12	6.08	11.38	9.00	10.23	12.00	59.70	3.49	3.00
7920	Co-Pro-Co. Corn Products Refining Co., New York City.	Westerly: C. W. Campbell Co. 5.88	5.79	10.06	9.00	13.15	12.00	61.67	3.45	2.50
9924	Davis. R. G. Davis & Sons, New Haven, Conn	Milford: Milford Grain Co 10.51	4.02	9.63	9.00	7.65	10.00	64.71	3.48	3.00

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred									
			Water	Ash		rotein x 6.25)	1	Fiber			Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Found	Guaranteed, not less than	
	PROPRIETARY MIXED FEEDS— Continued.		%	%	%	%	%	%	%	%	%	
	Horse Feed, etc.—Continued.				679	Barrier.		13.79		744	Reg	
9962	Davis No. 1 Provender. R. G. Davis & Sons, New Haven,											
312	Conn	Ansonia: Ansonia Flour & Feed	11.85	2.86	10.00	10.00	8.18	8.00	64.23	2.88	3.50	
7619	Conn	New Haven: R. G. Davis & Sons	10.48	3.26	10.56	10.00	7.83	8.00	63.87	4.00	3.50	
9927	Lamar, Colorado	New Haven: R. G. Davis & Sons		9.86	13.63	13.00						
618	rado	Devon: Devon Coal & Ice Co	9.44	9.03	14.50	13.00	30.53	33.00	34.54	1.96	1.00	
	falfa Milling Co., Lamar, Colorado	New Haven: R. G. Davis & Sons		14.35	19.38	20.00						

		N	8:								
9928	Alfalfa Leaf Meal (Leafalfa										
	Brand). Denver Alfalfa Milling and Products Co.,			10.01	24.05	22.00		10.00	00 50	0.00	0 50
8645	Lamar, Colorado Eastern States Open Formula.	Devon: Devon Coal & Ice Co.	9.90	12.21	21.25	20.00	14.03	18.00	39.53	3.08	2.50
	Eastern States Farmers' Exchange, Springfield, Mass	North Haven: Ridgewood Farm	7 40	3 94	11.00	11 00	5.90	7.00	67.37	4.39	3.50
159	Elmore, with Molasses. Elmore	Thomaston: Thomaston Supply									0.50
8273	Milling Co., Oneonta, N. Y. Eshelman's Red Rose 85. John	Co	11.80	3.33	10.50	9.00	6.73	11.00	63.61	4.03	2.50
	W. Eshelman & Sons, Lan- caster, Pa	Hamden: I. W. Beers	6.41	3.38	9.06	9.00	5.43	10.00	72.37	3.35	3.00
218	Liberty. John W. Eshelman & Sons, Lancaster, Pa	Southport: C. Buckingham & Co	11 63	7.45	9.06	7.00	9.60	10.00	59 76	2.50	2.00
219	Lancaster 60. John W. Eshel-										
7948	man & Sons, Lancaster, Pa. Flory's. Flory Milling Co.,	So. Norwalk: Roodner Feed Co.		4.37	9.81	9.00		10.00		3.43	2.50
107	Bangor, Pa	Long Hill: Long Hill Feed Store	8.01	4.09	9.13	9.00	9.30	10.00	65.82	3.65	2.50
	gor, Pa	Long Hill: Long Hill Feed Store	11.43	5.37	6.88	6.00	13.55	12.00	60.77	2.00	2.00
7800	Bronco. Grain Belt Mills Co., St. Joseph, Mo	Plantsville: Mehmel & Sarvi	10.45	6.58	10.94	9.00	13.33	15.00	57.10	1.60	2.00
1111	Bronco. Grain Belt Mills Co.,			100		5 7 8				1 00	2.00
1581	So. St. Joseph, Mo	Westville: R. G. Davis & Sons East Hartford: Meech Grain			11.13			15.00		1.88	
8272	St. Louis, Mo	. Co	11.25	6.59	9.75	9.00	8.50	14.00	61.88	2.03	2.00
	Co., Chicago, Ill	Highwood: T. C. Hadden & Co.	5.04	5.54	9.25	9.00	10.93	15.00	66.96	2.28	2.00
112	College. Hales & Hunter Co., Chicago, Ill	Highwood: T. C. Hadden & Co.	6.88	4.99	10.63	9.00	9.80	10.00	64.82	2.88	2.50
117	Pioneer Hog Feed. Hales &				21.06		6.70			4.28	4.00
	Hunter Co., Chicago, Ill	Highwood: T. C. Hadden & Co.	0.18	0.02	21.00	10.00	0.70	9.00	30.00	4.40	4.00

Fiber

Guaranteed, not more than

%

28.00

4.60

12.00

10.00

6.63 10.00 68.32

10.00 64.57

extracetc.)

Nitrogen-free (starch, gum, e

%

52.36

68.81

66.16

51.18

Fat

Found

%

2.73

4.35

2.98

5.60

3.73

3.93

3.00

tranteed. less than

Guan not 1

Protein (N x 6.25)

Found

%

7.38

9.81

10.50

19.50

9.63

9.19

Guaranteed, not less than

5.00

9.50

8.00

18.00

8.00

9.00

24.45

4.90

5.13

9.05

8.75

Water

%

6.58

10.05

9.95

8.65

%

6.50

2.08

2.90

6.24

3.37

3.28

Retail Dealer

Middletown: Meech & Stoddard

Middletown: Meech & Stoddard

Thomaston: I. Levy......

New Milford: Geo. E. Ackley

Co.....

Middlefield: Middlefield Grain

& Coal.....

Inc.....

Inc.....

Collinsville: Lawton-Miner Co. 8.43

Manufacturer and Brand

PROPRIETARY MIXED FEEDS-Continued. Horse Feed, etc.-Continued. Re-Ground Oat Feed. Hecker-H. O. Company, Buffalo,

H. U. Collipany, N. Y.

N. Y.

Imperial Steam Cooked. Imperial Grain & Mill Co., Toledo, Ohio.

Badger. Chas. A. Krause Milling Co., Milwaukee, Wis.

Larro Hog Feed. Larrowe Milling Co., Detroit, Mich.

Bull Brand with Molasses.

Maritime Milling Co., Buffalo, N. Y.

Red Wing Molasses. Meech &

Steddard Inc. Middletown

Stoddard, Inc., Middletown,

Conn.....

No. Station

130

8707

156

412

440

8803

								18			
318	"1795" Steam Cooked Corn and				Sec.						
8319	Oats. Miner-Hillard Milling Co., Wilkes-Barre, Pa Old Mill Provender. Fred C.	Westerly: C. W. Campbell Co.			10.75	9.50	6.20		67.47	4.18	4.00
9922 7852	Morse, Guilford, Conn Fred C. Morse, Guilford, Conn. Domino Pep-O-Lene. Nowak	Guilford: Fred C. Morse Guilford: Fred C. Morse	$6.65 \\ 12.52$	$\begin{bmatrix} 2.51 \\ 3.97 \end{bmatrix}$	10.81	10.00	5.50 6.33		69.08 61.37	5.45 4.12	4.00
52	Milling Corp., Hammond, Ind	Higganum: F. A. Petrofsky	12.20	2.98	9.00	8.00	7.68	10.00	64.34	3.80	2.00
7845	Milling Corp., Hammond, Ind	Bloomfield: Bloomfield Farmers' Exchange		3.69	9.88	8.00	7.18		64.58	4.12	2.00
7797	Est., Branford, Conn Belmont. Park & Pollard Co., Buffalo, N. Y.	Branford: S. V. Osborn Est West Cheshire: Cheshire Grain & Coal			11.31		5.75		65.39 62.75	4.05	4.00
7922 8479	Corn & Oats ½ and ½. Park & Pollard Co., Buffalo, N. Y Arlington. Park & Pollard Co.,	Shelton: Shelton Feed Co			10.25		8.23		63.24		1.50
181	Buffalo, N. Y	Plainville: F. B. Newton		3.62 7.01	9.88	9.00			66.68 57.92	4.55	2.50
8710	Buffalo, N. Y	Waterbury: Spencer Grain Co. West Cheshire: Cheshire Grain									
320	man, New Mexico	& Coal							40.65	2.05	1.50
7589	man, New Mexico	Botsford: G. T. Rasmussen Danbury: C. S. Barnum & Son			1	17.00	21.45 10.06			2.55	1.50
185	Utility. Pratt Food Co., Buffalo, N. Y.	Bristol: Bristol Grain & Supply		4.88					64.36		

1				1880							
392	Diamond 85%. Rockville, Grain & Coal Co., Rockville,	Manchester: Manchester Grain									
8761	Conn	& Coal Co	10.05	3.25	10.44	9.00	7.15	10.00	64.71	4.40	3.00
9995	Sons, Brooklyn, N. Y Wirthmore. St. Albans Grain	Bridgeport: Conn. Feed Co	6.40	11.35	9.38	6.00	8.79	15.00	61.35	2.73	0.80
214	Co., St. Albans, Vt Charlestock: St. Albans Grain				10.69		6.88	9.00	62.64	3.19	3.25
143	Co., St. Albans, Vt Syragold, with Molasses. Syra- cuse Milking Co., Syracuse,	Co	9.23	4.02	10.44	9.00	11.40	14.00	60.13	4.78	4.00
144	Jordan, with Molasses. Syracuse	East Bridgeport: J. Simon		4.34	9.81	8.00	10.15	12.00	65.72	2.50	2.50
335	Milling Co., Syracuse, N. Y. Syragold Ground Corn and Oat Feed. Syracuse Milling Co.,	East Bridgeport: J. Simon	7.78	6.40	9.50	7.00	12.00	12.00	61.57	2.75	2.00
8753	Syracuse, N. Y	Colchester: P. Cutler, Inc New Britain: Stanley-Svea		2.81	11.13	10.00	7.78	9.50	63.00	4.65	4.00
8759	Waverly, N. Y	Grain Co	11.55	3.58	10.56	10.00	7.13	9.00	63.33	3.85	3.50
256	Waverly, N. Y	So. Norwalk: Roodner Feed Co.	13.80	1.47	8.88	9.02	2.95	3.50	69.05	3.85	3.06
	Empire Feed Mills, Waverly, N. Y.	Hawleyville: W. A. Honan	10 13	2 83	10.69	9.20	7.70	8 00	63.62	5.03	4.00
8621	Special Rosebro. Vitality Mills, Inc., Chicago, Ill	East Bridgeport: Kaplan Feed									
	The., Chicago, III	· Co	2.35	4.45	9.25	9.00	6.43	11.00	73.89	3.63	2.00
	Dairy Feeds.										
8477	Claco. C. L. Adams Co., Wood- bury, Conn	West Cheshire: Cheshire Grain & Coal Co	6 90	7 10	00 00	20.00	7 04	0.00			
7901	Amco 20% (Flexible Formula.)	a coar co	6.20	7.10	22.00	20.00	7.94	9.00	51.81	4.95	5.00
	American Milling Co., Peoria, Ill	Middletown: Charles Dragoo	11.25	7.76	23.25	20.00	6.25	9.00	47.13	4.36	4.00

CONNECTICUT EXPERIMENT STATION

BULLETIN 303

Table I. Analyses of Commercial Feeds, Inspection of 1928—Continued.

						Pound	ls per Hu	indred			
						Protein (N x 6.25)		ber	extract etc.)	F	at
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e: (starch, gum, et	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—Continued.		%	%	%	%	%	%	%	%	%
7903 7914	Dairy Feeds—Continued. Amco 20% National. American Milling Co., Peoria, Ill. Amco 24% (Flexible Formula). American Milling Co., Pe-	Middletown: Charles Dragoo	11.05	7.82	21.06	20.00	7.35	9.00	48.29	4.43	4.50
8574	oria, Ill	Middletown: Charles Dragoo	9.95	7.16	25.56	24.00	7.18	9.00	45.57	4.58	4.00
375	oria, III	Newington: Thos. Holt	8.58	8.35	21.00	20.00	5.63	9.00	53.14	3.30	4.00
397	oria, III	Gildersleeve: John H. Fay Farmington: T. E. Stephenson			22.81 21.19		6.25 8.65		51.41	3.38	4.00
7814	Advanced Registry. Arcady Farms Milling Co., Chicago, Ill.	Simsbury: Woods-Chandler Co.				25.00	113	32102		5.00	5.00

7 4							1		1	1	
29	Advanced Registry. Arcady Farms Milling Co., Chicago,								100		
394	Ill	Simsbury: Woods-Chandler Co.	9.33	5.27	24.13	25.00	9.83	10.00	46.74	4.70	5.00
7839	ing Co., Chicago, Ill Milkers Ready Ration. Arcady	Colchester: J. Buratz	9.13	9.11	23.88	24.00	10.00	11.00	42.50	5.38	4.50
	Farms Milling Co., Chicago, Ill	So. Manchester: Smith Bros	10.31	8.59	22.81	22.00	9.75	11.00	43.89	4.65	4.00
297	Milkers Ready Ration. Arcady Farms Milling Co., Chicago,						1000				
30	Ill	Colchester: J. Buratz	8.85	8.91	24.31	22.00	12.50	11.00	39.98	5.45	4.00
070	Arcady Farms Milling Co., Chicago, Ill	Simsbury: Woods-Chandler Co.	9.70	6.69	21.88	20.00	9.65	10.00	48.28	3.80	4.00
370 8496	Sweet 16. Arcady Farms Milling Co., Chicago, Ill Wonder. Arcady Farms Mill-	Danielson: Dayville Grain Co.	10.18	9.65	15.63	16.00	12.65	12.00	47.34	4.55	4.00
7908	ing Co., Chicago, Ill Bailey's Open Formula 20%.	Plantsville: Mehmel & Sarvi	7.70	8.25	25.00	24.00	7.05	10.00	46.55	5.45	5.00
1000	E. W. Bailey & Co., Montpelier, Vt	Merrow: I. F. Wilcox	9.80	10 41	20.38	20.00	10.43	9 00	44.33	4.65	4.50
7909	Bailey's Open Formula 24%. E. W. Bailey & Co., Mont-	Mansfield Depot: Martin M.	0.00	10.11	20.00	20.00	10.10	0.00	11.00	2.00	1.00
298	pelier, Vt	Hansen	10.60	8.18	25.00	24.00	8.43	9.00	42.19	5.60	4.50
398	Śwanton, Vt	Hansen	9.50		24.13		8.30	9.00	47.86	4.93	4.50
7936	Swanton, Vt	West Willington: H. M. Hansen New Milford: W. L. Richmond				20.00			49.79	4.30	4.50
9952	Inc., Cayuga, N. Y	& Son	9.60	6.26	20.00	20.00	8.50	9.00	51.04	4.60	5.00
	Milling Co., Inc., Cayuga, N. Y	Shelton: Shelton Feed Co	10.41	7.41	20.38	20.00	7.30	10.00	50.26	4.24	4.50

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						Pound	ls per Hı	ındred			
	Manufacturer and Brand		9.14			otein 6.25)	F	ber	extract etc.)	F	'at
Station No.	January and January	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, et	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—Continued.		%	%	%	%	%	%	%	%	
28 396 169 7795 7821 8560 193 8212	Dairy Feeds—Continued. Beacon Sweet 24. Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Sweet 24. Beacon Milling Co., Inc., Cayuga, N. Y. Beacon. Beacon Milling Co., Inc., Cayuga, N. Y. Beers. I. W. Beers, Hamden, Conn. Success. A. D. Bridges' Sons, Hazardville, Conn. Success. A. D. Bridges' Sons, Hazardville, Conn. L. B. Milk Ration. L. Broder, Colchester, Conn. C. B. C. Buckingham & Co., Southport, Conn.	New Britain: C. W. Lines Co. Danbury: C. S. Barnum & Son Danbury: C. S. Barnum & Son Hamden: I. W. Beers Hazardville: A. D. Bridges' Sons Hazardville: A. D. Bridges' Sons Colchester: L. Broder Southport: C. Buckingham & Co	9.00 8.65 11.30 9.65 8.00 9.00	6.91 7.89 4.93 5.17 4.90	25.13 24.00 20.25 21.63 21.06 20.19	24.00 24.00 24.00 19.00 20.00 20.00 22.82	7,80 7.50 8.85 7.61 9.50 8.89 6.85 9.08	9.00 10.00 8.00 9.50 8.50	48.03 47.81 46.01 51.30 49.24 51.82 51.63 46.79	4.08 3.65 4.60 4.61 4.81 5.33 5.55 4.83	4.50 4.50 5.00 3.75 5.20 5.00 5.50 4.61

									1	- 1	
301	No-Botheration. C. W. Camp-	Groton: C. W. Campbell Co	0 33	6.28	20.00	20.00	7 10	9 00	52.16	5.13	5.00
5	Ajax 16%. Chapin & Co.,	Plantsville: C. A. Cowles							52.45	3.15	3.00
7929	Chicago, Ill	East Winsted: Leonard Grain							43.54	4.78	4.50
162	Chicago, Ill			2015					43.59	4.45	4.50
8682	Chicago, Ill	Danbury: F. C. Benjamin	9.33	9.04	20.19	24.00	0.00	12.00	40.00	1.10	1.00
	Coles Co., Middletown,	Middletown: The Coles Co	7.10	6.66	20.75	20.00	6.83	9.00	53.91	4.75	4.00
8549	Fortune 24% Molasses. The Coles Co., Middletown, Conn.	Plantsville: Mehmel & Sarvi	8.15	6.38	24.13	24.00	9.20	9.00	47.16	4.98	4.50
8487	Unicorn. Chapin & Co., Chicago, Ill	Plantsville: C. A. Cowles			23.81	24.00	7.13	10.00	45.09	5.20	5.00
8016	Gecco. G. E. Conkey Co., Cleveland, Ohio	Ansonia: A. Hodos & Son				20.00	6.40	9.00	50.49	4.90	4.50
9971	Conkey's Gecco 20%. G. E. Conkey Co., Cleveland, Ohio					20.00	8.00	9.00	49.54	4.95	4.50
7802	Cowles 24%. C. A. Cowles, Plantsville, Conn	Plantsville: C. A. Cowles	1985		1.5	24.00	8.31	10.00	46.10	6.08	6.00
8547	Cowles 24%. C. A. Cowles, Plantsville, Conn	Plantsville: C. A. Cowles				24.00		10.00	50.67	5.60	6.00
9946	Crosby's Balanced Ration. Crosby Milling Co., Brattle-		0.00	1.00					1		
0050	boro, Vt	Shelton: Wolf Savitsky	9.65	6.79	25.13	25.00	7.65	9.00	45.45	5.33	5.50
9950	Crosby's Ready Ration. Crosby Milling Co., Brattleboro,	Shelton: Wolf Savitsky	10.20	5 33	20.88	20.00	8 65	10.00	49 30	5.54	5.00
8281	Vt			0.00	20.00	20.00	0.00	10.00	10.00	0.01	0.00
	Davis & Son. New Haven, Conn	Ansonia: Ansonia Flour & Grain Co	9.30	6.59	20.75	20.00	8.00	8.00	51.08	4.28	4.00
			*								

670	

						Pound	s per Hu	indred			
					Protein (N x 6.25)		Fi	Fiber		F	at
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—Continued.		%	%	%	%	%	%	%	%	
	Dairy Feeds—Continued.										
8562 8750 286	Basic Dairy Ration. R. G. Davis & Sons, New Haven, Conn. Delaware. Delaware Mills, Deposit, N. Y. Delco 20%. Delaware Mills, Deposit, N. Y.	Grain Co	9.15 7.20	7.22	23.13	20.00 23.00 20.00		9.00	48.75	4.50	4.50
7949	Devon Coal & Ice Co., Devon,	Devon: Devon Coal & Ice Co.				22.00	9.05 8.45	9.00	48.66	4.28	4.00
8718 8648	Devon Coal & Ice Co., Devon, Conn. Eastern States Ful Pail Open Formula. Eastern States Farmers' Exchange, Spring- field, Mass.	Devon: Devon Coal & Ice Co. North Haven: Ridgewood Farm				22.00	7.93	9.00	50.35	5.15 4.35	4.00

			,							
8650	Eastern States Fitting Ration Open Formula. Eastern									
8791	States Farmers' Exchange, Springfield, Mass Eastern States Milkmore (Open Formula.) Eastern States	North Haven: Ridgewood Farm 9.45	6.59	13.00	12.00	6.43	7.00	59.03	5.50	3.50
7932	Farmers' Exchange, Spring-field, Mass	Assoc	7.62	23.31	24.00	7.65	8.00	49.62	4.70	4.50
232	Emco. Elmore Milling Co., Oneonta, N. Y Elmore Milk Grains. Elmore	Winsted: Chas. R. Hawley 10.30	4.69	21.44	20.00	9.98	10.00	48.66	4.93	4.50
290	Milling Co., Oneonta, N. Y. Elmore Waldorf Formula. Elmore Milling Co., Oneonta,	Hazardville: A. D. Bridges' Sons 8.78	7.22	24.38	25.00	9.75	11.00	45.22	4.65	5.00
289	N. Y	Newtown: R. H. Holcomb & Co. 9.25		21.00			10.00		4.15	3.50
7588	ing Co., Oneonta, N. Y Golden Rod 25%. John W. Eshelman & Sons, Lancaster,	Shelton: Wolf Savitsky 8.38 Brookfield: W. L. Richmond &	8.87	22.88	20.00	8.08	11.00	48.66	3.13	4.00
8755	Pa John W. Eshel-	Son				10.35			5.36	5.00
8554	man & Sons, Lancaster, Pa Red Rose 24. John W. Eshel- man & Sons, Lancaster, Pa.	Co		20.00			11.00		4.05	4.00
9926	Pennsy 16. John W. Eshelman & Sons, Lancaster, Pa Open Formula 20%. John W.	Devon: Devon Coal & Ice Co 10.90	7.95	17.25	16.00	8.78	11.00	51.51	3.61	3.00
	Eshelman & Sons, Lancaster, Pa	New Haven: Moran-Patton Co. 10.98	6.73	20.63	20.00	8.15	9.00	49.81	3.70	4.50
313	Open Formula 20%. John W. Eshelman & Sons, Lancaster, Pa	New Haven: Moran-Patton Co. 9.93	7 16	22.50	20.00	8.38	9 00	47.73	4.30	4.50
110	R. Own. A. W. Forbes, East Haven, Conn.	East Haven: A. W. Forbes 10.00		21.88		6.28		53.78	2.97	4.00
			100							

						Pound	1s per H	undred			
					Pro (N x		F	iber	extract etc.)	I	Fat
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS— Continued. Dairy Feeds—Continued.		%	%	%	%	%	%	%	%	%
399 7915	R. Own. A. W. Forbes, East Haven, Conn	East Haven: A. W. Forbes	9.58	6.66	22.00	20.00	7.53	9.00	50.08	4.15	4.00
7822	H. Grandin Milling Co., Jamestown, N. Y	Quinnebaug: M. T. Dart			22.38		9.28		47.92	4.77	5.00
9789	Windsor, Conn	Windsor: L. W. Hudson Windsor: L. W. Hudson		5.24	18.38		8.50 8.36		52.57 52.14	5.15	5.50
235 116	"Hudson's". L. W. Hudson, Windsor, Conn	Windsor: L. W. Hudson	9.55		17.63		8.55	1 1	54.03	4.73	5.50
291	H & H. Hales & Hunter Co., Chicago, Ill				22.00		7.05		50.27	3.88	4.00
7930	Inc., Waverly, N. Y Beats All Milk Grains. Kasco Mills Inc., Waverly, N. Y	Co Leonard Grain	8.30 9.80		21.38 21.69			11.00		4.75	4.50

292 9790	Beats All Milk Grains. Kasco Mills Inc., Waverly, N. Y. Badger 16½% Sweet. Chas. A. Krause Milling Co., Mil-	East Winsted: Leonard Grain		8.19	22.00	22.00	9.03	10.00	47.93	4.90	4.50
8846	waukee, Wis. Larro Ready Ration. Larrowe Milling Co., Detroit, Mich	Thomaston: I. Levy Bristol: Bristol Grain & Supply	100				12.15 10.60			4.53 3.85	5.00
7811	Mill Pride. C. W. Lines Co., New Britain, Conn	New Britain: C. W. Lines Co			26.63		F 12 E F 3	10.00		4.35	5.50
8207	Mill Pride. C. W. Lines Co., New Britain, Conn	New Britain: C. W. Lines Co			24.50			10.00		4.63	5.00
7927	Common Sense. Litchfield Co- op. Assoc., Torrington, Conn.	Torrington: Litchfield Co-op. Assoc.			22.38				46.49	5.98	5.00
237	Common Sense. Litchfield Co- op. Assoc., Torrington, Conn.	Torrington: Litchfield Co-op. Assoc			20.00				49.27	4.65	5.00
166	Square Deal. Long Hill Feed Store, Long Hill, Conn	Long Hill: Long Hill Feed Store	8.10				11.15	10.00	48.05	4.41	5.00
239	Red Star. E. Manchester & Sons, Winsted, Conn	Winsted: E. Manchester & Sons	8.70	8.89	24.63	23.00	8.03	10.00	45.07	4.68	4.00
247	Marmico (with Molasses). Maritime Milling Co., Buffalo,	Riverton: L. A. Coe	10.40	6 40	15 90	16 00	10.15	19.00	E2 00	9.60	4.00
296	N. Y Red-E-Mixt (Sweetened). Maritime Milling Co., Buffalo,			0.49	10.00	10.00	10.15	12.00	33.84	3.68	4.00
8497	N. Y	Co	9.75	5.13	22.63	20.00	8.73	10.00	49.98	3.78	5.00
8802	Conn		7.08		22.81				49.02	6.63	5.50
122	Inc., Middletown, Conn Moon's 24%. Geo. Q. Moon &	& Coal Co			20.31				52.53	6.10	5.50
125	Co., Binghamton, N. Y Moon's X. Geo. Q. Moon &	Manchester: I. P. Campbell			23.81			10.00		5.40	5.00
	Co., Binghamton, N. Y	Manchester: I. P. Campbell	10.13	8.17	16.06	16.00	13.83	12.00	48.32	3.49	4.00

CONNECTICUT EXPERIMENT STATION

						Pound	ls per Hu	indred			
						otein 6.25)	Fi	ber	extract etc.)	F	₹at
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than.	Found	Guaranteed, not more than	Nitrogen-free e. (starch, gum, et	Found	Guaranteed, not less than
	Proprietary Mixed Feeds— Continued. Dairy Feeds—Continued.		%	%	%	%	%	%	%	%	%
8316 9921 4	Old Mill. Fred C. Morse, Guilford, Conn	Guilford: Fred C. Morse Guilford: Fred C. Morse			22.25 20.06		8.48 8.05		49.69 49.59	5.25	5.00
401	ton Feed Co., Milwaukee, Wis	Plantsville: C. A. Cowles	11.00	8.34	18.75	20.00	8.63	12.00	50.28	3.00	3.00
179	Wis. Institutional 24% Sweet. Newton Feed Co., Milwaukee,	Farmington: Winchell Smith	10.58	7.78	20.38	20.00	10.55	12.00	47.56	3.15	3.00
8726	Wis	Plantsville: C. A. Cowles Plantsville: C. A. Cowles			21.38 16.88		9.98	9.00	47.79 56.48	3.33 5.03	3.00 5.00
8210	Newtrio 20%. Newton Feed Co., Milwaukee, Wis	Plantsville: C. A. Cowles	4.88	7.35	19.75	20.00	8.25	9.00	54.18	5.59	5.00

3575	Newtrio 20%. Newton Feed											
	Co., Milwaukee, Wis	Newington	: Thos. Holt	6.75	6.66	18.13	20.00	7.60	9.00	55.78	5.08	5.00
3749	Newtrio 24%. Newton Feed Co., Milwaukee, Wis	Plantsmille	C. A. Cowles	9.50	8 38	21.94	24 00	7.25	9 00	47.83	5.10	5.00
3211	Newtrio Growing & Fitting	1 vanisomie.	. C. 11. COWIES	0.00	0.00	21.01	21.00	1.20	0.00	1	0.10	0.00
	Ration. Newton Feed Co.,						10.00					
2051	Milwaukee, Wis	Plantsville.	: C. A. Cowles	5.18	8.29	14.25	12.00	7.51	9.00	59.62	5.15	5.00
7851	Domino Butterine. Nowak Milling Corp., Hammond,											
	Ind	Higganum	: F. A. Petrofsky	10.76	9.75	17.63	17.00	9.03	13.50	48.18	4.65	4.00
51	Domino 24½. Nowak Milling		: Bloomfield Farmers						40.00	1	0 -0	- 00
000	Corp., Hammond, Ind		ge	8.38	7.62	27.25	24.50	7.90	10.00	45.12	3.73	5.00
373	Domino 24½. Nowak Milling Corp., Hammond, Ind		Bloomfield Farmers	8.30	7 79	26 00	24.50	8 18	10.00	45 05	4.68	5.00
3669	Uncle John's 24% Cream Pot.	Dachang		0.00		20.00	1.00	0.10	20.00	10.00	1.00	0.00
	Ontario Milling Co., Oswego,						0.500 1110					
	N. Y		H. Grulich	7.80	6.70	23.06	24.00	6.88	9.00	49.83	5.73	5.50
3681	Big Value. Ontario Milling		ingford: D. W. Ives	6.10	6 34	20 88	20.00	8 03	10.00	52 20	5.55	4.50
364	Co., Oswego, N. Y	East Watt	ngjora. D. W. IVES	0.10	0.51	20.88	20.00	0.90	10.00	02.20	0.00	1.00
	Pollard Co., Buffalo, N. Y.	Moosup:	T. E. Main & Sons	10.00	6.57	22.88	20.00	7.35	9.00	48.87	4.33	4.00
7916	Herdhelth 16%. Park & Pol-		m T 15: 00	11 00	10 51	17 00	10 00	11 21	10 00	44.10	4 50	1 00
369	lard Co., Buffalo, N. Y	Moosup:	T. E. Main & Sons	11.60	10.51	17.69	16.00	11.51	12.00	44.19	4.50	4.00
309	lard Co., Buffalo, N. Y	Putnam:	Bosworth Bros	10.58	9.15	17.19	16.00	11.00	12.00	48.95	3.13	3.00
3769	Milk-Maid 24% Sweetened.											
	Park & Pollard Co., Buffalo,			0.05	0 45	04 10	01.00	0.05	11 00	45 55	4 ==	1 50
7798	N. Y Darla & Dalland		: Spencer Grain Co hire: Cheshire Grain		8.45	24.13	24.00	8.05	11.00	45.57	4.55	4.50
130	Overall 24%. Park & Pollard Co., Buffalo, N. Y		Co Cheshire Grain	7.70	8.18	25.06	24.00	7.88	9.00	45.88	5.30	6.00
3474	Overall 24%. Park & Pollard		hire: Cheshire Grain									
	Co., Buffalo, N. Y		Co	6.53	6.56	25.13	24.00	7.70	9.00	49.25	4.83	4.50
368	Top Notch 16%. Park & Pollard Co., Buffalo, N. Y	35 . 7	Γ. E. Main & Sons	9.43	0 00	18.25	10 00	0.00	10 00	50:50	2.90	3.50

Found

%

7.93

8.15

8.60

7.33

11.90

14.18

9.68

Fiber

Guaranteed, not more than

%

10.00

9.00

10.00

8.50

13.50

10.50

12.00 53.64

Protein (N x 6.25)

Found

%

20.50

23.13

23.13

25.63

19.31

15.75

7.41 24.88 24.00

Ash

%

6.52

6.02

7.88

6.71

6.75

6.52

%

9.10

7.75

9.50

8.88

ranteed, less than

Guar not 1

%

20.00

24.00

24.00

24.00

20.00

16.00

extract etc.)

Nitrogen-free (starch, gum,

%

50.82

50.03

46.10

46.70

50.82

43.67

Fat

Found

%

5.13

4.92

4.79

4.75

3.30

3.40

4.88

Guaranteed, not less than

%

5.00

5.00

5.00

4.00

3.25

4.00

Retail Dealer

New Milford: Geo. T. Soule...

Granby: E. H. Rollins.....

Norwalk: Frank Libner & Sons

Simsbury: Woods, Chandler Co.

Norwalk: Frank Libner & Sons 5.10

Norwalk: Frank Libner & Sons 9.33

Norwalk: Frank Libner & Sons 9.48

Manufacturer and Brand

PROPRIETARY MIXED FEEDS-Continued. Dairy Feeds—Continued. illsbury's. Pillsbury Flour

Mills Co., Minneapolis,

Minn
Burt's. Postum Co., Battle
Creek, Mich.
Pratt's Sweet. Pratt Food Co.,
Buffalo, N. Y.
Producer. H. C. Puffer Co.,
Springfield, Mass.
Quaker Big Q 20% Protein.
Quaker Oats Co., Chicago,
Ill.
Ouaker 16% Protein. Ouaker

Oats Co., Chicago, III.... Quaker Boss 24% Protein. Quaker Oats Co., Chicago,

ĬĬI..

Quaker

Quaker 16% Protein.

Pillsbury's.

No.

Station

184

7817

357

42

8631

187

186

				•							
7816	Blue Checker Cow Chow. Ralston	* * *	- 8								4
	Purina Co., St. Louis, Mo	Granby: E. H. Rollins	0.30	7.28	22.00	20.00	10.93	12.00	46.99	2.50	3.00
8561	Blue Checker Cow Chow. Ralston	Ansonia: Ansonia Flour & Feed				E46.4					
	Purina Co., St. Louis, Mo	Co 9	9.58	7.21	21.63	20.00	11.30	12.00	46.10	4.18	3.20
8671	Purina Cow Chow. Ralston										
	Purina Co., St. Louis, Mo	Meriden: H. Grulich 7	7.05	7.46	25.38	24.00	10.35	12.00	45.71	4.05	4.00
20	Purina Buffalo Green Checker					er and	100		H-1-3-	A 123 1	Q.55
	24% Cow Chow. Ralston				2700 202				LC-CT	W 200	
	Purina Co., St. Louis, Mo	Meriden: H. Grulich	0.00	7.56	25.13	24.00	11.18	12.00	42.54	3.59	2.30
212	Purina Orange Checker Cow					\$ 15 H	2.5				
211	Chow. Ralston Purina Co.,	Ridgefield: Ridgefield Lumber			40.00	40.00	0 -	10 00	-1 00	0.00	9 00
404	St. Louis, Mo	Co	0.48	6.73	18.88	16.00	9.58	12.00	51.33	3.00	3.00
191	Protena. Ralston Purina Co.,	Norwalk: Clapboard Hills Feed		- 11	1= 0=	10 50	11 05	10 00	FO FO	4 00	0.50
000	St. Louis, Mo	Co 9	9.65	7.41	17.25	16.50	11.05	12.00	50.56	4.08	3.50
389	Diamond 24%. Rockville	M I I M I I O I				7 2 24					
	Grain & Coal Co., Rockville,	Manchester: Manchester Grain	9.15	0 17	26.44	94 00	6 00	11.00	16 10	3.18	4.00
9787	Conn		9.10	8.17	20.44	24.00	0.00	11.00	40.10	0.10	4.00
9101	& Coal Co., Seymour, Conn.	Coal Co 9	9.83	6.58	20.44	20 00	8.70	0 00	49.25	5.20	4.50
7809	Mill Stream 20%. Winchell	Coar Co 9	9.00	0.56	20.44	20.00	0.10	9.00	49.20	0.20	4.00
1003	Smith, Farmington, Conn.	Farmington: Winchell Smith 10	25	6 20	19.56	20 00	8.35	8 00	50.80	4.65	5.00
7810	Mill Stream Boomerang. Win-	Tarmington. Whichen Shifth10	0.00	0.29	19.00	20.00	0.00	0.00	30.00	1.00	0.00
1010	chell Smith, Farmington,						- 5			1	
	Conn	Farmington: Winchell Smith 11	1 00	5 40	22.19	24 00	5 57	10.00	50 80	4.95	6.00
101	Mill Stream Boomerang. Win-	Turmingion. Winchen Simin11	1.00	0.10	22.10	21.00	0.01	10.00	00.00	1.00	0.00
101	chell Smith, Farmington,									MODE T	
	Conn	Farmington: Winchell Smith. 10	73	5 25	22.06	24 00	6 05	10.00	51.51	4.40	6.00
403	Mill Stream Boomerang. Win-	Tallington (Timonon Simon)		0.20							
	chell Smith, Farmington,	무슨 생기 회사 기업 경기 등 이 없는 그 사람				-		-			
	Conn	Farmington: Winchell Smith. 9	9.68	5.54	21.88	24.00	6.33	10.00	52.09	4.48	6.00
8278	Paragon Sweetened. St. Albans										
	Grain Co., St. Albans, Vt	New Milford: Geo. T. Soule 5	5.38	8.61	23.56	22.00	10.50	12.00	47.25	4.70	4.00
9956	Paragon Sweetened. St. Albans				100						
	Grain Co., St. Albans, Vt	Ansonia: Ansonia Flour & Feed 10	0.24	11.53	21.94	22.00	10.00	12.00	42.14	4.15	4.00
						200-		2 2 2 2	C. L.		

						Pound	ls per Hu	indred			
						tein 6.25)	F	iber	extract etc.)	F	at
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS— Continued.		%	%	%	%	%	%	%	%	%
215	Dairy Feeds—Continued. Paragon. St. Albans Grain Co., St. Albans, Vt.	New Milford: Geo. T. Soule Willimantic: Willimantic Grain	8.35	7.22	23.25	22.00	11.65	12.00	45.23	4.30	4.00
907	Hygrade. St. Albans Grain Co., St. Albans, Vt	Co	11.00	8.92	19.63	20.00	7.33	8.50	48.67	4.45	4.50
339 983	Hygrade Sweetened. St. Albans Grain Co., St. Albans, Vt. Hygrade Sweetened 16%. St.	North Haven: W. L. Thorpe	7.53	9.10	19.50	20.00	6.30	8.50	53.17	4.40	4.50
	Álbans Grain Co., St. Albans, Vt	Southbury: H. R. Stone Willimantic: Willimantic Grain	11,90	7.12	17.81	16.00	7.13	9.00	51.79	4.25	3.75
53 7	King Sweetened. St. Albans Grain Co., St. Albans, Vt Wirthmore with Beet Pulp. St.	Co	9.50	7.41	22.19	22.00	8.73	9.00	47.99	4.18	4.50
19	Albans Grain Co., St. Albans, Vt	Plantsville: C. A. Cowles		7.24	21.00	21.00	8.23	11.00	49.47	4.28	4.50
	tion. St. Albans Grain Co., St. Albans, Vt	Thompsonville: Geo. S. Phelps & Co	10.40	10:79	18.50	16.00	6.38	8.50	49.65	4.28	4.00

388	Wirthmore 16% Sweetened. St. Albans Grain Co., St. Albans,										
0055	Vt	Stepney M. Nusbaum		10.89	17.63	16.00	6.63	8.50	51.42	3.68	4.00
9955	Wirthmore 20%. St. Albans Grain Co., St. Albans, Vt	Ansonia: Ansonia Flour & Feed Co	10.52	4.93	20.38	20.00	7.08	8.50	52.31	4.78	5.00
8576	Wirthmore 20% Sweetened. St. Albans Grain Co., St. Albans,										
	Vt	Newington: Thos. Holt	7.93	5.84	20.94	20.00	6.58	8.00	54.06	4.65	5.00
331	Wirthmore 20% Sweetened. St. Albans Grain Co., St. Albans,			100							
7702	Vt	Stepney: M. Nusbaum	8.78	5.97	20.75	20.00	7.95	8.00	51.45	5.10	5.00
7793	Wirthmore 25% Protein Bal- anced Ration. St. Albans						0.10				
8678	Grain Co., St. Albans, Vt Wirthmore 25% Protein Bal-	Hamden: I. W. Beers	10.65	7.73	24.38	25.00	6.40	9.00	45.74	5.10	5.50
	anced Ration. St. Albans	Viust C. D. Labianiaa	5.98	6 20	25.63	25 00	7.85	0.00	48.95	5.20	5.00
8311	Grain Co., St. Albans, Vt Wirthmore 25% Balanced Ra-	Kensington: S. F. Labieniec.	0.90	0.59	20.00	25.00	1.00	3.00	10.00	0.20	0.00
	tion, Sweetened. St. Albans Grain Co., St. Albans, Vt	Branford S. V. Osborn, Est	6.10	10.56	27.81	25.00	6.80	8.50	43.58	5.15	5.00
333	Onondaga. Syracuse Milling				20.38		12.03	12.00	10.00	4.78	4.00
46	Co., Syracuse, N. Y	Colchester: P. Cutler Inc								45	
255	Co., Syracuse, N. Y	Granby: E. H. Rollins	8.55	5.40	23.75	24.00	9.83	12.00	47.59	4.88	4.50
200	cuse Milling Co., Syracuse,	75 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	0.00	~ 01	00.05	20.00	0.00	19.00	E1 45	4.63	4.00
7924	N. Y	Manchester: Little & McKinney	8.68		20.25			12.00			
8797	cott, Torrington, Conn	Torrington: D. L. Talcott Thomaston: Thomaston Supply	9.43	6.75	22.69	23.00	8.90	9.00	47.63	4.60	4.50
	Thomaston. Thomaston Supply Co., Thomaston, Conn	Co	6.98	7.41	21.31	20.00	8.23	8.00	48.57	7.50	6.00
259	E-Gee. Tioga Empire Feed Mills, Waverly, N. Y	Hawleyville: W. A. Honan	9.53	6.94	22.13	20.00	8.55	10.00	49.35	3.50	3.50
	,										
				1			1	1	1	1	1

						Pound	ls per Hu	indred			
						otein 6.25)	Fi	ber	extract etc.)	F	`at
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS-		%	%	%	%	%	%	1 %	1 %	1 %
	Continued. Dairy Feeds—Concluded.						/ 1				
20	Red Brand Ti-O-Ga. Tioga- Empire Feed Mills, Waverly,										
16	N. Ŷ	Guilford: Fred H. Rolf	6.83	6.67	24.88	24.00	8.33	10.00	48.84	4.45	5.0
383	Empire Feed Mills, Waverly, N. Y	Southport: C. Buckingham Co.	5.65	6.88	24.25	24.00	8.03	10.00	50.14	5.05	5.0
880	Sweet. Ubiko Milling Co., Cincinnati, Ohio Ubiko Union Grains 24%	Lebanon: Berkman Grain Co	9.35	7.83	20.38	20.00	8.13	10.00	49.08	5.23	4.0
81	Sweet. Ubiko Milling Co., Cincinnati, Ohio Union Grains Ubiko Biles	Lebanon: Berkman Grain Co	9.05	7.53	24.13	24.00	7.90	10.00	46.81	4.58	5.0
01	Ready Dairy Ration. Ubiko Milling Co., Cincinnati, Ohio Vitality 24%, Vitality Mills		8.10	8.31	24.25	24.00	8.38	10.00	46.01	4.95	5.0
	Inc., Chicago, Ill	Co	9.93	11.23	22.88	24.00	8.38	10.00	43.63	3.95	5.0

8667	Will Pay. Vitality Mills, Inc.,	Meriden: Reliable Grain & Feed									
8588	Chicago, Ill	Co	9.10	10.66	19.50	20.00	8.53	9.00	47.96	4.25	5.00
	Co., Warren, Ohio	Shelton: Shelton Feed Co	7.38	6.07	22 06	24.00	10 30	9 00	49.69	4.50	5.00
8589	Wadsworth Special. Wadsworth Feed Co., Warren,									1.00	0.00
7911	Ohio	Shelton: Shelton Feed Co		6.13	21.00	20.00	14.13	12.00	48.26	4.30	5.00
338	Norwich, Conn	Abington: Weeks Bros Stafford Springs: Stafford		6.24	20.75	20.00	9.98	13.00	50.02	3.40	4.00
361	ucts Co., Norwich, Conn Perfection. Yantic Grain &	Grainery		7.01	24.69	24.00	7.88	10.00	47.19	4.63	5.00
339	Products Co., Norwich, Conn	Norwich: Yantic Grain & Products Co	7.53	6.99	20.94	20.00	13.10	13.00	47.21	4.23	4.50
	ucts Co., Norwich, Conn	Willimantic: Boston Grain Co.	8.85	6.10	21.00	20.00	8.33	9.00	50.69	5.03	5.00
8578	Stock Feeds. Amco 12% Fitting Ration. American Milling Co.,										
7813	Peoria, Ill	Newington: Thos. Holt	4.75	4.02	14.31	12.00	7.58	9.00	64.99	4.35	4.50
299	Ill	Simsbury: Woods-Chandler Co.	9.11	9.18	22.13	20.00	12.25	12.00	42.31	5.02	4.00
7844	ton, Vt	New London: B. J. McCarthy	10.55	4.27	9.75	9.50	8.28	9.50	62.57	4.58	4.50
105	dletown, Conn	Middletown: The Coles Co		3.61	8.88	9.00	11.70	11.00	61.41	5.00	5.00
9945	dletown, Conn	Middletown: The Coles Co		2.90	8.50	9.00	9.80	11.00	64.21	3.44	3.50
8591	Brattleboro, Vt	Shelton: Wolf Savitsky	10.01	5.23	10.25	9.00	10.30	12.00	59.66	4.55	4.00
	New Haven, Conn	Milford: Milford Grain Co	7.50	4.04	12.13	10.50	9.63	14.00	63.39	3.31	2.00

3.77		유명병(기원하는 사용하다) 상태를 가는 그 때문				Pound	s per Hui	idica			
					Prot (N x 6		Fil	oer	extract etc.)	Fa	.t
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—		%	%	%	%	%	%	%	%	%
8812	Stock Feeds—Concluded. Delaware. Delaware Mills, Deposit, N. Y	Southington: Southington Lumber Co	6.95	5.92	8.81	9.00	13.93	12.00	61.04	3.35	3.00
8719	Devon Sweet Stock Feed. Devon	Devon: Devon Coal & Ice Co	7.00	5.48	9.50	8.00	15.60	16.00	59.07	3.35	2.50
2341	Coal & Ice Co., Devon, Conn. Eshelman's. John W. Eshel- man & Son, Lancaster, Pa.	South Manchester: Smith Bros.	9.48	3.84	9.13	9.00	9.48	11.00	64.70	3.37	3.00
441	Bull Brand Stock Feed. Maritime Milling Co., Buffalo,	New Milford: Geo. E. Ackley	9.12	4.22	9.50	9.50	13.45	11.00	59.23	4.48	3.50
7838	Red Wing. Meech & Stoddard	East Hartford: Meech Grain Co.	9.40	3.78	10.69	9.00	9.13	12.00	62.30	4.70	3.00
9993	Inc., Middletown, Conn Red Wing. Meech & Stoddard Inc., Middletown, Conn	G II 11 0 C-	the second	4.38	9,63	9.00	9.38	12.00	62.73	3.75	3.00
9932	Moon's Geo. O. Moon & Co.,				11.44	9.00	11.50	12.00	58.06	4.89	3.00
8670	Binghamton, N. Y	- C 1: 1		4.43	11.19	9.50	11.85	12.00	61.53	3.40	3.00

¹ Wire tags illegal.

8480	The Park & Pollard. The Park										
182	& Pollard Co., Buffalo, N. Y. Feed Meal. The Park & Pollard	Plainville: F. B. Newton	5.90	5.49	9.06	8.00	8.95	12.00	66.25	4.35	2.50
7807	Co., Buffalo, N. Y	Newtown: R. H. Holcomb & Co	10.45	1.75	9.88	9.00	4.35	4.00	69.37	4.20	2.50
8192	ker Oats Co., Chicago, Ill Quaker Sugared Schumacher.	Plainville: W. S. Eaton	9.15	4.50	8.94	9.00	14.10	14.00	58.31	5.00	3.00
8617	Quaker Oats Co., Chicago, III Quaker Schumacher. Quaker	Hamden: I. W. Beers	7.92	5.82	9.69	10.00	10.23	12.00	63.21	3.13	3.25
359	Oats Co., Chicago, Ill White Star, Fine. Quaker Oats	Southport: C. Buckingham Co.	3.50	4.14	11.00	10.00	11.45	12.00	66.06	3.85	3.25
330	Co., Chicago, Ill	Southport: C. Buckingham Co. Willimantic: Willimantic Grain		4.08	8.94	9.00	14.70	14.00	60.47	3.88	3.00
8665	Albans, Vt	Co	9.43	4.19	10.00	9.00	8.33	10.00	62.27	5.78	4.00
26	Co., St. Albans, Vt	Supply	9.75	2.72	8.31	9.00	5.75	9.50	70.22	3.25	4.00
340	Syracuse, N. Y	Kensington: S. F. Labieniec Stafford Springs: Stafford		4.67	9.88	9.00	8.95	12.00	62.52	3.70	3.00
	ucts Co., Norwich, Conn	Grainery	9.28	4.35	9.38	9.00	10.15	12.00	62.34	4.50	4.00
7905	Calf Feeds, Etc.										
7946	Amco. American Milling Co., Peoria, Ill	Middletown: Charles Dragoo	9.93	6.55	22.81	22.00	3.90	4.00	52.78	4.03	3.00
223	Inc., Cayuga, N. Y	Botsford: G. T. Rasmussen	10.85	4.19	24.63	25.00	3.80	6.00	53.23	3.30	3.00
104	Inc., Cayuga, N. Y	Botsford: G. T. Rasmussen Middletown: Meech & Stoddard,	10.10	4.49	26.13	25.00	4.18		51.75	3.35	3.00
371	Meal Co., Waukegan, Ill Blatchford's. Blatchford Calf	Inc	9.84	7.41	25.75	24.00	5.83	6.75	46.99	4.18	5.00
	Meal Co., Waukegan, Ill	Inc	9.38	8.10	25.94	24.00	5.50	6.75	46.79	4.29	5.00

						Poun	ds per H	undred			
	Manufacturer and Brand					rotein x 6.25)	F	iber	extract etc.)	I	Pat
Station No.		Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS— Continued.		%	%	%	%	%	%	%	%	%
	Calf Feeds, Etc.—Concluded.										
180	Elmore Three Point. Elmore Milling Co., Oneonta, N. Y. Milkade. The Park & Pollard	Shelton: Wolf Savitsky	10.43	5.61	27.13	24.00	3.90	4.00	49.80	3.13	4.00
23	Co., Buffalo, N. Y Schumacher's. Ouaker Oats	Danbury: C. S. Barnum & Son	7.90	9.10	23.81	20 00	5.35	7.50	46.69	7.15	7.0
25	Co., Chicago, Ill	Manchester: Little & McKinney	7.75	5.32	19.25	18.00	3.40	4.00	56.50	7.78	8.0
15	ker Oats Co., Chicago, Ill Purina Pig Chow. Ralston Pu-	Rockville: Rockville Milling Co.	9.10	8.43	18.63	18.00	6.28	7.00	53.53	4.03	4.00
19	rina Co., St. Louis, Mo Purina Calf Chow. Ralston Pu-	New Haven: Moran-Patton Co.	11.40	7.96	20.63	20.00	6.88	7.00	49.18	3.95	3.20
92	rina Co., St. Louis, Mo Wirthmore Pig Feed. St. Albans Grain Co., St. Albans,	New Haven: Moran-Patton Co.	10.67	5.60	27.75	27.00	3.13	4.50	49.76	3.09	3.2
	Vt	Milford: Milford Grain Co	1.25	8.96	17.81	17.00	6.63	9.00	60.25	5.10	4.0

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8593	Wirthmore Hog Feed. St. Albans											
9990	Grain Co., St. Albans, Vt Tioga. Tioga-Empire Feed		lford Grain Co	6.20	8.44	21.81	17.00	6.00	7.00	52.40	5.15	4.50
0000	Mills, Waverly, N. Y		H. R. Stone	10.48	6.55	23.25	21,00	4.93	7.00	49.87	4.92	4.00
	Poultry Feeds.											
7904	Amco Egg Mash. American											
376	Milling Co., Peoria, Ill	Middletown:	Charles Dragoo	10.45	8.65	20.44	20.00	4.73	7.00	49.80	5.93	4.00
310	Amco Egg Mash. American Milling Co., Peoria, Ill		John H. Fay	0.70	0 01	00 00	00 00	0 70	- 00	FO 00	4 00	
377	Amco Egg Mash with Dried	Guaersieeve:	John H. Fay	9.78	8.21	20.38	20.00	3.73	7.00	53.00	4.90	4.00
	Buttermilk, American Mill-											
	ing Co., Pedria, Ill	Gildersleeve:	John H. Fay	9.80	6.98	18.25	18.00	4.85	7.00	55.69	4.43	4.00
378	Amco Starting & Growing Mash with Dried Buttermilk. Amer-											
	ican Milling Co., Peoria, Ill.	Gilder cleane.	John H. Fay	0 10	9.19	17.81	17 00	4.63	6 00	F4 00	4 00	0 =0
7921	Arcady Scratch Grains. Arcady	anacisiecte.	John 11. Pay	9.40	9.19	17.01	17.00	4.05	0.00	54.29	4.60	3.50
	Farms Milling Co., Chicago,											
0401	III.,	Portland: Ea	arl Prout	12.43	1.59	9.81	10.00	2.75	5.00	70.27	3.15	2.50
8491	Arcady Scratch Grains. Arcady Farms Milling Co., Chicago,											
	I'arms winning Co., Cincago,	Plantsville.	Mehmel & Sarvi	13 25	1.91	10.75	10.00	2.48	5.00	68.93	2.68	2.50
9978	Beacon Broiler Feed. Beacon	1 10111011110.	dictimer & barvi	10.20	1.31	10.75	10.00	4.40	5.00	08.95	4.08	2.50
	Milling Co., Cayuga, N. Y.	Southbury: I	H. R. Stone	11.56	6.26	17.38	16.00	5.33	6.00	55.14	4.33	4.00
9979	Beacon Duck Fattener. Beacon	C T	T D 0									
9980	Milling Co., Cayuga, N. Y. Beacon Duck Growing Mash.	Southbury: F	I. R. Stone	11.10	8.15	17.88	14.00	4.75	5.50	53.57	4.55	5.00
0000	Beacon Milling Co., Cayuga,											
	N. Y	Southbury: H	I. R. Stone	11.23	7.06	16.88	17.00	4.95	7.00	54.95	4.93	4.50
9981	Beacon Developer Feed. Beacon									01.00	1.00	1.00
8569	Milling Co., Cayuga, N. Y	Southbury: H	I. R. Stone	13.18	1.75	10.50	10.00	2.00	5.00	69.36	3.21	2.50
0000	Beacon Egg Mash with Butter- milk. Beacon Milling Co.,											
	Cayuga, N. Y	Shelton: Shel	ton Feed Co	7 23	10 47	21 13	21 00	6.05	7.00	50.27	4.85	4.50
100						21.10	21.00	0.00	1.00	00.21	1.00	±.00

Found

%

5.90

5.93

8.03

1.70

2.75

4.75

5.53

Fiber

Guaranteed, not more than

%

6.00

7.00

8.00

3.50

5.00

6,00

6.00

Protein (N x 6.25)

Found

%

15.75

16.88

19.94

9.13

10.50

15.63

15.63

ranteed, less than

Guan

%

14.00

17.00

20.00

9.00

9.00

14.00

14.00

extract etc.)

Nitrogen-free e (starch, gum, e

%

54.19

56.65

48.93

71.92

70.52

56.81

57.78

Fat

Found

%

5.28

4.35

4.97

2.85

2.58

4.55

4.70

Guaranteed, not less than

%

4.50

4.50

5.00

3.00

3.00

4.50

4.50

Water

%

9.35

7.00

8.58

Ash

%

9.53

9.19

9.55

1.25

1.50

7.86

8.96

Retail Dealer

Shelton: Shelton Feed Co....

Shelton: Shelton Feed Co.....

Danbury: C. S. Barnum & Son

Botsford: G. T. Rasmussen . . . 13.15

Danbury: C. S. Barnum & Son 12.15

Danbury: C. S. Barnum & Son 10.40

Shelton: Shelton Feed Co..... 7.40

Manufacturer and Brand

PROPRIETARY MIXED FEEDS-Continued. Poultry Feeds—Continued. Beacon Fleshing Mash with But-

termilk. Beacon Milling Co.

Inc., Cayuga, N. Y.......

Beacon Growing Mash. Beacon
Milling Co., Cayuga, N. Y..

Beacon Laying Mash. Beacon
Milling Co., Cayuga, N. Y..

Beacon Special Scratch Grains.

Beacon Milling Co., Cayuga, N. Y... Beacon Scratch Grains. Beacon

Milling Co., Cayuga, N. Y.. Beacon Starting Mash. Beacon

Milling Co., Cayuga, N. Y.. Beacon Starting Mash. Beacon Milling Co., Cayuga, N. Y..

Station No.

226

8590

170

7945

150

7942

8570

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TEN BY											and the same of th	all and a second
225	Beacon Turkey Growing Feed. Beacon Milling Co. Inc.,			21/8								
8557	Cayuga, N. Y	Shelton:	Shelton Feed Co	9.75	10.13	15.94	15.00	5.88	6.00	53.80	4.50	4.00
224	Cayuga, N. Y		Shelton Feed Co			20.56		6.63		51.33	5.00	4.00
7796	Milling Co., Cayuga, N. Y Beers Scratch Feed. I. W.	Botsford:	G. T. Rasmussen	9.58	9.74	17.06	15.00	6.30	7.00	52.39	4.93	4.00
2400	Beers, Hamden, Conn	Hamden:	I. W. Beers	. 12.65	1.58	10.19	9.00	3.20	4.00	68.92	3.46	3.00
8190	Beers Scratch Feed. I. W. Beers, Hamden, Conn	Uamdons	I W Doom	0 70	1 77	10 10	0.00	4 60	1 00		0.00	
7794	Beers' Laying Mash. I. W.	muen.	I. W. Beers	8.73	1.77	10.13	9.00	4.36	4.00	71.73	3.28	3.00
8189	Beers, Hamden, Conn Beers' Laying Mash. I. W.		I. W. Beers			18.50	22.00	7.26	7.00	51.05	4.95	5.00
8722	Beers, Hamden, Conn Bristol Scratch Feed. Bristol		I. W. Beers		9.03	20.25	20.00	6.40	7.00	49.81	5.63	5.00
8723	Grain & Supply Co., Bristol, Conn	Bristol: I	Bristol Grain & Suppl	10.00	1.52	9.38	10.00	2.05	4.00	73.80	3.25	3.00
8611	Grain & Supply Co., Bristol, Conn		Bristol Grain & Suppl		9.50	20.69	18.00	6.75	10.00	50.58	4.68	4.00
	Co., Southport, Conn	Southport	C. Buckingham Co	6.28	7.98	20.63	19.00	5.40	8.00	54.71	5.00	5.00
8596	C. B. Growing Mash. C. Buck-				35							
8597	ingham Co., Southport, Conn. C. B. Scratch Feed. C. Bucking-	Southport	C. Buckingham Co	8.25	6.08	15.38	15.00	4.48	7.00	61.76	4.05	5.00
308	ham Co., Southport, Conn Egg-O-Dry Mash. C. W. Camp-	Southport.	C. Buckingham Co	9.05	1.63	10.44	11.19	3.30	3.80	73.03	2.55	2.76
	bell Co., Stonington, Conn	Groton:	C. W. Campbell Co	9.58	10.53	20.19	18.00	7.90	12.00	46.67	5.13	2.00
309	Egg-O-Scratch. C. W. Camp-					200	A-5 - 5 - 5					
40	bell Co., Stonington, Conn Chapin Kernels Egg Mash.	Stonington	i: C. W. Campbell Co e: Rourke-Robothan	12.05	1.87	14.31	10.00	3.10	9.00	66.22	2.45	2.00
20	Chapin & Co., Chicago, Ill.		e: Kourke-Kobothan		10.42	19.63	18.00	3.18	5.50	54.64	3.88	4.50

Retail Dealer

Danbury: F. C. Benjamin.... Collinsville: Rourke-Robotham

Riverton: L. A. Coe........... Collinsville: Rourke-Robotham

Danbury: F. C. Benjamin Collinsville: Rourke-Robotham

Collinsville: Rourke-Robotham

Co.....

Manufacturer and Brand

PROPRIETARY MIXED FEEDS-

Continued.

Poultry Feeds—Continued.

Chapin Kernels Egg Mash.
Chapin & Co., Chicago, Ill...
Chapin Kernels Grow-All.
Chapin & Co., Chicago, Ill...
Chapin Kernels Grow-All.
Chapin & Co., Chicago, Ill...
Chapin Kernels Lay All. Chapin & Co., Chicago, Ill...

pin & Co., Chicago, Ill..... Chapin Kernels Lay All. Cha-

pin & Co., Chicago, Ill..... Chapin Kernels Start All. Cha-

pin & Co., Chicago, Ill.... Unicorn Egg Mash with Buttermilk. Chapin & Co., Chi-

cago, Ill.....

Station No.

395

35

294

41

293

34

32

Fat

Found

%

5.10

3.38

3.35

3.53

3.33

4.90

4.70

Guaranteed, not less than

4.50

4.50

4.50

4.50

4.50

4.00

4.50

Pounds per Hundred

%

3.08

2.73

2.88

2.85

3.40

2.35

4.53

Fiber

Guaranteed, not more than

5.50 53.85

60.87

60.72

60.86

60.12

60.13

7.00 48.58

5.50

5.50

5.50

5.50

4.50

Protein (N x 6.25)

%

19.44

16.31

16.38

16.63

17.00

7.66 15.94

11.88 21.38

Ash

%

10.18

8.01

8.27

7.43

8.42

%

8.35

8.70

8.40

8.70

7.73

9.02

8.93

Guaranteed, not less than

18.00

16.00

16.00

16.00

16.00

15.00

20.00

extract etc.)

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31	Unicorn Growing Mash with Buttermilk. Chapin & Co.,	Collinswill	e: Rourke-Robotham									
	Chicago, Ill		Rourke-Robotham		11.78	18.00	18.00	3.53	7.00	53.14	4.25	4.50
33	Unicorn Scratch Feed. Chapin											
3019	& Co., Chicago, Ill Conkey's Buttermilk Meat Grain	Co		11.15	1.84	10.69	10.00	3.28	5.00	69.39	3.65	2.50
3013	and Bone Growing Mash. G.											
	E. Conkey Co., Cleveland,											
	Ohio	Ansonia:	A. Hodos & Son	10.40	11.33	20.56	18.00	4.90	5.00	47.71	5.10	4.00
9964	Conkey's Chick Grains. G. E.	1	A TT-1 0 C	11 01	1 71	11 04	11 00	1 00	0.00	00.00	0.00	
3014	Conkey Co., Cleveland, Ohio Conkey's Gecco Egg Mash. G. E.	Ansonia:	A. Hodos & Son	11.84	1.74	11.94	11.00	1.83	2.00	68.85	3.80	2.50
,011	Conkey Co., Cleveland, Ohio	Ansonia:	A. Hodos & Son	10.20	9.25	20.06	20.00	4.48	7 00	49.91	6.10	5.00
9968	Conkey's Gecco Egg Mash. G. E.						1			10.01	0.10	0.00
	Conkey Co., Cleveland, Ohio	Ansonia:	A. Hodos & Son	10.05	10.51	21.19	20.00	4.68	7.00	48.21	5.36	5.00
9969	Conkey's Geccofat with Butter- milk and Y-O. G. E. Conkey											
	Co., Cleveland, Ohio	Ansonia.	A. Hodos & Son	10 78	4 65	15 04	15.00	5.13	5 00	58.45	5.05	5.50
966	Conkey's Gecco Growing Mash.	11/100/11/01	11. 1100005 60 5011	100	1.00	10.01	15.00	0.10	3.00	00.40	3.05	3.30
	G. E. Conkey Co., Cleve-											
20.05	land, Ohio	Ansonia:	A. Hodos & Son	10.33	9.22	18.69	18.00	5.00	7.00	51.35	5.41	4.00
3967	Conkey's Gecco Scratch Grains. G. E. Conkey Co., Cleve-											
	land, Ohio	Ansonia.	A. Hodos & Son	12 95	1 67	10 13	10.50	2.88	3 00	69.30	3.07	2.50
965	Conkey's Growing Grains. G. E.		21. 210000 00 0011	12.00	1.01	10.10	10.00	2.00	3.00	09.00	3.01	2.50
	Conkey Co., Cleveland, Ohio	Ansonia:	A. Hodos & Son	12.51	1.67	11.75	11.00	1.88	2.50	68.31	3.88	2.50
9970	Conkey's (The Original) Grow-											
	ing Mash with Buttermilk. G. E. Conkey Co., Cleve-											
	land, Ohio	Ansonia:	A. Hodos & Son	10 43	11 52	21 88	18 00	4.15	6 00	46.58	5.44	4.00
9963	Conkey's (The Original) Laying		220 220 00 0017	10.10	11.02	21.00	10.00	1.10	0.00	10.00	0.44	4.00
	Mash with Buttermilk. G. E.											
	Conkey Co., Cleveland, Ohio	Ansonia:	A. Hodos & Son	10.33	9.87	22.94	20.00	4.75	6.00	46.28	5.83	5.00

						Pound	ls per Hu	indred			
			Ē			otein 6.25)	Fi	ber	extract etc.)	I	Fat
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS— Continued.		%	%	%	%	%	%	%	%	%
8018 8708 8015 8017 8020 8705	Poultry Feeds—Continued. Conkey's Pigeon Feed (Breeders). G. E. Conkey Co., Cleveland, Ohio Conkey's (The Original) Starting Feed with Buttermilk. G. E. Conkey Co., Cleveland, Ohio Conkey's Scratch Grains. G. E. Conkey Co., Cleveland, Ohio Gecco Scratch Grains. G. E. Conkey Co., Cleveland, Ohio Superior Scratch. G. E. Conkey Co., Cleveland, Ohio Fortune Egg Mash with Dried Buttermilk. The Coles Co., Middletown, Conn		9.33 12.25 12.43 12.50	5.43 1.38 1.52 1.30	9.25		4.28 3.60 2.35 2.50 2.08 5.03	4.00 3.00 5.00 3.00	62.91 63.04 71.09 70.70 72.02 50.41	4.90 4.60 2.80 3.10 2.85 5.35	3.00 1.75 3.00 2.50

7843	Fortune Growing Feed. The										
	Coles Co., Middletown,	William The Color Co	0.40	7 70	19 06	10.00	6.65	8 00	52.44	5.75	1.50
8704	Conn	Middletown: The Coles Co	9.40	1.10	10.00	10.00	0.00	8.00	92.11	0.10	1.00
0104	Coles Co., Middletown,										
	_ Conn	Middletown: The Coles Co	8.65	9.85	18.00	10.00	5.00	8.00	54.25	4.25	1.50
8706	Fortune Scratch Feed. The Coles Co., Middletown,										
	Conn	Middletown: The Coles Co	10.95	1.55	10.00	10.00	2.88	5.00	71.34	3.28	2.50
7803	C. A. Blue Seal Mash. C. A.						- 00	0.00	10 00	5.45	4.00
0710	Cowles, Plantsville, Conn	Plantsville: C. A. Cowles	10.13	11.48	17.25	18.00	5.83	0.00	49.86	0.40	4.00
8546	C. A. Blue Seal Mash. C. A. Cowles, Plantsville, Conn	Plantsville: C. A. Cowles	7.75	8.57	17.88	18.00	5.95	6.00	54.77	5.08	4.00
8548	Cowles Scratch Feed. C. A.									0.00	1 50
	Cowles, Plantsville, Conn	Plantsville: C. A. Cowles	9.45	1.30	9.75	10.00	2.48	5.00	74.72	2.30	1.50
9948	Crosby's Egg Mash. Crosby Milling Co., Brattleboro, Vt.	Shelton: Wolf Savitsky	10 99	6 49	19.75	20 00	5.60	7.00	52.17	5.00	4.00
262	Crosby's Scratch Feed. Crosby	Shehon. Wolf Bavitsky	10.55								
	Milling Co., Brattleboro, Vt.	Manchester: O. E. Bailey	10.83	1,71	10.31	11.00	3.33	5.00	71.02	2.80	3.00
9925	Davis Buttermilk Mash. R. G.										
	Davis & Sons, New Haven,	Milford: Milford Grain Co	10 33	8.34	18.50	18.00	6.33	7.00	51.40	5.10	5.00
9992	Davis Scratch Feed. R. G.	mujora. minora Gram Co	10.00								
	Davis & Sons, New Haven,	Westville Branch: R. G. Davis	10.00	1 00	10 00	10 00	0 60	= 00	60 10	3.16	2.00
0044	Conn	& Son	12.93	1.83	10.00	10.00	2.68	5.00	69.40	5.10	2.00
8811	Delaware Chick Grains. Delaware Mills, Deposit, N. Y	ber Co		1.08	10.00	10.00	1.18	3.00	76.09	2.05	3.00
8788	Delaware Chick Starting Mash										
	(with Dried Buttermilk). Del-	Southington: Southington Lum-	0.00	7 70	15 00	15 00	4.75	5 00	57.92	5.28	4.00
7805	aware Mills, Deposit, N. Y. Delaware Growing Mash. Dela-	ber CoSouthington Lum-	9.20	1.19	15.00	15.00	4.70	0.00	01.32	0.20	1.00
1000	ware Mills, Deposit, N. Y.	ber Co	10.85	6.33	16.81	17.00	5.28	6.00	55.16	5.57	5.00
7804	Delaware Scratch Grains. Dela-	Southington: Southington Lum-					9.00	F 00	GO 27	3.17	2.50
	ware Mills, Deposit, N. Y	ber Co	12.95	1.54	9.94	10.00	3.03	5.00	69.37	0.17	2.50
				1	1		1		1		

Retail Dealer

Winsted: C. R. Hawley 11.78

North Haven: Ridgewood Farm 5.88

North Haven: Ridgewood Farm 8.35

Winsted: Chas. R. Hawley....
East Bridgeport: Kaplan Feed
Co.....

Devon: Devon Coal & Ice Co...

Manufacturer and Brand

PROPRIETARY MIXED FEEDS-

Continued. Poultry Feeds-Continued.

Poultry Feeds—Continued.
Delaware Scratch Grains. Delaware Mills, Deposit, N. Y...
Indian Laying Mash (with Dried Buttermilk). Delaware Mills, Deposit, N. Y....
Indian Scratch Grains. Delaware Mills, Deposit, N. Y...
Devon Laying Mash. Devon

Devon Laying Mash. Devon Coal & Ice Co., Devon, Conn.

Eastern States Egg Mash, Open Formula. Eastern States Farmers' Exchange, Spring-

Springfield, Mass.....

No. Station

160

164

8808

8720

8646

8649

CONNECTICUT

Pounds per Hundred

Found

%

2.98

5.28

2.63

7.83

5.93

5.55

Fiber

Guaranteed, not more than

%

5.00

7.00

5.00

Protein (N x 6.25)

Found

%

9.25

18.88

18.06

Ash

%

1.21

8.82

8.23

1.70 10.81

7.33 18.19

8.12 17.69

%

9.98

12.10

8.40

Guaranteed, not less than

%

10.00

18.00

10.00

18.00

16.50

16.00

extract etc.)

Nitrogen-free (starch, gum, e

%

70.29

53:90

72.76

7.00 51.57

7.00 | 56.73

7.00 54.36

2.44

5.32

2.05

4.50

5.65

5.45

Fat

%

2.50

4.00

2.50

4.50

3.50

3.50

Z
BULLETIN
303

8647	Eastern States Scratch Grains									
	Open Formula. (1927) Eastern States Farmers' Ex-									
	change, Springfield, Mass.	North Haven: Ridgewood Farm 9.50	1.44	10.88	9.50	2.08	3.00	73.05	3.05	2.50
8772	Eastern States Scratch Grains									
	Open Formula. (Old) East-									
	ern States Farmers' Ex-	Watertown: Watertown Co-op.			10.00	0 00			0 40	0 40
	change, Springfield, Mass	Assoc	1.70	10.50	10.00	2.93	4.00	70.94	3.13	2.50
233	Chixsaver. Elmore Milling Co.,	Hazardville: A. D. Bridges	0.01	1 01	10 00	1.05	0 00	FF 02	1 07	4.00
00.47	Oneonta, N. Y	Sons 9.68	9.91	15.81	18.00	4.05	9.00	55.93	4.67	4.00
9947	Elmore Egg Mash. Elmore	Shelton: Wolf Savitsky 10.48	9 56	21.69	18 00	5.25	8 00	47.88	6.14	4.00
7820	Milling Co., Oneonta, N. Y. Elmore Growing Mash. Elmore	Hazardville: A. D. Bridges'	0.00	21.09	10.00	0.20	0.00	11.00	0.11	1.00
1020	Milling Co., Oneonta, N. Y.	Sons	8 48	19.13	17 00	5.65	8 00	50.45	5.14	4.00
9951	Elmore Growing Mash. Elmore		0.10	10.10	1	0.00	0.00	00.10	0.11	1.00
	Milling Co., Oneonta, N. Y.	Shelton: Wolf Savitsky 10.30	9.66	19.00	17.00	5.40	8.00	50.21	5.43	4.00
163	Elmore (Storrs Formula) Lay-									82.72
	ing Mash. Elmore Milling									
	Co., Oneonta, N. Y	Newtown: R. H. Holcomb & Co. 9.63	7.77	18.31	18.00	6.70	7.00	52.09	5.50	4.00
8662	Eshelman's Baby Chick Starter.									
	John W. Eshelman & Sons,	TIV III A TO TI II	0	110 00	11 00	4 0=	0 00	01 45	1 00	1 00
2000	Lancaster, Pa	Wallingford: A. E. Hall 6.80	6.17	16.06	14.00	4.65	6.00	61.47	4.85	4.00
8663	Eshelman's Chick Feed. John									
	W. Eshelman & Sons, Lan- caster, Pa	Wallingford: A. E. Hall 9.50	1 00	11 95	10 00	1.80	3 00	71.32	4.25	3.00
22	Eshelman's Fattening Mash.	Waningjora. 11. 12. 11an 9.00	1.00	11.20	10.00	1.00	0.00	11.02	1.20	0.00
22	John W. Eshelman & Sons.									
	Lancaster, Pa	New Haven: Moran-Patton Co. 10.30	6.39	17.63	13.00	4.18	6.00	57.50	4.00	4.00
3630	Eshelman Growing Mash. John									
	W. Eshelman & Sons, Lan-									
	caster, Pa	Norwalk: Frank Libner & Sons 6.78	6.23	17.13	16.00	5.28	7.00	59.66	4.97	4.00
3633	Eshelman's Laying Mash. John				22.1					
	W. Eshelman & Sons, Lan-		0 00	00 00	00 00	- 00	H 00			- 00
	caster, Pa	Norwalk: Frank Libner & Sons 6.18	8.68	20.50	20.00	5.23	7.00	53.74	5.70	5.00

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						Pound	ls per Hu	Pounds per Hundred *									
			Water	Ash		otein 6.25)	Fiber		extract etc.)		Fat						
Station No.	Manufacturer and Brand	Retail Dealer			Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than						
	PROPRIETARY MIXED FEEDS— Continued. Poultry Feeds—Continued.		%	%	%	%	%	%	%	%	%						
8188	Eshelman's Scratch Feed. John W. Eshelman & Sons, Lancaster, Pa	Hamden: I. W. Beers	7.97	1.38	10.13	10.00	2.43	4.00	75.40	2.69	2.50						
8555	Imperial Scratch Feed. John W. Eshelman & Sons, Lancaster, Pa.				10.13	9.00	2.30	4.00	73.89	2.93	2.50						
9929	Lancaster Scratch Feed. John W. Eshelman & Sons, Lan- caster, Pa				10.75		3.00		69.79	2.65	2.50						
108	Flory's Chick Starter. Flory Milling Co., Inc., Bangor, Pa.	Bloomfield: Bloomfield Farmers' Exchange	10.45		14.63		3.95		59.41	4.34	3.00						
44	Flory's Egg Mash. Flory Milling Co., Inc., Bangor, Pa Flory's Growing Mash. Flory	Exchange	9.50		19.56		8.20		48.13	5.20	4.50						
372	Milling Co. Inc., Bangor Pa. Flory's Growing Mash. Flory Milling Co. Inc., Bangor, Pa.		9.90 10.05			17.00 17.00	4.73		57.46 57.45	5.10	4.50						

7812	Flory's Intermediate Chick Feed. Flory Milling Co., Inc., Bangor, Pa.	Bloomfield: Bloomfield Farmers'	19 61	1 24	0.00	0.00	1.00	F 00	70.01	9.10	9.70
109	Flory's Intermediate Chick Feed. Flory Milling Co., Inc., Ban-			1.34	9.06	9.00	1.80	5.00	72.01	3.18	2.50
43	gor, Pa	Exchange	12.75	1.41	9.75	9.00	2.70	5.00	71.30	2.09	2.50
8801	Milling Co. Inc., Bangor, Pa. R-Own Laying Mash. A. W.	Exchange	12.55		10.00		2.88	5.00	70.26	2.65	2.50
8787	Forbes, East Haven, Conn R-Own Scratch Feed. A. W.	East Haven: A. W. Forbes				20.00	5.48		51.52		5.00
7934	Forbes, East Haven, Conn Grandin's Laying Mash with Buttermilk. D. H. Grandin	East Haven: A. W. Forbes	9.50	1.69	10.38	10.00	2.70	5.00	72.48	3.25	3.00
7935-	Milling Co., Jamestown, N.Y, Grandin's Screened Scratch Feed. D. H. Grandin Milling	Falls Village: H. E. Dean	9.18	13.51	21.31	20.00	6.65	8.00	44.80	4.55	4.00
8182	Co., Jamestown, N. Y	Falls Village: H. E. Dean	12.00	1.58	10.63	10.00	2.90	5.00	70.09	2.80	2.50
8181	& Hunter Co., Chicago, Ill. Red Comb Egg Mash. Hales &	Highwood: T. C. Hadden & Co.		MUSAUS IS		14.00	3.58	5.00	61.23	4.84	4.00
8754	Hunter Co., Chicago, Ill Red Comb Growing Mash. Hales								57.06		4.00
8185	& Hunter Co., Chicago, Ill. Red Comb Scratch Feed, No	Grain Co	8.95	9.27	16.63	14.00	4.98	6.00	55.57	4.60	4.00
8760	Grit. Hales & Hunter Co., Chicago, Ill	Highwood: T. C. Hadden & Co.		1.76	10.63	10.00	2.60	5.00	72.58	3.18	2.50
7824	Feed. Hecker H. O. Co., Buffalo, N. Y	South Norwalk: Roodner Feed Co	8.45	1.63	12.50	12.00	1.33	4.00	72.94	3.15	3.00
8806	W. Hudson, Windsor, Conn. Hudson's Developing Mash. L.	Windsor: L. W. Hudson	9.85	8.29	18.00	17.00	5.03	5.40	53.87	4.96	6.00
	W. Hudson, Windsor, Conn.	Windsor: L. W. Hudson	7.40	7.95	18.00	17.00	5.30	5.40	56.10	5.25	6.00

		Pounds per Hundred									
					Protein (N x 6.25)		Fiber		extract etc.)	F	at
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—		%	%	%	%	%	%	%	%	
7823 9791	Poultry Feeds—Continued. Hudson's Laying Mash. L. W. Hudson, Windsor, Conn Blue Top Chick Feed, No Grit.	Windsor: L. W. Hudson	10.10	9.38	17.38	19.00	6.48	5.00	51.61	5.05	6.00
8813	Chas. A. Krause Milling Co., Milwaukee, Wis Blue Top Egg Mash. Chas. A.		12.05	1.23	9.88	10.00	1.68	5.00	73.31	1.85	2.50
8814	Krause Milling Co., Milwaukee, Wis	Thomaston: I. Levy	6.05	7.67	20.38	20.00	6.43		54.09	5.38	5.00
7840	ing Co., Milwaukee, Wis Dry Mash. S. F. Labieniec, Kensington, Conn	Thomaston: I. Levy Kensington: S. F. Labieniec			10.38 18.75		2.45 7.73		72.70 50.02	2.85 6.00	2.50
8675 8757	Dry Mash. S. F. Labieniec, Kensington, Conn	Kensington: S. F. Labieniec.	7.10		19.25		7.80		51.38	5.35	5.00
0101	Milling Co., Detroit, Mich.	Co	10.25	5.80	15.38	14.00	4.33	6.50	59.19	5.05	4.50

3551	Larro Egg Mash. Larrowe										
	Milling Co., Detroit, Mich.	Plainville: F. B. Newton	7.40	11.56	19.94	19.00	6.38	8 00	49.02	5.70	5.00
48	Larro Growing Mash. Larrowe						0.00	0,00	10.02	0.10	0.00
7846	Milling Co., Detroit, Mich.	Collinsville: Lawton Miner Co.	9.73	8.25	16.88	16.00	5.80	6.50	54.77	4.57	5.00
040	Larro Scratch Grains. Larrowe Milling Co., Detroit, Mich.	Branford: S. V. Csborn, Est	11 60	1 69	11 00	10.00	2.88	4 00	70.05	0.0=	0 *0
3550	Larro Scratch Grains. Larrowe	Dianjora. S. V. (Sboili, Est	11.00	1.02	11.00	10.00	4.00	4.00	70.05	2.85	2.50
	Milling Co., Detroit, Mich.	Plainville: F. B. Newton	9.10	1.64	10.88	10.00	2.90	4 00	72.30	3.18	2.50
3208	Homestead Dry Mash. C. W.				2			2.00	.2.00	0.10	2.00
	Lines Co., New Britain,	37 D '									
206	Conn	New Britain: C. W. Lines Co.	7.70	10.04	20.38	18.00	6.18	7.00	50.27	5.43	4.00
200	Lines Co., New Britain,										
	Conn	New Britain: C. W. Lines Co.	10.75	1.26	9.50	9.00	2.03	5 00	74.26	2.20	2.50
3209	Mill Pride Fancy Scratch Feed.						2.00	0.00	1.20	2.20	2.50
	C. W. Lines Co., New Brit-	N Division Transfer							100		
3205	ain, Conn	New Britain: C. W. Lines Co.	9.93	1.36	10.06	10.00	2.77	5.00	73.20	2.68	3.00
0200	Lines Co., New Britain.										
	Conn	New Britain: C. W. Lines Co.	7 30	11 64	18 88	18 00	6 98	7 50	50.10	5.10	5.00
7928	Common Sense Laying Mash.			11.01	10.00	10.00	0.00	1.00	00.10	0.10	3.00
	Litchfield Co-op. Assoc.,	Torrington: Litchfield Co-op.									
165	Torrington, Conn	Assoc	10.25	8.40	15.81	15.00	7.48	8.00	53.11	4.95	4.00
100	Mash. Long Hill Feed Store.										
	Long Hill, Conn	Long Hill: Long Hill Feed Store	8 58	14 46	16 69	20 00	6.65	7 00	48.13	5.49	5.00
244	Buttermilk Mash. E. Manches-						0.00	1.00	40.10	0.49	5.00
044	ter & Sons, Winsted, Conn	Winsted: E. Manchester & Sons	7.85	16.38	15.00	20.00	6.40	6.00	49.14	5.23	4.00
241	Red Star Egg Mash. E. Man-										
	chester & Sons, Winsted,	Winsted: E. Manchester & Sons	0.12	11 00	10 75	10 00	F 00	0.00	10 01		
240	Red Star Scratch Feed. E.	W Wisten. 12. Wanchester & Sons	9.15	11.80	18.75	18.00	5.83	8.00	49.04	5.45	4.00
	Manchester & Sons, Win-										
	sted, Conn	Winsted: E. Manchester & Sons	11 68	1 96	11.38	9.00	3.10	7 00	69.65	2.23	3.50

Retail Dealer

Riverton: L. A. Coe.....

Riverton: L. A. Coe.....

Riverton: L. A. Coe.....

New Milford: Geo. E. Ackley &

New Milford: Geo. E. Ackley &

Co.....

Manufacturer and Brand

PROPRIETARY MIXED FEEDS-

Continued.

Poultry Feeds—Continued.

Bull Brand Chick Feed. Mari-

time Milling Co., Buffalo, N. Y...

Bull Brand Chick Starter (with Dried Buttermilk). Maritime

Milling Co., Buffalo, N. Y..
Bull Brand Growing Mash (with
Dried Buttermilk). Maritime

Milling Co., Buffalo, N. Y.. Bull Brand Laying Mash (with Dried Buttermilk). Maritime

Milling Co., Buffalo, N. Y..

Bull Brand Scratch Feed. Maritime Milling Co., Buffalo,
N. Y....

Station No.

249

248

245

167

177

Pounds per Hundred

%

1.70

4.23

5.35

7.65

4.33

Fiber

Guaranteed, not more than

4.00 72.52

7.00 51.88

8.00 47.07

4.00 67.52

58.49

4.00

extracetc.)

Nitrogen-free e (starch, gum, e

%

1.70

4.43

5.25

5.50

3.20

2.50

4.00

5.00

5.00

2.50

Protein (N x 6.25)

Found

%

10.38 11.00

20.75 20.00

11.13 10.00

15.31

18.06

Ash

1.30

7.94

10.03

1.94

12.40

9.60

9.65

9.00

11.88

Guaranteed, not less than

%

12.00

18.00

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7938	Red E Lay Laying Mash. Mar-	37 34'74 1 C T3 A 11 0										
400	itime Milling Co., Buffalo,	New Milford: Geo. E. Ackley & Co		9.18	19.25	18.00	6.30	9.00	50.41	5.20	5.00	
168	Red-E-Mixt Egg Mash. Maritime Milling Co., Buffalo,	New Milford: Geo. E. Ackley &	0.10	10.10	10.50	10.00	0.50	0.00	40.05	F 70	~ 00	
246	N. Y Jersey Dry Mash (with Dried	Co	9.13	10.16	19.50	18.00	6.53	9.00	48.95	5.73	5.00	
8493	Buttermilk). Maritime Milling Co., Buffalo, N. Y Red Wing Scratch Feed. Meech	Riverton: L. A. Coe	8.78	8.30	19.81	18.00	6.50	9.00	50.56	6.05	5.00	
0483	& Stoddard, Inc., Middle- town, Conn	Plantsville: Mehmel & Sarvi	12 58	1.42	0.38	10.00	2.60	5.00	71.34	2.68	3.00	
8763	Red Wing Special Buttermilk Chick Starter. Meech &	Transome. Menner & Sarvi	12.00	1.42	9.00	10.00	2.00	0.00	11.01	2.00	0.00	
	Stoddard, Inc., Middletown, Conn	Middletown: Meech & Stoddard, Inc	8.85	12.76	16.13	13.00	5.65	5.00	51.96	4.65	4.00	
8762	Red Wing Special Buttermilk Growing Feed. Meech &											
	Stoddard, Inc., Middletown, Conn	Middletown: Meech & Stoddard, Inc	8.85	13.64	17.19	17.00	5.93	8.00	49.69	4.70	5.50	
8494	Red Wing Special Buttermilk Laying Mash. Meech &											
	Stoddard, Inc., Middletown,	Plantsville: Mehmel & Sarvi	8.88	8.17	19.44	17.00	6.28	8.00	51.53	5.70	5.50	
8764	Red Wing Special Chick Feed. Meech & Stoddard, Inc.,	Middletown: Meech & Stoddard, Inc	10 55	1 20	10.01	10.00	1 10	F 00	71.10	2.70	3.00	
8765	Middletown, Conn Red Wing Special Intermediate Chick Feed. Meech & Stod-	inc	12.00	1.50	10.81	10.00	1.48	3.00.	71.10	2.70	3.00	
	dard, Inc., Middletown,	Middletown: Meech & Stoddard,	11 63	1 55	11 25	10.00	2 56	5 00	69.83	3.18	3.00	
123	Moon's Developing Grains. Geo. Q. Moon & Co., Bing-		11.00	1.00	11.20	10.00	2.00	0.00	00.00	0.10	0.00	
	hamton, N. Y	Manchester: I. P. Campbell	11.53	1.87	11.63	10.00	1.98	5.00	69.54	3.45	2.00	
-					1	1	1					

						Pound	ls per Hu	indred			
	Manufacturer and Brand					Protein (N x 6.25)		ber	extract etc.)	F	at
Station No.		Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, et	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—		%	%	%	%	%	% .	%	%	%
287	Poultry Feeds—Continued. Moon's Growing Mash. Geo. Q. Moon & Co., Binghamton, N. Y.	Manchester: I. P. Campbell	8.28	11.60	19.50	17.00	5.80	7.00	49.44	5.38	4.00
121	Moon's Laying Mash with Dried Buttermilk. Geo. Q. Moon & Co., Binghamton, N. Y.	Manchester: -I. P. Campbell	9.20	9.42	20.00	20.00	6.15	9.00	49.65	5.58	4.00
124	Moon's Scratch Feed. Geo. Q. Moon & Co., Binghamton, N. Y.	Manchester: I. P. Campbell		1.42		10.00	3.03		71.22	2.20	2.00
18 8317	C. B. Mash. Moran-Patton Co., New Haven, Conn Old Mill Buttermilk Laying	New Haven: Moran-Patton Co.		8.21			7.33		49.93	5.20	4.00
8318	Mash. Fred C. Morse, Guilford, Conn	Guilford: Fred C. Morse Guilford: Fred C. Morse			20.13		7.45 7.50		51.27 51.92	6.70 5.25	5.00 5.00

			,								
128	Old Mill Growing Mash with Milk. Fred C. Morse, Guil-										
	ford, Conn	Guilford: Fred C. Morse	9.85	6.49	16.25	16.00	6.18	7.00	56.30	4.93	5.00
7847	Old Mill Scratch Feed. Fred C. Morse, Guilford, Conn	Guilford: Fred C. Morse	11.36	1.56	10.44	10.00	2.63	4.00	70.63	3.38	3.00
7951	Mystic Laying Mash. Newman Bros. Grain Co., Rochester,										
	N. Y	Naugatuck: Davis Feed Store	10.50	8.04	19.25	19.00	7.25	10.00	48.96	6.00	4.00
8668	Marathon Laying Mash with Buttermilk, Nowak Milling	Meriden: Reliable Grain & Feed									
	Corp., Hammond, Ind	Co	7.60	10.59	20.56	20.00	6.45	9.00	49.80	5.00	4.50
23	Aunt Mary's Egg Mash with Dried Buttermilk. Ontario										
8809	Milling Co., Oswego, N. Y. Aunt Mary's Scratch Feed.	Meriden: H. Grulich	9.68	9.88	20.00	19.00	5.50	8.50	49.36	5.58	4.00
0000	Ontario Milling Co., Oswego,		10 55	1 07	10.00	10.00	0.00	- 00	70.00	0.05	0.50
8666	N. Y	Meriden: H. Grulich	10.55	1.67	10.38	10.00	2.93	5.00	70.82	3.65	2.50
0000	and Fish. Ontario Milling	Meriden: Reliable Grain & Feed Co	7 75	0.97	19.00	19 00	6.13	9 50	53.07	4.18	4.00
8810	Co., Oswego, N. Y										
8314	Milling Co., Oswego, N. Y. Osborn's Mash. S. V. Osborn,	Meriden: H. Grulich	10.00	1.59	10.00	10.00	2.93	5.00	71.58	3.90	2.50
	Est., Branford, Conn	Branford: S. V. Osborn, Est	7.00	4.35	14.13	12.00	6.96	8.00	63.95	3.61	3.00
8313	Osborn's Scratch. S. V. Osborn, Est., Branford, Conn	Branford: S. V. Osborn, Est	7.45	1.56	10.50	10.00	2.33	5.00	75.51	2.65	2.00
147	Bidwell Dry Mash. Park										
	& Pollard Co., Buffalo, N. Y	Bridgeport: Samp Mortar Mills	9.20	11.46	23.25	18.00	5.53	10.00	46.88	3.68	1.50
8567	Bidwell Scratch Feed. Park & Pollard Co., Buffalo, N. Y.	Derby: Peterson-Hendee Co	8.73	1.48	10.25	10.00	2.65	5.00	73.64	3.25	1.50
53	Bonnie Booster. Park & Pollard	Bristol: Bristol Grain & Supply							63.10		3.00
	Co., Buffalo, N. Y	Co	10.03	4.34	15.25	12.00	4.18	5.00	05.10	5.10	5.00

Table I. Analyses of Commercial Feeds, Inspection of 1928—Continued.

						Pound	ls per Hu	indred			
Station No.	Manufacturer and Brand					Protein (N x 6.25)		ber	extract etc.)	F	Pat
		Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e. (starch, gum, et	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—Continued.		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
251	Growing Feed. Park & Pollard Co., Buffalo, N. Y	New Hartford: G. W. Case Inc.	10.15	7.99	15.19	14 00	5.68	8 00	57.66	3.33	1.50
3752 3478	Intermediate Chick Feed. Park & Pollard Co., Buffalo, N. Y. Lay or Bust Dry Mash. Park &	Plainville: F. B. Newton	12.40		10.06		2.08		71.03	3.03	1.50
481	Pollard Co., Buffalo, N. Y Red Ribbon Scratch Feed. Park	& Coal	7.30	9.26	20.81	18.00	5.68	10.00	53.05	3.90	1.50
11	& Pollard Co., Buffalo, N. Y. Platco Laying Mash. Frank S.	Plainville: F. B. Newton	8.20	1.43	10.50	10.00	2.52	5.00	74.65	2.70	1.50
321	Platt Co., New Haven, Conn. Platco Laying Mash. Frank S.	New Haven: Frank S. Platt Co.		11.93			5.50	7.00	45.88	5.03	5.50
021	Platt Co., New Haven, Conn. Platco Perfection Grain Mix- ture. Frank S. Platt Co.,	New Haven: Frank S. Platt Co.	9.08	11.99	21.38	20.00	5.98	7.00	45.89	5.68	5.50
	New Haven, Conn	New Haven: Frank S. Platt Co.	11.30	1.90	11.19	10.50	4.00	4.50	67.56	4.05	3.00

									N. N.		
354	Platco Perfection Grain Mix- ture. Frank S. Platt Co.,									z.	
8807	New Haven, Conn Puritan Scratch Feed. W. N. Potter & Sons, Springfield,	New Haven: Frank S. Platt Co.	11.30	1.44	10.31	10.50	2.98	4.50	70.87	3.10	3.50
252	Mass	Windsor: L. W. Hudson		1.66	10.13	10.00	3.65	2.50	71.33	3.08	3.00
54	Potter & Sons, Springfield, Mass Pratt's Baby Chick Food with	Bloomfield: Bloomfield Farmers' Exchange	11.65	1.72	10.63	10.00	3.70	2.50	69.30	3.00	3.00
7806	Buttermilk. Pratt Food Co., Buffalo, N. Y Pratt's Circle A Chick Scratch.	Bristol: Bristol Grain & Supply Co	9.14	9.21	14.38	13.00	3.75	3.80	59.05	4.47	3.50
8724	Pratt Food Co., Hammond, Ind	Bristol: Bristol Grain & Supply Co	12.16	1.04	10.50	10.00	1.28	5.00	71.97	3.05	2.50
8632	Feed. Pratt Food Co., Ham- mond, Ind	Bristol: Bristol Grain & Supply Co	9.95	1.35	10.00	10.00	3.13	5.00	73.09	2.48	2.50
	Feed. Pratt Food Co., Hammond, Ind	Norwalk: Frank Libner & Sons	5.80	2.03	13.25	10.00	1.60	5.00	74.82	2.50	2.00
27	Pratt's Supreme Growing Mash with Buttermilk. Pratt Food Co., Hammond, Ind	New Britain: S. P. Strople	9.20	10.61	17.63	17.50	4.90	7.00	51.96	5.70	4.50
8635	Pratt's Victory Chick Scratch Feed. Pratt Food Co., Ham- mond, Ind.	Norwalk: Frank Libner & Sons			12 5/12	10.00		5 00	78.95	1.80	2.00
8751	Pratt's Victory Laying Mash with Buttermilk. Pratt Food										
253	Co., Hammond, Ind Egg-Em-On Laying Mash. H. C. Puffer Co., Springfield,							8.00	46.70	6.10	4.00
	Mass	Suffield: Spencer Bros	9.70	9.48	21.63	20.00	7.60	8.00	47.16	4.43	4.00

CONNECTICUT

303

563

9930	Schumacher's Scratch Grains,										
	No Grit. Quaker Oats Co.,	Stratford: Farmers' Flour &									
7918	Chicago, Ill	Grain Co	11.80	1.73	11.25	10.00	3.15	3.50	69.47	2.60	2.00
1910	Fine Ground Green Poultry Alfalfa Meal. Ralston Purina										
	Mills, St. Louis, Mo	Westerly: C. W. Campbell Co.	8 61	10.04	19 60	17 00	22 05	25 00	27 46	2.35	1.60
8702	Purina Baby Chick Chow Feed.	westerny. C. W. Campben Co.	0.01	10.01	10.09	11.00	44.00	25.00	37.40	4.55	1.00
	Ralston Purina Co., St.	Middletown: The Coles Com-									
	Louis, Mo	pany	10.25	1.81	11.50	10.00	2.20	4.00	71.34	2.90	2.00
8703	Purina Chicken Chowder Feed.										
	Ralston Purina Co., St.				00 04						
190	Louis, Mo	pany	9.05	8.26	20.31	19.00	7.35	8.00	50.68	4.35	4.00
100	Ralston Purina Co., St.	Stamford: Clapboard Hill Feed									
	Louis, Mo	Co	9 33	4 23	15 88	15.50	3.65	1 50	62.78	4.13	4.00
14	Purina Chicken Fatena. Rals-		0.00	1.20	10.00	10.00	0.00	4.00	04.10	4.10	4.00
	ton Purina Co., St. Louis,					100					102.00
4.0	Mo	New Haven: Moran-Patton Co.	10.43	3.90	14.13	12.00	5.45	6.60	61.81	4.28	4.00
12	Purina Chick Growene Feed.										
	Ralston Purina Co., St. Louis, Mo	N 77 M D C	0.01	H 01	10 10	10 00					
189	Purina Chick Startena Feed.	New Haven: Moran-Patton Co.	9.01	7.91	18.19	16.80	5.73	7.00	52.55	6.01	4.00
100	Ralston Purina Co., St.	Stamford: Clapboard Hill Feed									
	Louis, Mo	Co	8.83	8 00	18 25	17.00	6.03	7 00	52.56	6.33	4 00
213	Purina Grainola Feed. Ralston	Stamford: Clapboard Hill Feed		0.00	10.20	100	0.00	1.00	02.00	0.00	4.00
	Purina Co., St. Louis, Mo	Co	12.15	3.69	9.00	8.00	8.83	15.00	63.75	2.58	2.00
13	Purina Hen Chow Feed. Rals-							2.3		is	
	ton Purina Co., St. Louis,	N II M D II G	10 00		10 ==						
129	Mo Purina Lamb Chow containing	New Haven: Moran-Patton Co.	12.38	1.78	10.75	10.00	2.55	4.00	69.72	2.82	2.50
123	Charcoal. Ralston Purina										
	Co., St. Louis, Mo	Middletown: Coles Company	11 10	5 07	16 75	14.00	0 53	12 00	54.12	3.43	3.00
363	Winner Scratch Feed. Ralston			3.01	10.10	11.00	0.00	12.00	01.12	0.10	3.00
	Purina Co., St. Louis, Mo	Norwich: Norwich Grain Co	11.90	1.70	10.88	10.00	2.75	5.00	70.12	2.65	2.00

						Pound	ls per Hu	undred			
						otein 6.25)	F	iber	extract etc.)	I	at
Station No.	Manufacturer and Brand	Retail Dea ier	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e.	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—		%	%	%	%	%	%	%	%	%
393 391	Poultry Feeds—Continued. Diamond Chick Feed. Rockville Grain & Coal Co., Rockville, Conn.	Manchester: Manchester Grain & Coal	11.28	1.89	10.88	10.00	1.60	3.00	69.95	4.40	3.00
390	Diamond Laying Mash. Rock- ville Grain & Coal Co., Rockville, Conn Diamond Scratch Feed. Rock-	Manchester: Manchester Grain & Coal	8.55		21.06		5.53		50.00	6.23	5.00
8289	ville Grain & Coal Co., Rockville, Conn	& Coal			10.50		2.45 5.35	4.00	72.03 48.38	5.58	2.50
127 8287	Rolf's Chic Grains. Fred H. Rolf, Guilford, Conn Rolf's Chick Mash. Fred H.	Guilford: Fred H. Rolf		1.41		10.00	1.55	4.00	72.25	3.23	4.00
8288	Rolf, Guilford, Conn Rolf's Scratch Grains. Fred H. Rolf, Guilford, Conn	Guilford: Fred H. Rolf Guilford: Fred H. Rolf		9.41	18.50 9.69		4.95 2.78		55.11 74.45	5.33	

788	See More Egg Mash with Butter-										
	milk. Seymour Grain & Coal	Seymour: Seymour Grain &									
.==	Co., Seymour, Conn	Coal Co	9.50	9.77	20.13	18.00	5.95	7.00	50.12	4.53	4.8
977	See More Egg Scratch Feed.	0 -:- 0									
	Seymour Grain & Coal Co.,	Seymour: Seymour Grain & Coal Co	19 05	1 59	10 19	10 00	2.88	6 00	69.77	9 75	3:0
586	Nelson's Laying Mash. Shel-	Coar Co	12.95	1.02	10.15	10.00	4.80	0.00	09.77	4.10	0.0
000	ton Feed Co., Shelton, Conn.	Shelton: Shelton Feed Co	6 85	7 18	18 00	16.00	6.05	8 00	56.29	5.33	4.0
87	Nelson's Mixed Chicken Feed.	Shellon: Shellon Feed Co	0.00	1.40	10.00	10.00	0.00	0.00	30.29	0.00	4.
01	Shelton Feed Co., Shelton,			E TOTAL SERVICE						388	
	Conn	Shelton: Shelton Feed Co	9 00	1 47	10 00	10 00	2 53	5 00	73.77	3 23	1.
55	Mill Streams "Fortune Hunter"	- Shellon I ced Co	0.00	1.1.	10.00	10.00	2.00	0.00	10.11	0.20	1
	Scratch Grains. Winchell										
	Smith, Farmington, Conn.	Farmington: Winchell Smith	11.95	1.87	11.00	10.00	3.65	3.00	67.96	3.57	2.
00	Mill Streams "Lightnin" Lay-										1
	ing Mash. Winchell Smith,										
	Farmington, Conn	Farmington: Winchell Smith	10.38	9.52	21.13	16.00	5.60	8.00	48.92	4.45	3
06	King Growing Feed containing										13
	Dried Buttermilk and Beef										1
	Scraps. St. Albans Grain	Willimantic: Willimantic Grain									
	Co., St. Albans, Vt	Co	10.75	8.79	16.19	15.00	4.88	5.00	53.74	5.65	4.
29	King Mash Feed containing										
	Buttermilk, Fish and Meat								- 25	130	
	Scraps. St. Albans Grain	Willimantic: Willimantic Grain	0 49	0.00	00 01	10 50	0.05	7 50	10 50	1 00	4
00	Co., St. Albans, Vt			9.23	20.81	19.50	0.35	7.50	49.53	4.65	4.
28	King Scratch Feed. St. Albans	Willimantic: Willimantic Grain	11 05	9 19	11 95	10.00	3.05	5 50	69.00	2.63	2.
34	Grain Co., St. Albans, Vt Paragon Scratch Feed. St. Al-	C0	11.90	4.14	11.20	10.00	5.05	0.00	09.00	2.00	4.
)4	bans Grain Co., St. Albans,	Maridan : West End Poultry									
	Vt.	Meriden: West End Poultry Supply	10.80	1 45	10 00	10 00	2.40	5 00	72.65	2.70	2
5	Wirthmore All Grain Chick	Suppry	10.00	1.10	10.00	10.00	2.40	0.00	12.00	2.10	-
.0	Feed (Fine Chick Scratch).										
	St. Albans Grain Co., St.									(J. S.)	
3074	Albans, Vt	Southport: C. Buckingham	7 15	1 20	10 75	11 00	1 69	2 50	74.58	4.20	2.

Found

%

3.62

2.65

5.13

1.68

5.38

Fiber

Guaranteed, not more than

%

5.00

5.00

extracetc.)

Nitrogen-free (starch, gum, e

%

60, 11

69.01

5.00 | 55.34

3.50 70.52

7.00 50.79

Fat

Found

%

3.98

3.25

5.33

2.70

5.88

Guaranteed, not less than

%

4.00

2.50

4.50

2.50

4.00

Protein (N x 6.25)

Ash

%

8.41

7.92

%

16.88

1.96 10.75 10.00

16.63

1.36 10.56

%

7.00

9.65

Guarante not less t

%

17.00

15.00

10.00

20.00

Retail Dealer

Southport: C. Buckingham....

Plainville: F. B. Newton....

Branford: S. V. Osborn Est... 12.38

Southbury: H. R. Stone..... 13.18

North Haven: W. L. Thorpe. 6.75 10.57 20.63

Manufacturer and Brand .

PROPRIETARY MIXED FEEDS-

Continued. Poultry Feeds-Continued.

Wirthmore Buttermilk Baby Chick Food. St. Albans, Grain Co., St. Albans, Vt.. Wirthmore Certified Scratch Feed. St. Albans Grain Co.,

St. Albans, Vt.

Wirthmore Growing Feed with

Dried Buttermik and Beef

Scraps. St. Albans Grain

Co., St. Albans, Vt.

Wirthmore Intermediate Chick Feed (Coarse Chick Scratch). St. Albans Grain Co., St.

Albans, Vt.

Wirthmore Laying Mash with
Buttermilk. St. Albans Grain
Co., St. Albans, Vt.

No.

Station

8613

137

8768

9982

8643

PERIMENT	
STATION	
BULLETIN	
303	

25	Wirthmore Poultry Greens St.						33436				1
	Albans Grain Co., St. Al-										
332	bans, Vt	Kensington: S. F. Labieniec	8.00	10.65	17.13	20.00	21.18	18.00	40.79	2.25	2.00
642	bans, Vt	Groton: C. W. Campbell Co	8.25	9.81	16.50	20.00	24.15	18.00	39.41	1.88	2.00
679	bans, Vt	North Haven: W. L. Thorpe		1.60	10.50	10.00	2.58	5.00	73.97	2.90	2.50
680	Stickell & Sons, Hagerstown, Md Victor Scratch Grains. D. A.	Grain Co	6.83	7.83	19.75	20.00	4.58	6.00	54.96	6.05	5.00
140	Stickell & Son, Hagerstown, Md	New Britain: Hugh Reynolds Grain Co	8.10	1.64	9.88	10.00	2.63	5.00	74.60	3.15	2.50
139	Milling Co., Syracuse, N. Y. Syragold Growing Mash. Syracuse Milling Co., Syracuse,	Higganum: Felix Petrofsky	9.85	7.39	19.88	18.00	6.53	8.00	51.62	4.73	3.00
334	N. Y	Higganum: Felix Petrofsky	9.65	10.13	17.06	16.00	3.50	7.00	54.86	4.80	4.00
141	Co., Syracuse, N. Y	Manchester: Little & McKinney	8.88	11.32	19.88	18.00	7.73	9.00	47.51	4.68	3.00
796	cuse Milling Co., Syracuse, N. Y	Higganum: Felix Petrofsky	12.10	1.67	10.63	10.00	2.95	5.00	69.70	2.95	2.50
798	aston Supply Co., Thomaston, Conn	Thomaston: Thomaston Supply Co	7.65	9.80	20.25	20.00	7.48	7.00	50.17	4.65	4.50
758	Thomaston Supply Co.,	Co	10.10	2.05	10.44	10.00	3.01	5 00	69.70	4.70	4.00
198	Mills, Waverly, N. Y	South Norwalk: Roodner Feed	9.33		20.88		4.08		53.67	5.05	3.00

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ANALYSES	

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						Poun	ds per H	undred			
						otein (6.25)	F	iber	extract etc.)		Fat
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, et	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—		%	%	%	%	%	%	-%	%	%
257	Poultry Feeds—Concluded. Derby Scratch Feed. Tioga Empire Feed Mills, Waverly,										
8756	N. Y Egatine. Tioga Empire Feed	Hawleyville: W. A. Honan South Norwalk: Roodner Feed			11.19	9.00	3.53	4.50	68.89	2.63	2.04
8789	Mills, Waverly, N. Y Neverfail Scratch Feed. Tioga		8.95	8.30	25.56	23.00	4.50	6.00	47.74	4.95	2.50
8614	Empire Feed Mills, Waverly, N. Y	South Norwalk: Roodner Feed Co		1.54	10.19	9.00	3.00	5.00	71.92	2.75	1.50
	ga-Empire Feed Mills, Wa- verly, N. Y	Southport: C. Buckingham & Co	7.10	6.57	10.75	10.00	1.83	4.00	70.10	3.65	2.50
258	Tioga Laying Food. Tioga Empire Feed Mills, Waverly, N. Y	Hawleyville: W. A. Honan	8.98	7.28	18.88	17.00	5.98	6.00	53.10	5.78	2.50
8628	Advance Scratch, No Grit. Vitality Mills, Inc., Chicago			1.61		10.00	2.20		77.33	2.63	2.00

14											
8618	Vitality Chick Starter. Vitality Mills, Inc., Chicago, Ill	Co	5.95	7.45	16.06	15.00	5.10	6.00	60.04	5.40	5.00
8619	Vitality Egg Mash. Vitality Mills, Inc., Chicago, Ill	East Bridgeport: Kaplan Feed Co	5.40	15.45	20.38	20.00	4.45	8.00	49.22	5.10	4.00
8622	Vitality Fine Chick Scratch. Vitality Mills, Inc., Chicago, Ill							3.00	76.29		3.50
9998	Vitality Growing Mash. Vitality Mills, Inc., Chicago, Ill	Plantsville: C. A. Cowles	10.10	13.60	17.56	15.00	4.38	6.00	49.81	4.55	5.00
8620	Vitality Scratch Feed, No Grit. Vitality Mills, Inc., Chicago, Ill							5.00	75.90	2.78	2.50
217	Washburn's Gold Medal Vita- min Egg Mash, containing Wheat Germ (embryo). Wash- burn-Crosby Co., Minneap-										
349	olis, Minn Big (Y) Growing Feed. Yantic Grain & Products Co., Nor-							7.00	49.18	5.10	5.00
350	wich, Conn Big (Y) Laying Mash. Yantic Grain & Products Co., Nor-		9.68	7.64	18.06	17.00	5.50	7.00	54.32	4.80	4.00
314	wich, Conn	Willimantic: Boston Grain Co. New London: New London						7.00	51.73	5.70	4.00
351	Norwich, Conn	Grain Co			The state of the		× 3. 12. 13.	5.00	70.21	2.38	3.00
		Stafford Springs: Stafford Grainery	11.88	1.65	10.38	10.00	2.65	5.00	71.01	2.43	3.00
8612	Beef Scraps, Etc. Capital Meat & Bone Scrap. American Agricultural Chemical Co., N. Y	Southport: C. Buckingham Co.	6.35	30.27	45.00	45.00	2.20	3.00	8.83	7.35	6.00

			Pounds per Hundred									
						otein 6.25)	Fi	ber	extract etc.)	F	at	
	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e: (starch, gum, et	Found	Guaranteed, not less than	
	PROPRIETARY MIXED FEEDS—		%	%	%	%	%	%	%	%	%	
20	Beef Scraps, Etc. Protox Meat Scraps. American Agricultural Chemical Co., N. Y.	Botsford: G. T. Rasmussen	8 10	21.08	55 56	55 00	2.38	3.00	3.65	9.23	6.00	
53 14	Sterilized Steam Bone. Apothecaries Hall Co., Waterbury, Conn. Atlan's Diamond Pick Meat	Watertown: Watertown Co-op		84.25	5.81	5.00	0.61	4.00	4.23	0.65	1.00	
32	and Bone Scraps. Atlan Mfg. Co., Jersey City, N. J Atlan Diamond Meat Scrap.	Botsford: G. T. Rasmussen	5.40	37.39	41.19	45.00	0.75	2.00	6.42	8.85	6.00	
1	Atlan Mfg. Co., Jersey City, N. J. Atlan's Diamond Pick Meat &	Botsford: G. T. Rasmussen	5.65	36.62	42.50	45.00	,		10.10	5.13	6.00	
•	Bone Scrap. Jersey City, N. J	Botsford: G. T. Rasmussen	6.38	38.00	43.88	45.00	1.33	2.00	0.81	9.60	6.00	
22	"Atco". Atlantic Coast Fisheries Corp., N. Y	Winsted: E. Manchester & Sons	9.18	18.17	70.63	60.00	0.33	0.50	0.31	1.38	0.50	

				1						
300 4	Beach Star Brand Beef Scrap. Beach Soap Co., Lawrence,	Willimantic: Windham Grain	6 90	20.00	44.50	40.00				
261	Mass								12.13	
7591	Mich	East Haven: A. W. Forbes	6.68	8.61	34.50	32.00		 49.46	0.75	••••
413	Mass	Guilford: F. C. Morse		7.89	34.63	31.00		 48.761	1.02	0.20
8637	C. E. Buell, Inc., Boston, Mass B & B Brand Roller Process	Westville Branch: R. G. Davis & Sons		7.94	33.13	31.00		 52.35	0.78	0.20
161	Dried Skim Milk. C. E. Buell Inc., Boston, Mass Burck-Brand Powdered Skim	Waterbury: Spencer Grain Co	2.43	8.22	36.50	31.00		 52.65	0.20	0.20
8310	Milk. C. W. Burckhalter, Inc., N. Y	Naugatuck: Spencer Grain Co.	7.30	6.95	32.50	32.00		 52.40	0.85	0.75
8568	Fat Rendering & Fertilizer Corp., New Haven, Conn Corenco Bone Meal for Poultry.	East Haven: A. W. Forbes	5.55	29.59	48.31	45.00	1.68	 3.97	10.90	10.00
8194	Consolidated Rendering Co., Boston, Mass	Derby: Peterson-Hendee Co	4.78	65.33	24.13	20.00	•••••	 2.61	3.15	3.00
8660	ern Grain Co., Bridgewater, Mass	Wallingford: A. E. Hall	5.50	7.83	34.88	32.00		 50.34	1.45	0.75
0000	ern Grain Co., Bridgewater, Mass	Wallingford: A. E. Hall	4.70	8.22	34.25	32.00		 52.09	0.74	0.75

¹ Includes fiber.

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						Pound	ls per Hu	ndred			
					Pro (N x	otein 6.25)	Fil	ber	extract etc.)	F	°at
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS— Continued.		%	%	%	%	%	%	%	%	%
	Beef Scraps, Continued.										
360 8553	Butterfly Brand Dry Skim Milk. S. T. Edwards & Co., Chicago, III		6.40	7.95	33.69	36.00			50.91	1.05	1.00
316	L. T. Frisbie Co., New Haven, Conn	Co	3.85	31.73	48.56	45.00			5.56	10.30	8.00
317	A. G. Markham & Co., Springfield, Mass Special Cooked Meat & Bone	Hansen	7.90	33.16	47.25	45.00		.,,	3.49	8.20	8.00
24	Scrap. A. G. Markham & Co., Springfield, Mass Morse's Meat Scraps for Poul-	West Willington: H. M. Hansen	6.58	27.97	50.63	50.00			3.27	11.55	8.00
	try. Jas. F. Morse & Son, Somerville, Mass	Kensington: S. F. Labieniec	5.90	35.71	41.50	40.00	4.15		3.74	9.00	8.00

178	Morse's Meat Scraps for Poultry. Jas. F. Morse & Son, Somerville, Mass		6 70	90.00	40. 50	F0.00					
8488	Blue Seal Meat Scraps. New England By-Products Corp.,	Co	6.58	29.98	48.50	50.00			4.76	10.18	8.00
6	Lawrence, Mass	Plantsville: C. A. Cowles	6.00	33.63	47.19	50.00	1.60	3.00	1.53	10.05	5.00
319	Corp., Lawrence, Mass Gold Seal Dried Skim Milk. New England By-Products	Plantsville: C. A. Cowles	7.23	7.84	33.88	35.00			49.90	1.15	1.00
8489	Corp., Lawrence, Mass White Seal Meat Scraps. New England By-Products Corp.,	Plantsville: C. A. Cowles	6.95	7.86	33.94	35.00			50.17	1.08	1.00
8485	Lawrence, Mass	Plantsville: C. A. Cowles Norwich: Yantic Grain &		44.47	39.13	40.00	1.28	4.00	1.34	7.48	5.00
7919	low Co., Somerville, Mass Reardon's Meat Scrap. John Reardon & Sons Co., Cam-	Products Co	3.20	33.21	42.69	40.00			11.05	9.85	8.00
326	bridge, Mass	Westerly: C. W. Campbell Co.	6.63	27.11	55.00	55.00	2.30	3.00		8.96	6.00
327	bridge, Mass	Stonington: C. W. Campbell	6.40	26.21	55.56	55.00			4.08	7.75	6.00
7842	bridge, Mass	Mystic: C. W. Campbell Co	5.33	32.21	47.50	45.00			5.11	9.85	6.00
7586	dale Products Co., Chicago, III	Middletown: Meech & Stoddard, Inc	2.64	87.46	4.69	5.00			4.51	0.70	1.50
1900	D 7: D 0 TT 11 1	Rockville: Rockville Grain & Coal Co	10.37		23.88	23.85				0.38	0.25

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—Concluded.

						Poun	ds per Hu	indred			
						otein 6.25)	Fi	iber	extract etc.)		Fat
Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Nitrogen-free e (starch, gum, e	Found	Guaranteed,
	PROPRIETARY MIXED FEEDS—		%	%	%	%	%	%	%	%	%
8793 7910	Beef Scraps, Etc.—Concluded. Rogers & Hubbard's Edible Bone Flour for Cattle & Poultry. Rogers & Hubbard Co., Portland, Conn Chic Chuck "The Ideal Concentrated Poultry Food". Russia C e m e n t Co., Gloucester,	Thomaston: Thomaston Supply	6.70	65.09	24.69	23.85	••••		3.12	0.40	0.25
254	Mass	Thompsonville: Geo. S. Phelps								1.30	0.10
7947	field, Mass	& Co	7.28								8.00
1311	Co., N. Y	Long Hill: Long Hill Feed Store									10.00
	City	Long Hill: Long Hill Feed Store	6.98	33.36	41.00	45.00	1.43	3.00	4.53	12.70	10.00

¹ Old stock, 1927.

				1	10 10 10	l comment			ne-re-sec		
8193	Struven's Fish Meal. Chas. M. Struven & Co., Baltimore,	Middletown: Meech & Stoddard.									
8636	Md Vico Meat Scraps. Van Ider-	Inc	5.59	20.49	61.50	55.00	0.50	2.00	5.47	6.45	4.00
0000	stine Co., Long Island City,		1 00	20.00	- 00	FF 00	1 50	0.00	0.01	10 10	- 00
. 336	N. Y		1.00	28.23	50.00	55.00	1.70	3.00	6.94	12.13	5.00
	Rendering Co., Auburn, Mass		7 35	35 25	42.88	45 00			5.24	9.28	8.00
337	P. W. Special Meat Scraps.		1.00	00.20	12.00	10.00			0.21	9.20	0.00
	Worcester Rendering Co., Auburn, Mass		6.80	25.20	56.06	55.00			2.14	9.80	8.00
		DESCRIPTION OF THE STATE OF		16.5.27							

				Pounds Per Hundred				
Station No.	Material	Submitted by	Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether Extract (Crude fat)
	Brewers' AND DISTILLERS' PRODUCTS Dairy Rations, etc.		%	%	% -	%	%	%
9033	Distillers' Grains	New York City: C. J. Martinis						
7593 8748	Dairy Feed	Grain Co	$7.65 \\ 12.93$	9.90		12.72 10.10	41.60	8.55 4.16
9408 7774	C. B. Dairy Feed Fortune 20% Molasses Dairy	Co			15.19 23.25	8.03 8.35	60.00	4.55 4.18
7775	Feed	Middletown: The Coles Co	12.10	7.95	22.19	6.40	46.31	5.05
8009 8077 8089 37 228 7537 8000	Feed Dairy Ration Dairy Ration No. 2 Dairy Ration Dairy Ration Dairy Ration Dairy Ration Dairy Feed Dairy Ration No. 2 Naugatuck Dairy Ration	Middletown: The Coles Co New Haven: R. G. Davis & Sons Naugatuck: Davis Feed Store	8 46 9 60 9 20 8 48 6 65 11 93	8.45 9.46	24.50 23.44 21.19 21.75 20.56 27.13 20.81 19.56	9.25 8.95 8.83 13.15	41.67 45.80 44.41 	6.70 3.95 3.55 10.45 3.56 4.50 8.50 4.14

8011 8012 8073 7756 8130	Institutional 20% Dairy Feed Institutional 24% Dairy Feed Dairy Feed Dairy Ration with Molasses Dairy Feed No. 1	Falls Village: H. E. Dean	9.86 9.35 9.94 11.60	7.38		9.65 6.55 7.70 7.79	44.50	4.50 3.35 4.80 4.35
8131	Dairy Feed No. 2	St. Albans, Vt.: St. Albans Grain	8.73	11.15			46.59	4.15
8132	Dairy Feed No. 3	Co	8.35	10.48	25.75		45.10 45.22	4.01
8133	Dairy Feed No. 4	Stl Albans, Vt.: St. Albans Grain	8.50	5.33			53.89	5.15
8134 8135	Dairy Feed No. 5	St. Albans, Vt.: St. Albans Grain Co St. Albans, Vt.: St. Albans Grain	8.10	6.64	25.06	8.86	46.22	5.30
8136	Dairy Feed No. 7	Co St. Albans Grain St. Albans, Vt.: St. Albans Grain	8.71	9.70		10.00	47.96	4.50
8137	Dairy Feed No. 8	Co St. Albans, Vt.: St. Albans Grain Co	8 53	7.53	22.13 21.75	7.30	49.63	4.88
8363 423 8977	Big Value Dairy Ration Dairy Mixture Syragold Milk Ration	Wallingford: Ray R. Stevens Southbury: H. R. Stone Bridgeport: E. C. Dana	5.95 9.33 7.60	7.27	21.88 21.25 19.81	9.83 8.53 9.35	48.88	4.82 4.74 5.70
	Poultry Feeds.							
8001	Bristol Laying Mash	Bristol: Bristol Grain & Supply	8.68		20.75	7.23		5.45
8002	Bristol Scratch Feed	Bristol: Bristol Grain & Supply			9.75	1.88		3.70
7960 7788	Scratch Feed Steamed Bone Meal	Southport: C. Buckingham & Co. Westerly: C. W. Campbell Co	10.38 2.61	1.88 89.98	11.19 3.44	3.80	69.99	2.76 0.95

TABLE II. ANALYSES OF FEEDS SUBMITTED BY INDIVIDUALS—Concluded.

				Pounds Per Hundred				
Station No.	Material.	Submitted by	Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether Extract (Crude fat)
486 7956 7616 7673 6402	Brewers' AND DISTILLERS' PRODUCTS—Concluded Poultry Feeds—Concluded. Square Deal Buttermilk Laying Mash. Poultry Mash Laying Mash. Beef Scrap. New England Special Concentrated Buttermilk.	Long Hill: Long Hill Feed Store Branford: Sagalou Farms Torrington: D. L. Talcott Thomaston: Thomaston Supply Co	$ \begin{array}{c c} 11.10 \\ 11.20 \\ \hline 9.05 \end{array} $	8.53	20.13 16.00 17.88 40.50	7.33 5.78 8.99	% 44.84 54.14 	4.70 4.45 5.08 10.21 2.18
7562 7563	Miscellaneous. Alfalfa Meal No. 1 Alfalfa Meal No. 2	Rockville: Samuel Kostolefsky Rockville: Samuel Kostolefsky		30.20 37.30	11.50 8.44	9.40 10.45	41.75 35.03	1.05 1.50

Connecticut Agricultural Experiment Station

Nem Haven, Connecticut

THE ASIATIC BEETLE IN CONNECTICUT

ROGER B. FRIEND

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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CONTENTS

	Page
Introduction	585
History and Distribution	586
Natural Conditions in New Haven	588
Systematic Position	591
Description of Stages	593
The Adult	593
Head	596
Cervix	602
Thorax	602
Prothorax	602
Mesothorax	604
Metathorax	607
Abdomen	610
The Egg	613
The Larva	613
Head	614
Cervix.	622
Thorax	622
Abdomen	626
The Prepupa	627
The Pupa	627
Life History and Habits	630
Adult emergence and habits, p. 630; location of eggs and period	050
of incubation, p. 632; development and habits of larvae, p.	
634; hibernation, p. 638; spring activities of larvae, p. 645;	
prepupal period, p. 647; pupation, p. 647; length of life cycle,	
p. 648.	
Control	649
Natural factors	649
Insecticides	650
Recommendations for Control in Lawns	
	658
Fertilizing and Seeding	660
Treatment of Nursery Plants	660
Summary	660
Bibliography	661

The Asiatic Beetle in Connecticut*

ROGER B. FRIEND

INTRODUCTION

The Asiatic beetle, Anomala orientalis Waterhouse, presumably imported into Connecticut directly from Japan, is a serious pest of lawns in New Haven. It has not become abundant over any great area in the United States as yet, and its status as an enemy to agriculture is not known, although it has injured sugar-cane in Hawaii. However, there is no question as to the damage the larvae can do to lawns in a residential district. Over \$30,000 has been spent from State and Federal funds in a territory about one mile square, and the inhabitants of that territory have probably spent at least an equal sum in an effort to prevent the spread of the insect from the infested area to other parts of the State.

This bulletin includes the results of the investigations carried out by the writer at New Haven, Connecticut, on the biology and control of the Asiatic beetle during the years 1926, 1927, and 1928. In view of the fact that this is an introduced species which seems to have become well established, a brief discussion is given of the climatic and soil conditions of the infested region. It is hoped that the pages given over to the description of the various stages will aid in determining the species, for the adults vary in color, and the immature stages superficially resemble other Scarabaeidae. The observations on the life history and habits cover three seasons, but most of the control work described in this bulletin was carreid out in 1928.

From the first, this work was planned as a co-operative project between the Federal Bureau of Entomology and this Station, and Mr. Loren B. Smith, of the Japanese Beetle laboratory has made many helpful suggestions during the progress of the investigations. Messrs. Fleming, Fox, Lipp, Hallock, King, and Smith of the Bureau have reviewed the manuscript of this bulletin and made some helpful criticisms, for which the writer expresses his appreciation.

The writer was assisted in the work during 1926 by Mr. Paul A. Davis, in 1927 by Mr. George R. Biecher, and in 1928 by Mr. Benj. W. McFarland.

Assistance has also been given the writer at various times by members of the staff of the Experiment Station, particularly

^{*}The Japanese Beetle Laboratory of the Bureau of Entomology, U. S. D. A., has collaborated with the Connecticut Agricultural Experiment Station in planning and carrying out these investigations.

Messrs. Fisher, Walden, Johnson, Morgan, and Jacobson. A number of citizens of Westville, New Haven, have permitted their lawns to be used for experimental purposes, not always to the benefit of the property, and the general co-operation by the inhabitants of this part of New Haven has been excellent. The entire Asiatic beetle project has been under the direction of the Station Entomologist, Dr. W. E. Britton. To all these, the writer expresses his thanks.

HISTORY AND DISTRIBUTION

Anomala orientalis was first described by Waterhouse in 1875 from specimens taken in Japan and the habitat given as Kawachi, Nagasaki, and Hakodadi. In 1895, Lewis revised the Lamellicornia of Japan and stated that the beetle occurred on all the islands. Some time before 1908, according to Muir, it was imported into Hawaii and became established in the cane fields on the island of Oahu. In 1920 adults were collected in a nursery in New Haven, Connecticut, and in 1922 complaint was received of severe injury to lawns by the larvae. In view of the fact that this nursery imported plants, some of them with earth about the roots, from Japan in 1911, 1912, and 1916, it is probable that the insect came directly from Japan on imported nursery stock. There were two small infestations of beetles in West Haven, one of which has been eradicated, a few miles from the New Haven infestation, but except for this there are now no known infested areas in Connecticut outside of New Haven. The West Haven infestations were probably started by beetles accidentally brought from New Haven. In 1926, the beetle was discovered in Jericho, Long Island, New York, and it has since been found in large numbers there and in neighboring towns. Whether the beetles on Long Island came directly from Japan or are the result of a spread from New Haven is not known, and there is, of course, the remote possibility that the beetles spread from Long Island to New Haven. Since 1925 a few beetles have been found in several towns in Westchester County, New York, and Elizabeth, New Jersey and larvae have been found in Rutherford, New Jersey. The known distribution of Anomala orientalis includes the islands of Japan; Oahu Island in the Territory of Hawaii; New Haven and West Haven, Connecticut; Long Island and Westchester County, New York; Elizabeth and Rutherford, New Jersey. In the United States the larvae occur in the turf of lawns and similar places, and have not yet been found to injure agricultural crops. At Rutherford, N. J., at several localities in Westchester County, and on Long Island, New York, and at New Haven, Connecticut, this insect is present in sufficiently large numbers to be considered a serious pest. There is a possibility that it may become injurious to grain and forage crops some time in the future unless its increase and spread are checked.

Aside from the evidence furnished by the dates of importation of nursery stock from Japan, the great abundance of larvae found in lawns in New Haven, where instances of 1000 grubs per square yard of turf are not rare, indicates that this insect was present several years prior to its discovery in 1920. The rate of reproduction is not high when compared with that of other insects, nor is the natural spread very rapid. In Hawaii, where there are at least two generations a year and perhaps three, the known dis-

ASIATIC BEETLE IN CONNECTICUT

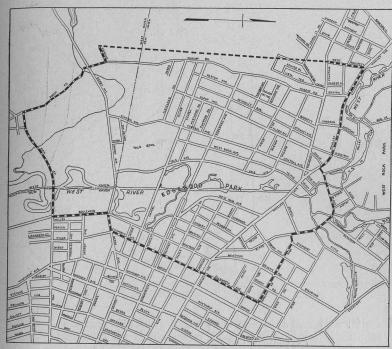


Fig. 33. Map of the Westville section of the City of New Haven. The area enclosed by the heavy dotted line is now quarantined on account of the Asiatic Beetle.

tribution in 1918, at least ten years after introduction, extended over an area of but six square miles. There is but one generation a year in New Haven and when one considers the habits of the insect and the tendency to concentrate in small areas, it is not remarkable that the present known infested area here should cover only about one square mile (Fig. 33). The adults do not fly far nor much of the time, and they are difficult to discover. In 1926, twelve scouts secured 2402 adults in two months, which is a small number compared with the number of larvae present in any one infested lawn. The larvae are easily confused with

those of other Scarabaeidae, and no injury to grass is apparent when the infestation is below about 150 larvae per square yard. It is quite possible that this insect occurs in localities where it is at present unknown. There was no quarantine in force in Connecticut until 1926, and the Japanese beetle quarantine, which would affect the distribution of Anomala larvae, was not extended to include the Long Island infestation until the same year. Up

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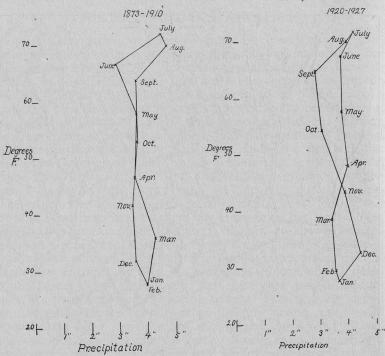


Fig. 34. Mean Monthly temperature and precipitation for the periods 1873-1910 and 1920-1927 at New Haven, Conn.

to this time plants with soil about the roots could have been freely shipped to any part of the country from the infested territory, and the larvae could have become distributed in this soil.

NATURAL CONDITIONS IN NEW HAVEN

The Asiatic beetle is indigenous to Japan and has flourished in the Territory of Hawaii, giving it a great range of latitude and a variety of natural conditions in those regions. It has in late years firmly established itself in Connecticut and some of the immediately surrounding sections. A brief summary of the natural conditions in New Haven is therefore pertinent to the subject and may aid in determining the possible future distribution of the insect in North America.

According to the definition of the life zones of the United States as given by C. Hart Merriam (1898) the coastal strip of

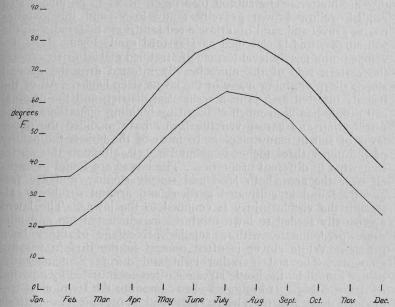


Fig. 35. Mean monthly maximum and minimum temperatures for the years 1873-1910 inclusive at New Haven, Conn.

Connecticut, approximately five to ten miles wide, and a strip of equal width along the Connecticut River to the northern boundary of the State are in the Upper Austral, the rest of the State being Transition. New Haven lies in the coastal strip and hence the area in which the Asiatic beetle is now found lies in the Upper Austral.

The mean temperature and precipitation for two periods, 1873-1910 inclusive and 1920-1927 inclusive are given in Figure 34. the data being obtained from the New Haven station of the U.S. Weather Bureau. The period covering the years 1873-1910 gives what is more nearly the mean conditions for New Haven, and the period from 1920 to 1927 covers the first seven years during which the Asiatic beetle was known to be present here. The temperature means of the two periods are nearly the same, but the precipitation differs somewhat. In Figure 35 are given the mean maximum and mean minimum temperature for the CONNECTICUT EXPERIMENT STATION

years 1873 to 1910 inclusive and these adequately represent conditions for 1920 to 1927. Table 1 contains the data on which both

figures are based. The section of New Haven which is at present infested with the Asiatic beetle has a surface soil to a depth of about eight inches of brown sandy loam which contains two to three per cent. organic matter. The subsoil to a depth of 24 to 30 inches is a reddish yellow brown gravelly sandy loam, and this overlies coarse gravel and sand of Triassic red sandstone material. In the soil survey, this is classified as Hartford sandy loam. It is developed on a nearly level terrace of stratified glacial drift. Along the eastern side of the more heavily infested area the ground slopes sharply, giving many of the lawns steep banks. All of the heavily infested area is in a residential district, and the original soil profile has been much changed by building operations. The fertilization and care given the lawns have modified the upper layer of soil in many places. In most of the lawns, the acidity of the upper three inches is about Ph 6. 0, although this varies somewhat in different properties. The larvae are found in lawns all over the area, both level and steeply sloping, and are frequently found in cultivated gardens and around shrubbery, although the visible injury is confined to the lawns. The lawns are usually seeded to lawn mixtures in which red top and blue grass predominate, with a smaller percentage of other lawn grasses. White clover is often present in the turf in varying amounts. The soil is rather light and during September the injury caused by the beetle larvae is often accentuated by a period of dry weather. If crab grass has come into the lawn, as it frequently does, the turf has a very bad appearance in October regardless of the number of beetle larvae present or the weather conditions.

TABLE 1-MEAN TEMPERATURE AND PRECIPITATION AT NEW HAVEN,

		1873-1910	Inclusive.		1920-1927	Inclusive
Month January February March April May June July	Mean Maximum Deg. F. 35. 7 36. 2 43. 4 55. 0 66. 6 75. 6 80. 3 78. 2	1873-1910 Temperature Mean Minimum Deg. F. 20.1 20.4 28.0 38.0 48.6 57.5 63.4 61.4		Precipitation Inches 4.01 4.31 3.61 3.71 3.04 4.60 4.79	Temperature Mean 27.7 29.5 38.6 48.0 57.5 67.3 71.8 70.0	Precipitation Inches 3.67 3.58 3.44 4.05 3.84 3.83 4.29 4.04
August September October November	72.2 61.5 49.3 39.4	55.1 44.1 34.0 24.4	63.7 52.8 41.6 31.9	3.73 3.74 3.54 3.63	64.9 54.1 43.3 32.8	2.92 3.16 3.93 4.43

SYSTEMATIC POSITION

The genus Anomala belongs to the tribe Anomalini, sub-family Rutelinae, of the family Scarabaeidae. Arrow (1910) in classifying the Lamellicornia, uses the division of the Scarabaeidae into Pleurosticti and Laprosticti, the former having the posterior spiracles situated in the dorsal part of the chitinous ventral segments, as is shown in Figure 43 of this bulletin, and including the Rutelinae. The genus is readily defined by the characters given by Blatchley (1911) or by Casey (1915). In 1907 Schaeffer published a key to the adults of the genus Anomala inhabiting North America but not only does this key include species no longer placed in the genus but also separates species on the basis of color. The Asiatic beetle varies too much in color to permit the use of such a character as specific, and we have made no attempt to fit this species into that key. The adults may be readily separated from Pachystethus lucicola Fab., which they closely resemble in size and color, by the presence of a protuberance of the metasternum in the latter species, this protuberance being lacking in Anomala.

The larva of Anomala orientalis Waterh. may be easily distinguished from some other closely related forms. Böving (1921) has translated and published part of Schiodte's work on the larvae of Lamellicornia in which Anomala aenaea de G. is used as a type of the genus. Böving gave a systematic key to the larvae of the Scarabaeidae closely related to Popillia japonica Newm. and the larval characters of Anomala orientalis agree with the description of the genus Anomala as given by him except that the holes of the spiracular respiratory plate (Plate XVII) are not perfectly oblong, nor are the transverse rows perfectly regular, but the alternative is "angulate-rotundate" and "irregularly distributed" which is no closer to the true condition. A systematic description of the larva of Anomala orientalis is here given according to the formula of Schiodte and Böving for the sake of comparison with other Ruteline larvae. Some of the principal differences between the larva of Anomala orientalis and that of Pachystethus lucicola Fabricius and Popillia japonica Newman are mentioned here. A more complete description of the larva is given later in the morphological part of this bulletin.

Anomala orientalis WATERHOUSE

Epicranial suture with margins very slightly or not at all raised. Antennae with subapical joint equal in length to basal joint. Maxillary palpus with length of subapical joint to prebasal joint as 3 to 4. Length of tibia in proportion to femur about 4 to 5 (this varies because the length of the femur increases posteriorly; that is, the mesothoracic femur is longer than the prothoracic, and the metathoracic longer than the mesothoracic; whereas the respective tibiae more nearly equal each other in length). Claws of the third pair of legs shorter. Respiratory plate with oval holes placed in irregular transverse series (see paragraph above and Plate XVII).

593

The above description applies to the third instar larva. In the first instar the subapical-basal joint ratio of the antenna is about 2 to 3, and the tibiae are more nearly equal to the femora. In the second instar the basal antennal joint is slightly longer than the subapical joint, although not as much so as in the first instar, and the subapical-prebasal joint ratio of the maxillary palpus is 2 to 3.

The larva of Pachystethus lucicola is very similar in appearance to that of Anomala orientalis but may be distinguished by the following characters, which, in the case of A. orientalis, are constant in all instars. The frons of A. orientalis has a row of four setae close to the anterior margin, as shown in Figure 46. In P. lucicola there are two setae only, and these are in the position of the median two of A. orientalis. There are usually in A. orientalis about four large and two or three small setae in a more or less definite line each side of the epicranial suture posteriorly. In P. lucicola these setae are much less numerous. The labral setae also differ. In A. orientalis there are on the disc two setae, one each side of the mid-line, and posteriorly there are two fairly large and one or two minute setae each side of the mid-line. In P. lucicola there are two setae each side of the mid-line on the disc and one large seta on each side of the mid-line posteriorly. The claws of the third pair of legs in Pachystethus are the same length as those of the first two pairs, and the holes of the respiratory plate are angulate-rotundate and irregularly distributed. In Anomala the claws of the third pair of legs are shorter and the holes in the respiratory plate are oval in shape and arranged in irregular transverse rows. The two median rows of spines on the ventral side of the tenth abdominal segment in Pachystethus lucicola contain about ten spines each. In Anomala orientalis these two rows contain ten to sixteen spines each, 28 third instar larvae averaging $12.8 \pm .2$ right and $12.6 \pm .2$ left. The number of spines in these rows in some specimens would not in itself be sufficient to determine the species, but in most cases this character is dependable.

The larva of *Popillia japonica* Newman can be immediately distinguished from that of *A. orientalis* by the number, form, and arrangement of the spines on the tenth abdominal segment. In the former species there are about seven spines in each row, and the rows converge sharply anteriorly. The illustrations of *Popillia japonica* by Böving (1921) and Davis (1920) show this arrangement very clearly.

In comparing the above two species with Anomala orientalis I have used the morphological descriptions of Böving (1921).

Hayes (1928) has published a systematic description of the epipharynx of Lamellicorn larvae and a key to common genera based largely on the morphological differences in this structure.

The Asiatic beetle is included and can be readily differentiated from other common Scarabaeid larvae by the characters given.

DESCRIPTION OF STAGES

In the following pages there are given brief morphological descriptions of all stages of the insect. The primary purpose of this is not to present a detailed morphological study (and some of the details are therefore omitted) but such a description of the external anatomy as will enable one to distinguish the immature and adult stages from those of similar and closely related species. The material was all collected in New Haven and the larval and pupal descriptions were checked with reared material. For references to publications on the comparative morphology of the Scarabaeidae which form a basis for the description given here, the bibliography may be consulted.

THE ADULT

The original description of the adult by Waterhouse (1875) is as follows:

"Ph. campestri affinis. Obscure cupreo-aenea, elytris plerumque flavovariegatis. Capite fere ut in Ph. horticola, fronte crebre punctulata, clypeo angulis rotundatis. Antennarum clava praelonga nigra. Thorace parum convexo, antice angustato, sat crebre fortiter punctato, lateribus arcuatis, angulis posticis obtusiusculis, basi fere rotundato, marginato. Scutello arcuatim triangulari, punctulato. Elytris thoracis basi latitudinem aequantibus postice paulo ampliatis, ad apicem obtusis, depressiusculis, fortiter striatis, striis fortiter irregulariter punctatis, interstitii convexis, subtiliter obsolete punctulatis.

"Long. 4-5½ lin.; lat. 2½-3 1-6 lin.

"Var. a. Testacea, fronte thoracisque maculis duabus aeneis; tarsis piceis.

"Var. b. Testacea, fronte thoracis limbo, elytrorumque fasciis duabus

irregularibus aeneis.

"Var. c. Aenea, elytris nigro-piceis, flavo-maculatis.

"Besides the colouration this species varies much in form, the smaller specimens being more convex and slightly ovate; the sculpture of the elytra also varies, the interstices being almost rugulose in some specimens, whereas they are almost smooth in others.

"Hab.-Kawachi; Nagasaki; Hakodadi. (Common in May and

June)."

The adults collected in New Haven conform to this general description (Plate XVII). They are elongate-oval in shape and typically Scarabaeid. The greatest width of the body is at a point about three-fourths of the distance from the base of the elytra to the tip. The elytra are striate, and the striae are punctate. The pygidium is fully exposed. The female abdomen is larger in proportion to the rest of the body than is the male abdomen, and the latter tends to be slightly concave on the ventral side, whereas the former is convex. The horizontal row of setae

on the eighth abdominal sternite follows a sinuate carina in the male, whereas in the female this row of setae follows the posterior margin of the sternite (Fig. 44). The labrum is concealed beneath the clypeus and does not appear in a dorsal view. The front legs are fossorial, though not extensively so developed. In the female, the prothoracic tibia is narrowly projected beyond the tarsal articulation, extending about to the base of the fourth tarsal joint. In the male, this projection is not quite as long and is much broader at the base, tapering more sharply (Fig. 39). The lamellae of the female antenna are distinctly shorter than the remainder of the antenna (Fig. 38), whereas in the male the lamellae are almost as long as the remainder of the antenna. These characters of the antenna and prothoracic tibia offer an easy means of determining the sex and are dealt with in more detail later.

BULLETIN 304

The females are larger than the males, as the following measurements show, and both sexes show much variation. These adults were collected in the summer of 1927, pinned, and the measurements made in March, 1928. Fifty-seven females and 56 males. all taken in the act of copulation, were used (one male was lost). As an indication of the variation in width, the base of the prothorax has been used. This is more easily measured and less subject to distortion than the width of the elvtra. The length was measured from the tip of the clypeus to the tip of the abdo-

TABLE 2-LENGTH OF BODY AND WIDTH OF PROTHORAX OF ADULTS.

		M	ale	Female	
Length of entire body:	mean	$9.05 \pm$.04 mm.	$10.34 \pm .0$	7 mm.
	maximum	10.4	"	11.7	"
	minimum coefficient	8.2	"	. 8.9.	"
	of variability	5.4		7.3	
Width of prothorax:	mean maximum	3.97 ± 4.5	.02 mm.	$4.46 \pm .0$ 5.1	".
	minimum coefficient	3.5	"	3.9	
	of variability	5.5		6.5	

The color of the adult varies from black to straw (about the honey-yellow of Ridgeway's color chart), with intermediate stages having black elytral bands and markings on the prothorax. The prothorax and head frequently have a bronze iridescence. In Figure 36 there are illustrated eight color types based on the color of the elytra and prothorax. These eight types vary within themselves and intergrade so that the individuals approximate only the types. There is no sexual color peculiarity, and both sexes show the same amount of variation. In the following table, the percentages of each color type are given of the 56 males and 57 females, of which the body measurements are given above, and

of 259 miscellaneous specimens. This tabulation is approximately true of all the adults collected in New Haven. Types 6 and 7 are given together as they really represent one type having one elytral bar and two distinct black areas on the prothorax. The thoracic markings of type 8 vary from light brown to black.

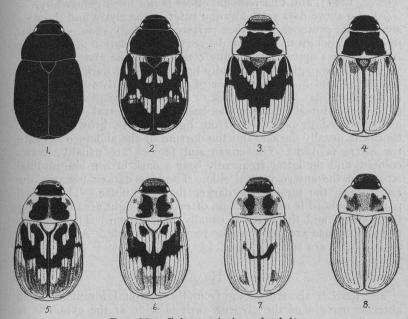


Fig. 36. Color variation of adults.

TABLE 3-COLOR VARIATION IN ADULTS.

Туре	56 Males	57 Females	259 Miscellaneous	Total	Per cent
1	4	5	21	30	8.1
$\bar{2}$	2	2	6	10	2.7
3	3	5	18	26	7.0
4	5	5	11	21	5.6
5	1	2	4	7	1.9
6 and 7	15	17	91	123	33.1
8	26	21	108	155	41.7
					(a)
	56	57	259	372	100.1

The eight types are defined as follows:

- Entirely black.
- Thorax with one black mark, elytra with two black bars.
- Thorax with one black mark, elytra with one black bar. Thorax with one black mark, elytra entirely straw.
- Thorax with two separate black marks, elytra with two black bars.
- Thorax with two separate black marks, elytra with one black bar.
- Thorax with two separate black marks, elytra with one black bar
- 8. Thorax with two separate dark marks, elytra entirely straw.

Almost half the adults have no elytral bars (types 4 and 8), and this is the most common type in New Haven. The coloration of adults found in other localities, where environmental conditions differ, may possibly not conform to the above, for environment causes regional variations in color among some beetles (see Tower, 1906), and this regional effect is not fixed genetically.

CONNECTICUT EXPERIMENT STATION

All the above data on coloration refer to the elytra and the dorsum of the prothorax. Other parts of the body show variations in color, although the general degree of pigmentation of the entire insect follows approximately the condition of the elytra and prothorax. The pygidium is usually light except in dark individuals of types 1 and 2, in the former of which it is always black and in the latter may be either black or straw. It frequently bears a dark band dorsally across the base. The ventral side of the abdomen and thorax varies from light to dark brown, but the thorax is usually darker, and the dorsum of the abdomen beneath the elytra is dark. The coxae and femora are usually strawcolored, and the latter frequently bear a dark brown longitudinal streak on the antero-ventral side. The legs darken towards the extremities, the tarsi being darker than the tibiae. The dorsal part of the head is usually black, often with a light area bordering the clypeus, and the latter is usually light brown. The lamellae of the antennae are dark but the remainder is pale. All individuals of type 1 are entirely black.

HEAD

The head is about as long from the occipital foramen to the anterior margin of the clypeus as it is wide at the eyes. It is normally partly withdrawn into the prothorax, and most of the

occipital region is invisible.

The vertex (Fig. 37a) is not divided longitudinally by an epicranial suture, the dorsal part of the head capsule being fused into one piece. Except in the region of the occiput, normally overlapped by the prothorax, the vertex on the dorsal side is coarsely and thickly punctate. The occipital region, which is not distinctly separated from the vertex, contains a few fine punctures and has many fine setae laterally and ventrally. The vertex extends on the ventral side to the gula and is partly covered on this side by fine setae. On the lateral side of the head a short distance behind the eyes, there originates a suture which extends diagonally across the ventral side of the head to the anterior part of the gula. The head capsule does not readily separate along this line, and the suture may be a secondary structure rather than the occipital suture. On the dorsal side the vertex extends anteriorly to the suture separating it from the clypeus. According to Stickney (1923) this suture represents an invagination of the frons, and hence indicates the position of the arms of the

epicranial suture. A pair of depressions along the line of this suture, one on each side near the lateral margin of the head, indicate the position of the anterior condyle (precoila) on which the mandible articulates. This condyle is on the ventral side of the clypeus (Fig. 38b). The frontal pits are on the ventral side of the head just lateral of the precoilae.

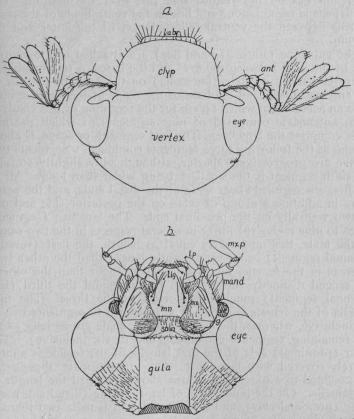


Fig. 37. The head, dorsal aspect above and ventral aspect below. ant, antenna; clyp, clypeus; g, gena; labr, labrum; lig, ligula; lp, labial palpus; mand, mandible; mn, mentum; mx, maxilla; mxp, maxillary palpus: smn, submentum.

From each anterior lateral angle of the vertex there extends posteriorly and partly over the eye a canthus. Between the eve and the mandible, on the ventral side of the head posterior to the antenna is the narrow gena. This is bounded posteriorly by a suture.

The clypeus (Figs. 37a and 38b) is approximately quadrate when viewed from the dorsal side. Its anterior margin is slightly

upturned, and the anterior part of the clypeus is folded ventrally on itself. The dorsally visible part represents most of the postclypeus and its surface is coarsely and thickly punctate like the vertex. Anteriorly the punctures become more shallow. Along the lateral and anterior margins of the postclypeus there is a row of setae. The anterior part of this postclypeus is reflected ventrally and lies on the ventral side just over the labrum. The preclypeus is membranous and lies on the ventral side of the postclypeus between the ventral reflected part of the latter and the labrum.

The antennae (Figs. 37a and 38e) are attached to the ventral side of the head between the eyes and the bases of the mandibles. There is a small condyle (antacoila) on the anterior margin of the antennal fossa, and the base of the scape of the antenna contains an acetabulum which serves for the reception of this condyle. Each antenna is composed of nine segments of which the last three comprise the lamellae. The first segment, or scape, is about as long as the following three segments combined. Segments two to five are progressively shorter, although only slightly so, and the sixth segment is the smallest, being wider than long. All of the first six segments bear setae at the distal ends, and the scape bears in addition a group of setae on the posterior side and one or two ventrally on the proximal end. The lamellae (segments seven to nine inclusive) differ in several respects in the two sexes. In the male, they are nearly equal in length, the first (seventh antennal segment) being very slightly longer than the other two, whereas in the female, the first is much longer than the others, the second distinctly shorter than the first, and the third (last antennal segment) much the shortest of the three. The first lamella of the female is about equal in length to segments two to six inclusive, whereas, the lamellae of the male are as long as all the remaining segments combined (one to six inclusive). The outer (proximal) side of the first lamella of the female is almost entirely covered with fine short setae. In the male, these setae are confined to a narrow oval area about one-third the length of the lamella. On the inner sides of lamellae one (distal side) and three (proximal side), and on both sides of lamella two there is a longitudinal row of shallow pits, presumably sensory in function, near the dorsal margin. The male has about six pits in each row and the female about four. There is a row of short setae around the margin of each lamella in both sexes, and the sides of the lamellae are finely punctate. When these last three segments of the antenna are closed they combine into a club, the outer faces of the first and third being convex and the inner faces of both, together with both faces of the second, being flat.

The compound eyes (Fig. 37) are approximately hemispherical and situated on the lateral sides of the head. Each is partly

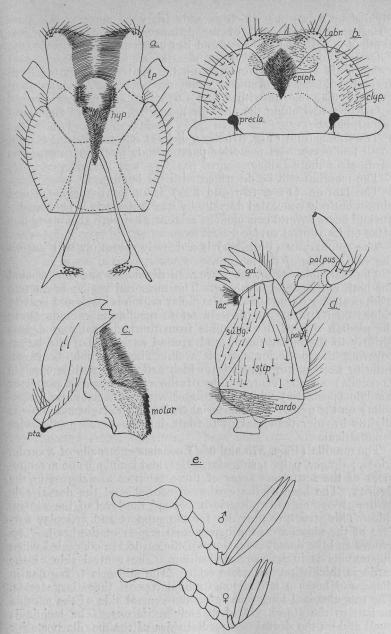


Fig. 38. a. Hypopharynx. b. Labrum and epipharynx. c. Right mandible, ventral aspect. d. Left maxilla, ventral aspect. e. Antennae, a male above, female below. clyp, clypeus; epiph, epipharynx; gal, galea; hyp, hypopharynx; labr, labrum; lac, lacinia; lp, labial palpus; palpf; palpifer; precla, precoila; pta, postartis; stip, stipes; subg, subgalea. Figures not all drawn to the same scale.

601

CONNECTICUT EXPERIMENT STATION

divided by a canthus which extends from the anterior side posteriorly about one-third of the distance across the eve. This canthus is part of the vertex and has been mentioned previously. There are no ocelli.

The gula (Fig. 37b) extends on the ventral side of the head from the occipital foramen to the submentum. It is a broad quadrangular sclerite with a smooth surface and no setae except a few in a row along the anterior margin. These are short and inconspicuous.

The submentum (Fig. 37b) is a distinct sclerite bearing several small fine setae. Its posterior part extends laterally toward the

cardines of the maxillae.

The mentum will be described with the labium.

The labrum (Figs. 37a and 38b) is under the clypeus and almost entirely concealed dorsally by it. Anteriorly it is emarginate and bears several conspicuous setae. There are also many fine setae on its ventral surface.

The epipharynx (Fig. 38b) is a densely setose organ lying on

the ventral side of the labrum.

The mandibles (Fig. 38c) are well developed and constructed for both cutting and crushing. The incisorial region bears two teeth posterior to the apex. The molar region is black and heavily ridged on its face. A densely setose membrane extends along the median side of the mandible from the incisorial region posteriorly to the molar region and around each side of the latter, covering the posterior face as well. The mandible bears an anterior acetabulum (preartis) which articulates with a condyle (precoila) on the ventral side of the clypeus and a posterior condyle (postartis) which articulates with an acetabulum (postcoila) on the gena. The incisorial region of the right mandible is slightly broader than that of the left, but the two are otherwise symmetrical.

The maxilla (Figs. 37b and 38d) consists externally of a cardo, stipes, palpiger, palpus, subgalea, galea, and lacinia. The arrangement of the setiferous areas of these sclerites are shown in the figures. The base of the cardo is grooved, and the dorsal side of the groove extends posteriorly beyond the level of the ventral side. This structure provides for the support and articular surface of the maxilla on the hypostomal region of the head. The groove and the dorsal extensions of the cardo are concealed when the maxilla is in its normal position. The ventral side of the cardo is thickly set with fine setae. The stipes is triangular in shape and bears a lateral longitudinal row of three large setae. The subgalea is a long sclerite on the ventral side of the maxilla median to the stipes. It is sparsely setiferous. The lacinia is small and on the dorsal and medial sides of the maxilla posterior to the galea. It bears many fine setae but no spines, teeth, or

lobes. The galea comprises the apex of the maxilla and terminates in six prominent teeth of which four are ventral and two dorsal. Its lateral margin bears a group of setae near the base. The palpifer is a long sclerite lateral to the stipes and visible on both the dorsal and ventral sides of the maxilla. It bears many large setae. The palpus is four-segmented, and there are many minute sensory papillae on its tip. The fourth segment is the longest, followed by the second, third and first in the order given.

ASIATIC BEETLE IN CONNECTICUT

The parts of the labium (Fig. 37b) are fused together, the mentum and ligula not being separated by a suture. The mentum is broader anteriorly and bears on each side near the lateral margin a longitudinal row of three large setae. There is a row of small setae along each lateral margin and a small seta in each anterior lateral angle. On the ventral surface along each lateral margin of the mentum there is a row of short striae, about eighteen per row. The sclerite here called mentum has been termed the anterior part of the submentum by Kadic (1902) and Hardenberg (1907), the mentum being considered as folded back over it. The ligula is emarginate anteriorly and bears a small seta at each anterior lateral angle. On the ventral side there are many small setae along the anterior margin, except near the mid-line, and two longitudinal rows of fine mesad-pointing setae. These rows converge slightly posteriorly. The palpigers are apparently folded under the mentum and are visible from the dorsal side only. The palpi are set in depressions and each consists of three segments of which the third is the longest, the first next, and the second shortest. The tip of the palpus bears sensory papillae similar to those on the maxillary palpus.

The hypopharynx (Fig. 38a) is a thickly setose triangular lobe on the dorsal side of the labium. A pair of long chitinous bars unite under its posterior end and extend posteriorly to two medially directed setose sclerites. These bars and sclerites are the

fulcrum hypopharyngeum and the pharyngeal sclerites.

The tentorium is essentially as described by Stickney (1923) for Pelidnota punctata. The corpotentorium is a narrow dorsallyarched bridge. The metatentorium expands posteriorly around the inner edge of the occipital foramen dorsally along the acciput and ventrally along the gula. It also follows the gular suture anteriorly as a tapering lamina along its entire length. The pretentorium arises at the end of the corpotentorium and is chitinized quite strongly at its base but soon becomes a narrow membranous thread. The anterior third is, however, strongly chitinized, although not large, and terminates between the base of the antenna and the precoila. The base of the pretentorium expands ventrally and laterally almost to the mid-line as a thin laminitentorium. This extends a short distance anteriorly, tapering towards its apex.

CERVIX

There are two lateral cervical sclerites on each side, one larger and anterior, the other smaller, posterior, and partly covered by the first. The anterior sclerite has a group of setae anteriorly and a few in the center. From its inner, side at the anterior end a blunt projection extends into the neck cavity. The anterior end of this sclerite articulates with the head at the posterior lateral angle of the gula and its posterior end overlays the second sclerite in part. The latter projects freely from the cervical membrane and its attachment is shown by the broken line in the figure. Pos-

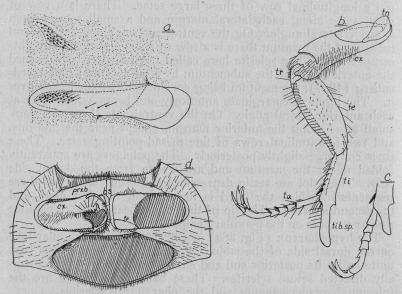


Fig. 39. a. Cervical sclerites, left side. b. Prothoracic leg of female. anterior aspect. c. Tibial spur and tarsus of male prothoracic leg. d. Ventral side of prothorax. bs, basisternum; cx, coxa; fe, femur; fp, furcal pit; prxb, precoxal bridge; ta, tarsus; ti, tibia, tn, trochantin, tr, trochanter. Drawings not all on the same scale.

teriorly it slightly overlaps the lateral end of the precoxal bridge of the prosternum. Dorsal to the anterior end of the first sclerite is a sub-triangular setiferous area which is not heavily chitinized.

THORAX

PROTHORAX

The prothorax, when viewed from the dorsal side, is about twice as wide as it is long at the mid-line. The anterior margin is concave, the lateral and posterior margins convex, and the dorsal sur-

face is convex both longitudinally and horizontally. Anteriorly the prothorax is about half as wide as it is along the posterior margin. The dorsal surface is thickly punctate and bears about four small setate at each anterior lateral margin. The lateral margins are carinate. On the ventral side the pronotum extends to the precoxal bridge in front of the coxal cavities and to the sternum behind it. This part of the notum which extends on the ventral side is called the pseudopleurum by Crampton (1926). It is almost entirely covered by fine setae. The basisternum is broad anteriorly, extending laterally in the precoxal bridge, and narrows between the coxal cavities. The furcasternum comprises the posterior part of the sternum and extends laterally and dorsally in a broad shelf which is visible when the coxae are removed. This shelf bears the furcal pits. A suture separates the notum from the precoxal bridge in front of the coxal cavity, but posterior to the coxal cavity the extremity of the notum rests in a groove in the sternum and is not fused to it. The spiracle is in the membrane under the posterior ventral margin of the notum. On the ventral surface of the dorsum of the pronotum there is a short crescentic raised bar at the surface of contact of the trochantin of the anterior leg. The trochantin lies attached to the coxa at the anterior lateral margin and is not externally visible. The coxa has a crescentic ridge at its distal end on the anterior side and bears many fine setae on the lateral side. The trochanter is irregular in shape and firmly attached to the femur, articulating with the coxa. The femur is about the length of the coxa. It bears a longitudinal row of fine setae on the anterior lateral side and stronger setae along the anterior and posterior faces. There is also a longitudinal row of fine setae on the medial face. The tibia from its base to the tip of the spur is slightly longer than the femur. The spur is a prolongation of the lateral side of the tibia beyond the base of the tarsus and differs in the two sexes. In the female it is about as long as the three basal segments combined and spatulate in shape. In the male the base of the spur is wider and its length equal to the length of the basal two segments of the tarsus combined. The male spur tapers more than that of the female. The length of this spur as measured from the lateral projection opposite the base of the tarsus to the tip was for 57 females 0.87 ± 0.005 mm. and for 56 males 0.74 ± 0.004 mm. There is a longitudinal row of fine setae on the anterior face of the tibia and several more conspicuous setae along the medial face and on the inner face of the spur. There is a prominent blunt spine on the inner side of the tibia just above the base of the tarsus. The tarsus is five-segmented and terminates in a pair of movable claws. The first four segments bear terminal setae which, on the posterior side are short and spine-like. The anterior of the two claws is heavy and bifid at the tip. The posterior claw

is smaller and simple. The tarsi of the sexes differ in a few respects. The male tarsus is heavier and the bifid claw more sharply curved than that of the female. Near the base of the fifth segment of the male tarsus there is a conspicuous mesad-directed tooth. On the female tarsus this tooth is very minute. Between the bases of the claws of both sexes there projects a conical papilla bearing two apical setae. The prothoracic coxae are capable of certain degree of movement and are not rigidly attached to the thorax. They project more from the body surface than do the other two pairs of coxae.

MESOTHORAX

The mesothorax is the least developed of the three thoracic divisions of the body. The notum is a single sclerite whose anterior region represents the scutum and whose posterior part the scutellum. The latter probably comprises at least two-thirds of the entire notum. A phragma projects into the body cavity from the anterior margin of the scutum, and along the mid-line there is an internal chitinous brace which extends from the phragma a short distance along the inner side of the scutum, being externally identified by an anterior longitudinal suture. The surface of the anterior part of the notum bears many fine setae set in pits in the chitin, but the posterior surface, exposed between the bases of the elytra, is bare, although pitted. At each anterior lateral angle there is an anterior notal wing process which supports the first axial sclerite and the dorsal end of the chitinous rod (parapterum?) found along the anterior margin of the episternum. The posterior notal wing process is not prominent. The sides of the scutum are reflected ventrally and give off two processes, one directed anteriorly and the other directed postero-laterally. The former lies over the metanotum and the latter projects under the axial cord of the elytron. There are many small setae at the top of the posterolateral process and along its posterior margin. The scutellum has a posterior reduplication which is setiferous. The posterior basal angles of the elytra fit under the lateral margins of the scutellum. The axial region bears four small chitinous plates. The shape of these is not accurately shown in the figure, as they are irregular and a three-dimensional diagram would be required to give a true picture. The first of these axial sclerites curves from the anterior notal process ventrally and posteriorly to a notch in the ventral side of the elytron. The second is approximately triangular in shape with its base towards the scutum and its apex in an incision in the base of the elytron. The third is bent at an obtuse angle. and lies along the region of the axial cord. The fourth, which is small and also sub-triangular in shape, lies just posterior to the second.

The pleural region is divided by a vertical suture into an anterior episternum and a posterior epimeron. The former is divided by a diagonal line of demarcation into a darker anterior area with a few setae along its posterior margin and a posterior lighter area devoid of setae. A short wing process (a continuation of the pleural ridge) which gives support to the elytron projects from the dorsal margin of the pleuron. A carina divides the epimeron into an upper approximately horizontal region and a lower vertical region. The anterior basal angle of the elytron rests on the upper

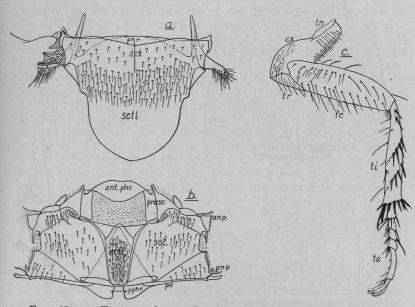


Fig. 40. a. Tergum of mesothorax. b. Tergum of metathorax. c. Mesothoracic leg, anterior aspect. The lateral scutal projections in "a" are displaced anteriorly. anp, anterior notal wing process; ant phr, anterior phragma of metatergum; phr, anterior phragma of mesotergum; pn, postnotum; pnp, posterior notal wing process; presc, prescutum; sct, scutum; sct, scutulm; sct, scutulm

horizontal area. The pleural coxal process extends from the ventral margin of the pleuron. Anterior to the episternum is a short, vertical rod (parapteron?) which extends to the anterior notal wing process.

The sternum is rigidly attached to the metathoracic sternum along the posterior margins of the coxal cavities. The surface is thickly set with fine setae whose bases are in shallow pits in the chitin. The basisternum extends between the pleura anteriorly and narrows between the coxal cavities. If the coxae are removed

the furcasternum, which bounds the coxal cavities medially, becomes visible, and the furcal pits are seen at the inner anterior

CONNECTICUT EXPERIMENT STATION

angles of the cavities.

The legs of the mesothorax are not so strongly developed as those of the other two thoracic segments. The coxae are apparently slightly mobile, although not near so much so as those of the prothorax. The pleural coxal process forms the point of articulation of the coxa on the pleuron, and the narrow trochantin

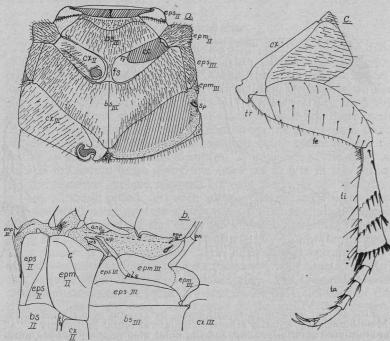


FIG. 41. a. Meso- and metathoracic sterna. b. Meso- and metathoracic pleura. c. Metathoracic leg, anterior aspect. bs, basisternum; cc, coxal cavity; epm, epimeron; eps, episternum; fs, furcasternum; sp, spiracle. The Roman numerals indicate the thoracic segments. For other abbreviations see previous figures. Drawings not all to the same scale.

lies at the inner basal angle of the coxa. The latter is about twothirds the length of the femur and is partly covered with fine setae as indicated in the figure. The trochanter is triangular in shape and setose and is firmly attached to the femur, articulating with the coxa. The femur is the longest segment of the leg, being slightly longer than the tibia. On the anterior side there are two irregular longitudinal rows of setae and on the posterior side a longitudinal row of fine setae. The tibia bears two diagonal rows of heavy setae on the anterior side and several small scattered setae on the posterior side. At the distal end of the tibia there are a number of short heavy spine-like setae on the anterior side, two prominent spines at the inner angle, and a few long setae on the posterior side. The anterior of the two spines at the inner angle is shorter than the posterior. The tarsus is five-segmented and similar to that of the prothorax. The claws are slightly smaller than those of the anterior tarsus and the sexes show no difference. The basal tooth on the fifth segment is small.

The elytra, when folded in repose, cover the dorsal part of the body from the anterior margin of the mesonotum to the anterior part of the pygidium except for the exposed part of the mesoscutellum which lies between their bases. There are eleven punctate striae on each elytron. The first of these striae lies close to the posterior margin (inner margin when the elytra are folded), and the second is very short. The eleventh, which lies close to the anterior margin, is also short. The anterior basal angle of the elytron is reflected ventrally to form a shelf which rests on the dorsal part of the epimeron. The posterior basal angle fits under the lateral margins of the scutellum, and the proximal part of the posterior margin fits into a groove in the metathoracic notum. The elytra meet along the dorsal mid-line except at the tips, a ridge along the margin of the left fitting into a groove in the right. The ventral side of the elytron has many fine setae on the proximal, distal, and anterior regions. The distal margin has the narrow thin membrane characteristic of the genus.

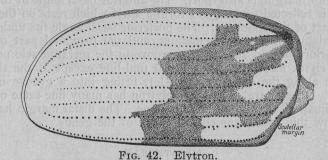
METATHORAX

The metathorax is much more highly developed than the preceding segment and its notum is more typical. The interpretation of the segment follows Snodgrass (1909 and 1927). The anterior border of the metanotum is the antecostal suture from which the anterior phragma projects anteriorly and ventrally into the body cavity. The prescutum comprises the anterior region of the notum and its heavily chitinized lateral areas are separated by a broad central membranous area which extends from the antecostal suture to the apex of the scutellum. The chitinous discs at the anterior lateral margins of the prescutum are for muscle attachment. At each anterior lateral angle of the notum is the triangular anterior notal wing process. The proscutum normally lies under the scutellum of the mesothorax. The scutum is separated into two lateral areas by a triangular scutellum whose borders are indicated by the broken line in the figure. The lateral margins of the scutum possess a pair of conspicuous indentations, and from the posterior lateral angles the posterior notal wing processes project. The axillary cords are posterior to these latter. From the anterior margin of the scutum extend the two converging parapsidal

ridges between which is the pair of longitudinal grooves for the reception of the margins of the elvtra. The scutum and the region between the parapsidal ridges bear many fine setae. The scutellum is a triangular area whose base meets the postnotum and whose apex touches the posterior border of the prescutum. Its boundaries are much more clearly indicated on the inner side of the notum than on the outer. The postnotum is a narrow sclerite extending laterally to the epimeron and forming the posterior border of the notum. Beneath it the posterior phragma projects into the body cavity.

CONNECTICUT EXPERIMENT STATION

The pleural region of the metathorax is divided by a pleural suture which runs approximately diagonally, giving more of horizontal orientation to the episternum and epimeron than vertical. The episternum lies below and anterior to the epimeron and is divided into two regions by a horizontal suture. The epimeron is divided into anterior and posterior regions by a light vertical



suture. A dorsal process of the epimeron lies along the anterior margin of the lateral region of the postnotum and the postnotum meets the epimeron just posterior to the base of this projection. There are two wing processes which project dorsally from the pleuron, the anterior being the episternal parapterum which has fused to the episternum and the latter being the true pleural wing process, a continuation of the pleural ridge. On the ventral margin of the pleuron there is another inconspicuous projection of the pleural ridge which serves as a point of articulation for the leg. The metathoracic spirale lies in the membrane between the mesoand metapleuron. The pleural sclerites are setose except for

the dorsal two-thirds of the anterior region of the epimeron. The externally visible part of the sternum is the basisternum which extends between the episterna anterior to the coxa. A median longitudinal suture, which indicates the position of an internal chitinous lamella extending from furca to sternum, divides the basisternum. Except for a median nude area the basisternum is setose. At its posterior tip the sternum is inflected and to the

inflected part is attached the membrane of the first abdominal segment. From the inflected part the furca extends into the body cavity. The furcal pits are not externally visible. At the posterior lateral angles of each basisternum is the small projection which fits into an acetabulum of the coxa.

There are four axillary plates in the membrane at the base of the wing which have been numbered according to Snodgrass (1927). In addition to these sclerites there is a median plate in

the median region of the wing base.

The venation of the metathoracic wing is given according to Forbes (1922), and since the veins are labeled in the figure, no further discussion is necessary here. The distal part of the wing folds under the elytra, and the folding pattern is discussed by Forbes in the paper above cited. The anterior margin of the wing bears a row of small hooks and distal to it a row of small setae.

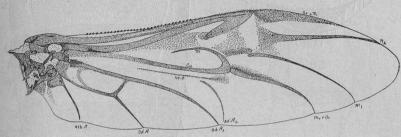


Fig. 43. Metathoracic wing. A, anal vein; Cu, cubitus; M, median; R, radius; Sc, subcosta; I, II, III, IV, axial sclerites.

The membraneous part of the wing anterior to the base of the costa usually folds back on it. At the base of the second anal

vein there is a group of small setae.

The coxae of the third pair of legs lie rather rigidly in the coxal cavities with the anterior-ventral side in the same plane as the sternum. The anterior-ventral and posterior-dorsal surfaces are covered with fine setae. At the proximal end of the anterior margin there is a small notch or acetabulum into which a projection from the sternum fits. There is no trochantin. At its distal end the coxa terminates in a rounded "head" which projects over the triangular trochanter, and near the margin of the trochanter there is a rather large seta.

As in the case of the prothoracic and mesothoracic legs, the trochanter articulates with the coxa and is firmly attached to the femur. On its anterior side is a conspicuous seta at the inner margin.

The femur is large, approximately straight along the medial margin, and convex along the outer margin. Its anterior face is sparsely pitted and bears two longitudinal rows of setae, one near the outer margin and one just mesad to the mid-line. There are one or two conspicuous setae on the medial margin near the base. The posterior side of the femur is smooth and nude except for a row of fine setae along the inner margin. The tibia is slightly shorter than the femur and slender. There are two diagonal rows of spine-like setae on the anterior face and a similar row along the anterior side of the apex. At the inner angle of the apex there are two heavy spines of which the anterior is slightly over half the length of the posterior. On the posterior side and along the inner margin there are several scattered setae of medium size.

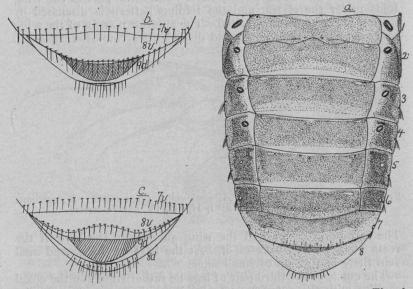


Fig. 44. Abdomen. a. Abdomen of female, dorsal aspect. v. Tip of female abdomen, ventral aspect. c. Tip of male abdomen, ventral aspect. The Arabic numerals indicate the segments. d signifies tergite and "v" signifies sternite.

The tarsus is similar to the mesothoracic tarsus in its essentials except that both claws are simple. In the other tarsi the anterior claw is bifid.

ABDOMEN

There are visible dorsally on the abdomen eight tergites and ventrally seven sternites. The first sternite is absent, and the ninth and tenth segments are concealed within the eighth. Tergites one to six inclusive are under the elytra and are weakly chitinized.

The dorsal part of segment seven is strongly chitinized and concealed beneath the tips of the elytra. The eighth tergite (pygidium) is fully exposed and the most strongly chitinized dorsal sclerite. This tergite slopes rather sharply downward to the tip of the abdomen and is slightly rugose. The tip of the abdomen

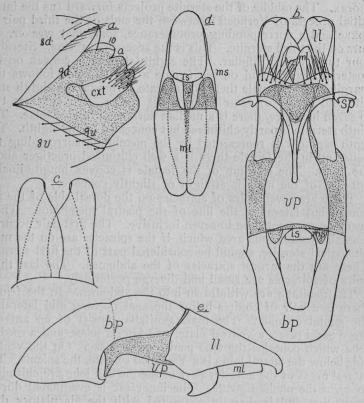


FIG. 45. External genitalia. a. Female, lateral aspect. b. Male, ventral aspect. c. Lateral lobes of male. d. Median lobe of male. e. Male, lateral aspect. a, anal opening; bp, basal piece; cxt, coxites; is, internal sac; ll, lateral lobe; ml, median lobe; ms, median strut; sp, spicule; vp, ventral plate. The Arabic numerals indicate the abdominal segment. and "d" signifies tergite, "v" sternite. The membranous parts are shaded,

bears a fringe of fine setae. The pygidium of the male tapers more sharply than that of the female.

The tergites do not all extend to the lateral margins of the abdomen, the pleural membrane being on the dorsal side in segments one to six inclusive. Segment seven is a completely chitinized

ASIATIC BEETLE IN CONNECTICUT

ring, but in segment eight the pleural folds are at the lateral

margins.

The first sternite, as mentioned above, is absent, and the second is narrow throughout most of its width, widening at the extreme lateral regions. The anterior margin of this sternite is concealed . by the metathoracic coxae and a membrane connects it to the thorax. The middle of the sternite projects forward (as the interstitial process of Verhoeff) between the ends of the third pair of coxae and a corresponding protuberance, somewhat weaker, occurs on the third sternite. This is the accessory process. Sternites four to seven are similar. The eighth sternite is convex on the posterior margin and on the female a row of setae follows this margin. On the male there is a sinuate carina on the eighth sternite and a row of setae follows this carina. On sternites two to seven inclusive, there is a median horizontal row of setae. The ninth sternite is partly chitinized but concealed by the eighth. The tenth segment is represented by the membrane surrounding the anus and in the female there is a well chitinized proctiger above the arms. The sternum of the female is convex longitudinally, but that of the male is straight or slightly concave.

There are seven pairs of spiracles on the dorsal side of the abdomen but lateral to the line of the pleural membrane. These occur on segments one to seven inclusive. The first pair occur in a small membranous area which, if the spiracles are on the morphological sternite, should be considered part of the first sternite. These are the largest spiracles of the abdomen. The last three

pairs of spiracles are small and diverge posteriorly.

The genitalia are withdrawn into the abdomen. In the female there is a pair of coxites below the anal opening and lateral to the genial opening. The male genitalia consist of an anterior large basal piece, a ventral plate, two lateral lobes, and a median lobe which contains the true penis or inner sac. On the ventral side below the lateral lobes is a Y-shaped sclerite, the spicule. The lateral areas of the anterior part of the median lobe are chitinized to form the median struts. The inner sac is evaginated during copulation and is directly connected with the ejaculatory duct which passes under the basal piece. The ventral distal part of the inner sac is chitinized and the proximal part is spinose. The median lobe lies between the paired lateral lobes and the ventral plate. Its lateral regions are chitinized. The genitalia of the male have been named according to Sharp and Muir (1912) and those of the female according to Tanner (1927).

THE EGG (PLATE XVIII)

When first laid the egg is white, ovoid, smooth, and measures about $1.2 \text{ mm.} \times 1.5 \text{ mm.}$ After being in the soil a few days it swells and becomes more nearly spherical in shape. The following measurements of eggs of different ages indicate the relative size.

TABLE 4—DIMENSION OF EGGS

No. of eggs	Maximum width mm.	Maximum length mm.	Age
10	$1.19 \pm .002$ $1.54 \pm .013$	$1.51 \pm .002$ $1.82 \pm .009$	When laid. Same eggs after 10 days at 24°C.
7	$1.59 \pm .021$	$1.91 \pm .043$	13-15 days at 24° C.
8	$1.58 \pm .024$	$1.96 \pm .041$	Large eggs collected in the field.

It is essential that a certain amount of moisture be present to enable the eggs to develop. Under air-dry conditions they do not swell but dry out and die. The total period of incubation at 24° C. is 17 days, so the last two lots of eggs given in the table represent very nearly if not actually the maximum size. A photograph of the eggs is shown on Plate XVIII.

THE LARVA (PLATE XVIII)

There have been published in recent years the description of the larvae of several Ruteline beetles fairly closely related to Anomala orientalis. Böving (1921) gave a systematic and morphological study of the larva of Popillia japonica and Pachystethus lucicola, and Hayes (1927) described the immature stages and larval anatomy of Anomala kansana. Rittershaus (1927) published an account of the biology and morphology of Phyllopertha horticola and Anomala aenea, giving particular attention to the genitalia. In the following description, mention is frequently made of the setal arrangement, for the determination of the species may be more easy if the setal pattern is known.

There are three larval instars, and these conform to the Ruteline type. When first hatched the larva measures about four millimeters in length. During the first instar it attains a length of about eight millimeters. The second instar attains a length of about 15 millimeters, and the fully grown larva is 20-25 millimeters long. The following table gives the width of the head capsule measured at the widest part (just behind the antennae). Although there is some variation in this within each instar, it is not great enough to cause any confusion in the determination of

the instar by measuring the head capsule.

When first hatched the larva is white except for the tips of the

mandibles, the egg burster, and some of the setae, these being brown. The head soon darkens to a light brown color and the body darkens, due to the filling of the intestines when feeding

TABLE 5-WIDTH OF HEAD CAPSULE OF LARVA

No. of larvae	Instar	Width of head
50	1st	1.15 ± .01 mm. Measured day of hatching.
21	1st	$1.19 \pm .01$ Preserved specimens from miscellaneous collections.
29	1st-	1.17 ± .06 Preserved specimens not over 24 hours old when killed.
17	2d	1.96 ± .08 Preserved specimens from miscellaneous collections.
8	2d ·	$1.81 \pm .02$ Measured 73-75 days after hatching. Reared in sod compost at 24°-25° C.
18	3d	3.07 ± .12 Measured 93 days after hatching. Reared in living turf at 24°-25° C.
20	3d	2.97 ± .03 Preserved specimens from miscellaneous collections.
7	3d	2.80 ± .04 Measured 116-118 days after hatching. Reared in sod compost at 24°-25° C.

begins. In the following description, the third instar was used, but the other two instars are essentially the same except for size, and where they differ in any important detail, this is noted in the description.

HEAD

The head is slightly longer (from occiput to anterior border of labrum) than broad. There are no ocelli but the antenna and

mouth parts are all well developed.

In the epicranium the Y-shaped epicranial suture extends from the occipital foramen to near the bases of the antennae where the arms become indistinct. The stem of the suture is about half the length of the frons. This stem is slightly thickened and from its inner side a tendon extends into the head cavity. The sides of the suture along the stem are very slightly if at all raised. The vertex is smooth and divided symmetrically by the epicranial suture. It extends laterally and posteriorly to the occiput. On the dorsal side the vertex bears a number of setae (Fig. 46). Along each side of the spicranial suture is a row of about seven setae extending from near the occiput to about opposite the middle of the frons. The number of setae in either row varies from five to eight in the all three larval instars. Between the end of this row of setae and the base of the antenna on each side is a group of two setae ("2" Fig 46.), which are constant and conspicuous, and there are numerous setae along the lateral sides of the vertex, the largest and most conspicuous of which are one near the base of the antenna ("1" Fig. 46) and one about midway between the occiput and antennae ("3" Fig. 46).

The occiput (Fig. 47) surrounds the occipital foramen laterally and dorsally. It is separated laterally on each side from the vertex by a suture and anteriorly from the postgena by another suture. The maxillariae, to which the cervix is attached, almost completely cover it. These are thinly chitinized sclerites which are folded back flatly against the posterior side of the head. Each bears near

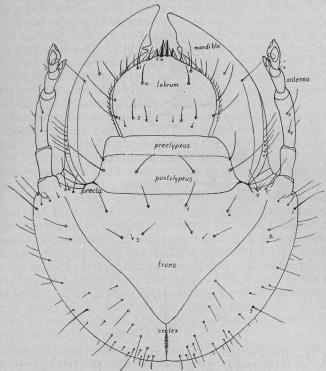


Fig. 46. Head of larva, dorsal aspect. The groups of more conspicuous and constant setae are numbered.

its latero-ventral angle a heavily chitinized point of articulation with the cervical sclerite of that side. This point of articulation is the odontoidea.

The postgena is more or less triangular in shape and separated from the occiput and gena by sutures. It bears at its median anterior angle the point of articulation with the maxilla, the paracoila or cardocondyle.

The gena is an area bordering the anterior lateral angle of the vertex and is found on the ventral side of the head capsule. It

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616

bears on its anterior margin the posterior point of articulation with the mandible, the postcoila. This is an acetabulum. There are several setae in the posterior part, two of which ("1" and "2" Fig. 47) are conspicuous and constant in position. The remainder are small and about eleven in number.

CONNECTICUT EXPERIMENT STATION

The occipital foramen is divided by a tentorium (Fig. 47) beneath which pass the nerve cords from the thoracic ganglion and above which passes the alimentary tract. The parts of the tentorium are probably as follows: The body (bt) constitutes the

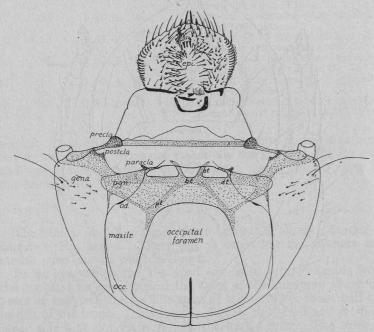


Fig. 47. Head of larva, ventral aspect, mandibles and maxillae removed. at, bt, dt, and pt, parts of tentorium. epi, epipharynx; maxilr, maxillaria; occ, occiput; od, odontoidea; paracla, paracoila; pgn, postgena; postcla, postcoila; precla, precoila.

main part and divides the occipital foramen. The arms are represented by the thickenings marked "at" (anterior), "pt" (posterior), and "dt" (dorsal). The dorsal arms continue as thickenings of the capsule along the line of attachments of the maxillae and mandibles and the posterior arms extend back to the border of the foramen. The anterior arms extend forward slightly into the head cavity. A chitinous "brace" connects the dorsal and posterior arms, and a thin chitinous sheet connects the body of the tentorium with the posterior arms. The tentorium is not well developed, and all the parts here described may not be homologous with those of the adult.

The frons (Fig. 46) occupies the region between the arms of the epicranial suture and the fronto-clypeal suture, being triangular in form. There are several small pores scattered over its surface, and it bears several prominent setae. On the anterior part are six setae constant in position and present in all instars. Of these six one pair is close to the anterior margin and near the mid-line ("1"). Lateral and somewhat posterior to each of this pair is another seta ("2"), about midway between "1" and the epicranial suture. Between the base of the antenna and the precoila on each side are two large setae ("4" and "5") and one or two minute setae. In the middle of the frons are four large and constant setae, one pair each side of the mid-line ("3") and there is frequently a minute seta associated with each of these pairs. The frons bears near each lateral anterior angle the anterior con-

dyle on which the mandible articulates, the precoila.

The antennae are four segmented and each is borne on a conical projection of the vertex. The first segment is short and bears no setae. The second is the longest of the four and bears two dorsal setae ("3" and "4" Fig. 46) and three or four ventrally. The third segment is short and terminates in a short conical projection on the inner side. There are two setae ("1" and "2" Fig. 46) on its ventral side. The conical spur on the median side of the distal end bears an oval sensory area on its outer surface. The fourth segment is conical and bears no setae. There are three sensory areas present on this segment, one large and oval in shape on the dorsal surface, one small and more or less quadrangular on the ventral surface, and one small and oval on the inner surface near the apex (Fig. 46). The ratios of the length of the segments has been used by Böving in describing Ruteline larvae and for the third instar of A. orientalis are approximately as follows: Subapical to basal segment 1:1; apical to basal segment 1.3:1; total length to basal segment 5:1.

The clypeus (Fig. 46) is approximately rectangular in shape and a little over twice as wide as it is long. It is divided into an anterior membranous preclypeus and a heavily chitinized postclypeus, but there is no dividing suture. The post-clypeus has a slightly rugose surface which contains many scattered "pores" and bears six prominent setae, one each side of the mid-line near the base, one each side near the middle of the lateral margin, and one at each anterior lateral angle. The preclypeus is asymmetrical, the left anterior angle being more prominent than the right.

The labrum (Fig. 46) is asymmetrical as shown in the figure. The dorsal surface is rugose and contains many "pores". There are eight prominent setae on the disc, two near the anterior margin ("1"), two a little anterior to the center ("2"), and four ("7")

near the posterior margin. The latter are grouped in two pairs, one pair each side of the mid-line, and close to each pair there are usually one or two minute setae. On each side of the labrum and on the posterior half are two large setae ("3" and "4"), the anterior of which is in a groove which runs longitudinally along the side. At the tip of the labrum are four heavy setae of which the outer two are about one-half the length of the inner two. Along each side and posterior to these apical setae is a row of about five setae. The setae around the edge of the labrum are set in slight depressions, which gives a crenulated appearance to the margin. The central setae ("2") on the disc are set in deep depressions, and the posterior setae ("7") in slight depressions.

CONNECTICUT EXPERIMENT STATION

The epipharynx (Fig. 47) has been described by Hayes (1928). It covers the ventral side of the labrum and is devoid of setae in the center. On each side of this nude area are several short heavy setae arranged in three more or less regular rows and all pointing centrally. Lateral to these are several very small setae. Anteriorly is a small papilla (distal sensory area) bearing three spines and, just anterior to the spines, a transverse row of eight or nine "pores." The area between the papilla and the tip of the labrum is covered with setae and contains a shallow longitudinal depression which extends from the right side of the papilla to the anterior margin of the labrum. Extending medially from each posterior lateral angle of the labrum and on the ventral side is a narrow chitinous plate, the torma. The one on the left curves anteriorly at its apex and posteriorly at its base. The right one is nearly straight. Between these lines a short conical chitinous papilla (sensory cone), and posterior to this cone is a heavily chitinized narrow transverse plate which is attached at its lateral end. Between the cone and the left torma is a transverse row of very fine short setae. Still further posteriorly is a lightly chitinized U-shaped band and two pores (clypeal sensillia). These structures posterior to the tormae are really on the ventral side of the clypeus. On the lateral side and extending from the posterior margin about two thirds of the distance to the apex is a row of chitinous striae, about 16 in number, each of which is accompanied by a small seta at its outer end (Fig. 47). The tips of the setae of these two rows are visible from the dorsal side.

The mandibles (Fig. 48a) are asymmetrical, the right being more acutely pointed than the left, having a shallower incision separating off the dentes, and having a differently constructed molar region. The tips of the mandibles and the molar regions are black, the remainder brown. The incisorial edge (gnathapex) of each mandible is slightly concave with one dentes (gnathodentes) posteriorly. On the dorsal surface of the mandible and about one-third the distance from the apex to the base is a conspicuous seta, and lateral of this is another larger seta. The base of the

mandible is three-sided. The outer face bears a longitudinal ridge ventral to which is a group of about seven setae and dorsal to which is a row of about ten pores. In the first and second instars, however, this face is smooth, although the setae are present. The ventral face bears a more or less oval stridulatory area of transverse ridges. These areas are similar in shape on each mandible (Fig. 48a). The outer basal angle of the ventral surface of each mandible bears a group of about five very small setae distal to the posterior condyle (postartis). This condyle articulates in an acetabulum (postcoila) on the gena. The anterior (or dorsal) articulation is by means of an acetabulum (gnathacetabulum or pre-artis) on the anterior dorsal face and a condyle (anterior condule or precoila) at the posterior lateral angle of the clypeus. The inner posterior (proximal) part of the mandible is the molar region. This has been figured for two species of Scarabeidae by Böving and its structure used to distinguish them. The molar regions of the mandibles meet the hypopharyngeal chitinization as well as each other. On the ventral side of each mandible and close to the molar region is a lobe which meets the hypopharynx. The right molar region consists of four granulose surfaces separated by grooves. The distal three constitute the crown (according to Böving) and the proximal one the heel or calyx The first lobe of the crown (cr) is in some specimens oval and is so drawn, but in many specimens of all instars it is very irregular. The other two lobes of the crown (cr2 and cr3) are elongate and curved, and the heel or calyx (ca) is flat, approximately oblong and about twice as broad as long. The dorsal posterior angle of the heel extends as an obtuse conical projection, and the posterior side of the face is not parallel with the distal but slopes in slightly toward the distal side. The proximal side of the molar region of the right mandible bears a dorso-ventral row of setae. The left molar region is projected medially at the anterior end, this projection meeting the sinuate upper part of the hypopharvngeal chitinization. The inner face of the molar region bears two anterior incised rugulose surfaces and a posterior smooth sub-triangular area. Projecting from the dorso-anterior angle of this latter area is a membranous lobe (hamus) from the apex of which runs a row of setae which extends around the posterior margin of the molar region. The dorsal and outer surfaces of the mandibles are rough, but the ventral surface, except for the stridulating area, is smooth. The exterior tendon of each mandible is attached along the posterior edge of the outer face, and the flexor tendon is attached along the posterior edge of the molar region. A membranous area (trochantin of the mandible) lies between the base of the mandible and the base of the antenna.

The maxillae (Fig. 48d and e) are paired structures articulating

with the head capsule by means of an acetabulum (parartis) on the basicardo and a condyle (paracondyle) on the postgena. The galea and lacinia are fused into one conical lobe, the mala, the outer part representing the galea and the inner the lacinia. Along the medial side and near the apex of the lobe are three fixed

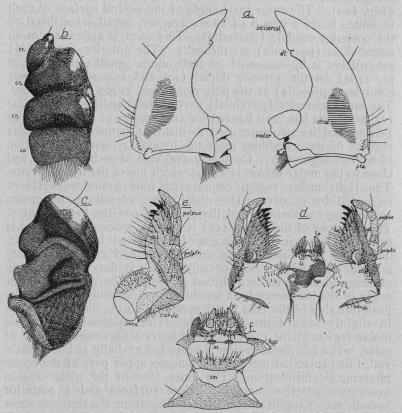


Fig. 48. Mouth-parts of larva. a. Mandibles, ventral aspect. [b. Molar region of right mandible. c. Molar region of left mandible. d, Maxillae, dorsal aspect. e. Left maxilla, ventral aspect. f. Labrum, ventral aspect. ca, calyx, or heel; cr., cr2, cr3, crown of molar of mandibles; dt, tooth of mandible; gal, galea; hyp, hypopharynx; lac, lacinia; li, labium; lig, ligula; lp, labial palpus; m, mentum; paplfr, palpifer; pta, postartis or posterior condyle of mandible; sm, submentum; stip, stipes; strid, stridulating area of mandible.

large spines in a longitudinal row, the largest of the three being the anterior and the smallest the posterior. On the dorsal side of the lobe are three more or less parallel rows of setae running obliquely across with a few scattered setae (about seven) posterior to them. The anterior of these three rows contains seven heavy setae, the next row eight more slender setae, and the posterior row about five slender setae. There are several short setae at the lateral basal angle of the lobe on the dorsal side. On the ventral side of the lobe is a longitudinal row of about six setae. Anterior to this row and at the apex are two heavy setae, and other setae are found as indicated in the figure. There are a few setae on the ventral side on the stipes and on the base of the palpifer. A small elongate sclerite medial to the stipes is the parastipes. It bears a row of about five minute setae. On the dorsal side of the stipes is a row of from five to seven (usually five or six) strong anteriorly directed hooks which comprise the maxillary part of the stridulatory apparatus. These rub against the corrugated area on the ventral side of the mandible. The cardo is divided into two sclerites, a basicardo and a much larger disticardo, both of which bear a few setae. The basicardo bears the acetabulum (parartis) of the maxilla. On the dorsal side the proximal part of the maxilla is membranous and bears many minute setae. On the ventral side this proximal region has a chitinized area bordering the cardo and a lightly chitinized setiferous area medially. The maxillary palpus is four-segmented and is borne on a projecting palpifer. The palpifer is setiferous and there is one seta on the ventral side of the first segment of the palpus, one anteriorly on the ventral side and one laterally on the second, two on the third placed similarly to those on the second. The apex of the fourth segment bears a number of minute sensory papillae. The relative lengths of the segments from basal to apical consecutively bear the following ratio, approximately: 1:2: 1.5: 2.5 (in the third instar). The relative lengths of these segments varies a little in the other instars, but the basal segment is always the shortest, the sub-apical next, the second segment next, and the apical segment longest.

The parts of the *labium* (Fig. 48f) are fused into a single structure. The submentum is approximately trapezoidal in shape and well chitinized over the basal two-thirds. There are four setae present, one large seta near each basal angle and one small seta in each apical angle (these latter are absent in the first instar). The mentum is broader at the apex than at the base and is much wider than long. It bears a chitinous band across its base on which are one pair of prominent setae near the midline and between and lateral to them several smaller setae. In the first instar there is only one small seta present lateral to the large setae. The ligula, representing the fused distal parts of the labium, is approximately conical with a pair of palpi borne on the ventral side near the apex. Near the mid-line and on the posterior border of the ligula are two small oval chitinous areas. The area around the base of each palpus on the ventral side is

heavily chitinized and setiferous, and the tip bears many setae. A little dorsal to the apex of the ligula is a depression with a pore in its center. The palpi are two-jointed and the apex of the terminal joint bears a number of minute sensory papillae.

The hypopharynx (Fig. 48d) lies on the dorsal side of the labium. Its anterior part is asymmetrical and heavily chitinized, projecting anteriorly on the right side, the hypopharyngeal chitinization of Böving. Against this chitinization the molar regions of the mandibles act, the anterior part of the left molar meeting the left side of the anterior projection of the chitinization. There is a group of small setae at each anterior angle of the hypopharynx and a row (approximately longitudinal) of setae on each side of the base of the chitinization. The left row is longer and curves medially at its anterior end. The right row is short and follows the edge of the chitinization. The sides of the hypopharynx as it passes into the pharynx are slightly chitinized.

CERVIX

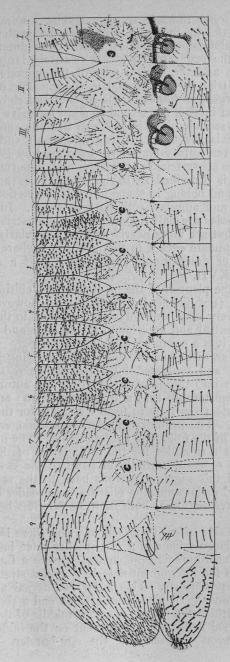
The most important part of the cervix consists of the sclerites, not separated from the rest of the cervical region by sutures, which extend from the episternum of the prothorax to the maxillariae, forming a support for the head, one sclerite on each side. The remainder of the cervix is membranous and devoid of setae except in the mid-ventral region where a group of setae belonging to the prothorax extends upon the cervical membrane.

THORAX

On the dorsal side the thoracic segments are divided into annulets. There are three of these on each segment, but the division between the first two of the prothorax is very faintly indicated. Figure 49 is a diagram of the body of a third instar larva and shows these annulets and the setal arrangements. The thoracic segments are indicated by Roman numerals. The third annulet of the prothorax and the second annulet of the meso and metathorax are devoid of setae, but the other annulets are setiferous.

There are certain setiferous areas laterally on the thorax, these areas being on slight protuberances of the integument (Fig. 49). On the prothorax these areas, except for one on the posterior-ventral angle of the pleuron, are poorly defined. On the meso-and metathorax there are on each side four such areas, one between the second and third annulets; one, circular in out-line, ventral to the first and between the ends of these annulets; two smaller, ventral to the second.

The prothorax bears a pair of spiracles (these belong phylogenetically to the mesothorax) close to the posterior margin,



these being the only thoracic spiracles. The respiratory plate (peritreme) of the prothoracic spiracle opens posteriorly, the reverse of the abdominal spiracles which open anteriorly. In the first instar the respiratory plate is relatively larger than in the other instars and the central part of the spiracle relatively small and more triangular than oval in shape. The prothoracic spiracle is the largest on the body, the seventh and eighth abdominal spiracles next in size, the second to sixth inclusive abdominal next, and the first abdominal is smallest. In the center of the respiratory plate is the bulla. The arrangement and shape of the holes of the respiratory plate have been used by Böving, following Schiödte, as systematic characters of importance. The genus Anomala is described as having these holes arranged in transverse rows and oblong in shape in contradistinction to irregularly arranged and angulate-rotundate in shape. In Anomala orientalis these holes are only approximately as described for the genus Anomala but are more nearly so than irregularly arranged and angulate-rotundate except in the first instar where they conform to the latter description. A photograph of a spiracle is shown on Plate XVII.

CONNECTICUT EXPERIMENT STATION

There are on the pleuron of the prothorax two chitinous plates near the spiracle (not distinct in the first instar, however). One of these is relatively large and dorsal and anterior to the spiracle. The other lies ventral and anterior to the spiracle and is a small bar. Just above it is a conspicuously large seta.

Each thoracic segment has two small sclerites lying just above the coxal cavity and separated by a perpendicular suture. A phragma projects into the body cavity from this suture. These sclerites are the episternum (es) and epimeron (em) and at their junction they project ventrally to form a condyle for the articulation of the coxa. The prothoracic sclerites are longer and narrower than those of the following two segments. The prothoracic episternum forms a shoulder for the articulation of the cervical sclerite and then extends ventrally in front of the coxal cavity. The epimeron of this segment extends back to the mesothorax. On the meso- and metathorax the sclerites are broader but not as long. On all three segments both of these sclerites bear two to four small setae.

On the ventral side of each thoracic segment there is a median group of rather large setae and a few smaller setae lateral to it. The meso- and metathoracic segments each have a light curved transverse fold in the integument anteriorly and a straight linear transverse ridge posteriorly. This latter is internal and serves for muscle attachment. It also bears at each end a short tendon (te) to which is attached a muscle from the middle of the pleuron.

In the first larval instar there is present on the middle of the metathoracic pleuron on each side the egg-burster. This has

been very well described as to form and function for other Scarabaeidae by Rittershaus (1927). It consists of a conical sharply pointed protuberance bearing a slender pointed spine on the posterior side of the apex (Fig. 50c) and serves as a point for the application of pressure from within when the larva breaks the egg chorion in order to hatch. It does not act as a means of cutting the chorion. This egg-burster is cast off at the first molt.

The thoracic legs are illustrated in Fig. 50a. Those of the prothorax are shortest and those of the metathorax longest. This difference in length occurs mainly in the coxa, although the more terminal part (except the tarsal claw) also shows a progressive increase in length from prothorax to metathorax. Each leg is composed of five segments, coxa, trochanter, femur, tibia-tarsus

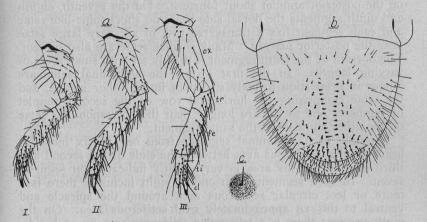


Fig. 50. a. Larval legs, all drawn to the same scale. b. 10th abdominal segment of larva, ventral(aspect. c. Egg-burster of larva. cl, tarsal claw; cx, coxa; fe, femur; ti, tibia-tarsus; tr, trochanter. The Roman numerals indicate the thoracic segments.

and tarsal claw. The principle articulations of the leg occur at the coxa-pleuron and coxa-trochanter joints, and in the prepupal stage the legs are folded at the latter joint. The proximal edge of the coxa bordering the thorax is heavily chitinized anteriorly where the coxa articulates on the thoracic sclerites (Figs. 49 and 50a), but this chitinization diminishes on each side and is practically absent posteriorly. All the leg segments except the tarsal claw bear numerous setae, but the claw bears two only, one on the median side and one on the postero-lateral side. This claw is heavily chitinized at the tip but quite fleshy proximally. The third tarsal claw is much shorter than that of either the meso- or prothorax, a character used in distinguishing Anomala from allied genera (see Böving 1921).

ABDOMEN

There are ten visible abdominal segments of which the first six are divided on the dorsal side into three annulets each, but the last four are simple. These annulets tend to confuse the limits of the segments, but Figure 49 shows what appears to be correct according to the internal muscle attachments. Each annulet of the first six segments except the first of segment one and the third of segment six bears a transverse row of fairly prominent setae posteriorly and a large number of very short spine-like setae, the general arrangement being similar on the corresponding annulet of each segment. In the two excepted annulets the setae are irregularly arranged. The usual number of setae on the anterior annulet is about ten, on the median annulet about eighteen, and on the posterior annulet about fourteen. On the seventh, eighth and ninth segments the dorsal side bears no short spine-like setae and each segment has a transverse row of six very large setae near the posterior margin. Many smaller setae are also present. The dorsum of the tenth segment is thickly set with small setae of varying lengths. In the first instar, the abdominal setae are longer in proportion to body size than in the other instars, and the setae comprising the horizontal row of the second annulet of segments one to six are longer than the corresponding setae on the other annulets of the same segment.

Laterally each abdominal segment from one to six inclusive bears an oval setiferous area between the ends of the second and third annulets. This area is very faintly indicated on segment seven. In each segment from one to eight inclusive there is a more or less circular setiferous area around the spiracle and ventral to this an approximately oval setiferous area. On the ninth segment there is a triangular setiferous area on each side, the ventral margin of this area being the line separating the ventral and pleural regions of the segment. All these setiferous areas are protuberances or folds of the integument. At each end of the anal slit on the tenth segment is a small group of setae which are somewhat longer than those on the dorsum. There are eight pairs of abdominal spiracles, one pair on each of the first eight segments. The respiratory plates of these spiracles open anteriorly, the reverse of the thoracic spiracle, and those of the first instar differ from those of the other two instars as mentioned above (page 624).

The ventral side of each abdominal segment (Fig. 49) except the tenth bears an irregular transverse row of setae and a few other setae laterally. The intra-segmental folds of the integument are shown by dotted lines in the figure. On the ventrum of the ninth segment there is a conspicuous setiferous protuberance laterally. The ventral side of the tenth segment bears two nearly parallel rows of very short, heavy, spine-like, recumbent setae which point mesad. The number of these setae varies and is not usually the same in both rows on one individual. There may be as few as ten and as many as sixteen in either row, and there may be as many as three more in one row than in the other. The number found is usually between eleven and fourteen. There is frequently a slight tendency for these rows to diverge anteriorly. This structure is frequently used in identifying Scarabaeid larvae, since it is relatively constant in one species and varies much among species but it alone cannot be relied on, since both Phyllopertha horticola (see Rittershaus 1927) and Pachystethus lucicola (see Böving 1921) have a similar arrangement and may have the same number of setae in some cases. In Anomala orientalis the distance between the border of the anal opening and the posterior end of the two rows is about half the length of the rows. There are several strap-like setae with hooked ends on each side of the central rows and between the anal opening and the posterior ends of the rows. The anal opening is bordering by fine setae similar to those found on the dorsum and is crescentic in shape.

THE PREPUPA (PLATE XIX)

The prepupa does not represent a morphologically distinct stage in the development of this insect but is merely a quiescent period which terminates the third larval instar. The larva is in the third instar but is not active. The legs are folded at the coxa-trochanter joint and are useless. The intestine is evacuated and the body of the larva appears creamy white in color.

THE PUPA (FIG. 51 AND PLATE XIX)

The pupa (Fig. 51) is about 10 mm. long, about 5 mm. in greatest diameter, and light brown in color. There are many fine setae on the legs, antennae, and dorsal surface of the body, and the caudal end of the abdomen bears a thick fringe of setae. The

entire body is covered with a very fine pubescence.

On the ventral side all the mouth parts and the thoracic appendages are distinct. The epicranial suture is evanescent, and the vertex and frons are fused together. The eyes are partly concealed by the bases of the antennae. The antennae border the mouth parts laterally and are indistinctly divided into three lobes. The clypeus is trapezoidal in shape with a slightly sinuate posterior margin (fronto-clypeal suture). The labrum is asymmetrical, being slightly larger on the left side than on the right, and slightly inflexed at the tip. The mandibles are crescentic and border the clypeus and labrum laterally, being partly concealed by them. The maxillae project from beneath the mandibles and each consists of one lobe to which is attached laterally an indis-

tinctly segmented palpus. The labial palpi touch each other at their tips and lie transversely across the base of the conical labium. Figure 51 is a diagram of a young pupa. Near the close of the pupal period the mouth parts become more inflexed and differ slightly in appearance from the diagram. The lateral areas of the pronotum border the eyes and antennae. The thoracic legs are folded so that medially the tip of the coxa and the base of the femur are visible beneath the tibia and tarsus. On the prothoracic legs there is a short spur at the outer apical angle of the tibia, and on the mesothoracic and metathoracic legs there are two spurs at the inner apical angle of the tibia. The former represents the tibial spur of the adult, whereas the latter represent heavy fixed spines. The anterior tarsi have the segments very slightly indicated, but the segmental divisions are a little more clearly shown on the mesothoracic tarsi, and they are quite distinct on the metathoracic tarsi. The tips of the anterior legs extend well into the posterior half of the metathoracic sternum, and the tips of the mesothoracic legs extend to about the middle of the third abdominal segment. The metathoracic legs extend to the ninth abdominal segment in the male and to the eighth in the female. The wings lie between the second and third pairs of legs. The mesothoracic wings cover those of the metathorax except at the tips and along the medial margin. The anterior wings are very faintly ridged. Between the first and second coxae there is a very small part of the mesothoracic sternum visible, but posterior to the second coxae the visible part of the metathoracic sternum is quite large.

CONNECTICUT EXPERIMENT STATION

BULLETIN 304

The ventral side of the abdomen differs in the two sexes. The first eight visible segments are similar in each sex, but posterior to the eighth visible (the ninth true abdominal segment) are the anlagen of the adult genitalia in the male. The first abdominal segment is not visible ventrally, and the second is almost entirely covered by the thoracic appendages. Segments three to nine are distinct. Three to six inclusive are about equal in length, but seven and eight are wider than those preceding, and the ninth is a very narrow band about one-third (female) to one-fourth (male) the width of the eighth. Laterally there is a pleural fold along the length of the abdomen which is very prominent on segment eight and posteriorly. Posterior to the ninth segment of the male there are two lobes, the anlagen of the parameres (lateral lobes), and posterior to this the anlage of the penis. This latter is partly divided by a suture representing the future ejaculatory duct. The abdomen of the male is more slender than that of the female. The external genital opening lies in segment nine. The visible area posterior to the genitalia of the male is the dorsal part of segment ten.

Dorsally the two sexes are alike. The pronotum is similar in shape to that of the adult. The mesonotum is about equal in

width to the metanotum and about one-half again as broad as long. The metanotum is about twice as broad as long and about half as long as the pronotum. The suture separating the mesoand metanotum is convex posteriorly. The wings of each segment are indistinguishably fused with the notum. There are

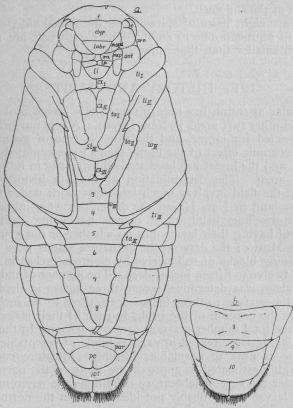


Fig. 51. a. Male pupa, ventral aspect. b. Tip of abdomen of female pupa, ventral aspect. ant, antenna; clyp, clypeus; cx, coxa; e, eye; f, frons; labr, labrum; li, labium; lp, labial palpus; mand, mandible; mx, maxilla; mxp, maxillary palpus; par, paramere; pen. penis; prn, pronotum; st, sternum; ta, tarsus; ti, tibia; w, wing. "t" signifies dorsal. The Roman numerals indicate the thoracic segments and the Arabic the abdominal.

dorsally visible nine abdominal segments. Close to the middle of each of the division lines separating the first seven segments from each other is a pair of incised pockets whose edges are slightly curved and heavily chitinized. The eighth segment is convex at the posterior margin, being wider at the middle, and represents the pygidium of the adult. The ninth segment extends to the tip of the abdomen. The anus is concealed by the anlage of the penis in the male and the tenth segment is probably represented by the membranous integument surrounding it. In the female the broad area on the ventral side posterior to the ninth sternite is the tenth, and the tenth tergite is on the ventral side of the tip of the abdomen.

CONNECTICUT EXPERIMENT STATION

There are eight pairs of spiracles on the dorsal side, one pair on each of segments one to eight. The eighth pair are reduced and much smaller than those preceding.

LIFE HISTORY AND HABITS

Particular attention has been given to this insect as it lives in lawns and other turf areas in New Haven. A few nurseries have been inspected for larvae, and the same is true of greenhouses. but the economic effect of the beetle seems to be confined entirely to lawns, and the insect has been studied primarily in its relations to these areas. The determination of the life history of soil insects in the field involves much laborious work under the best conditions, and in New Haven the difficulties were increased by this lawn-dwelling habit, most people not being particularly desirous of having their lawns dug up whether or not grubs were present. Most of the data on the immature stages were secured by examining blocks of soil twelve by eighteen inches in surface area and twelve to fifteen inches deep. The number of individuals of each stage was determined every three inches in depth; that is, from the surface to three inches deep, three to six inches, etc. This gave the position of the grubs in each of their stages in the soil and the total number per unit area of surface. In the insectary, the larvae were reared in various kinds of receptables under conditions as near to normal as possible. Moisture conditions were roughly estimated to approximate those of the normal soil. Even under the best of laboratory conditions the environment of growing larvae was probably not identical with the normal environment. The lengths of stages here given are those of insectary-reared individuals except where otherwise stated. These periods checked well with field observations except that the lengths of the larval instars in the insectary were somewhat longer than in the field. The data on the adults were secured both from captive beetles and from field observations. A brief summary of the life cycle in Hawaii has been published by Muir (1912) and in Connecticut by Friend (1927).

The adults emerge from the pupal stage in the ground during the latter part of June, and throughout the months of July and August. They usually remain in the soil one or more days before coming to the surface, and a few specimens have been observed to remain in the soil seven days, but these cases may represent a much longer time than the average in the field. Pupation occurs at three to nine inches below the surface of the ground, and the adults remain in the pupal chambers until the chitin hardens, which takes about one day. In 1926 the first adults were found in the field June 25, in 1927, June 29, and in 1928, June 26. The last were found August 28, 1926, and September 9, 1927. No field scouting for adults was carried on the latter part of the summer in 1928. In the insectary where conditions of temperature were essentially the same as out-doors, we secured adults as early as June 15 in 1927. During 1926 they were most abundant from July 13 to July 24, and during 1927 from July 11 to July 13. They live from two to three weeks.

Our observations indicate both diurnal and nocturnal activity. During the day the beetles are in flight during both morning and afternoon and are frequently found in flowers, where they feed on the petals, although not extensively. At night they are sometimes found around lights crawling on the ground, window frames, etc. They are not very active when compared with our native May beetles or with the Japanese beetle. Flight is short, often only a few feet, and much of the time is spent in the ground

where they are often found in burrows an inch or half an inch deep (Plate XX). No precise data are available on the effect of humidity and temperature on the activities of the adults. In 1927, a record was kept of the sex of 693 adults collected between July 13 and September 9, when the last adult was found. These beetles, with very few exceptions, were picked up on flowers and foliage or on the surface of lawns: 590 were females and 103 were males. The significance of this is not quite clear, for between July 19 and September 3 there emerged from our insectary tiles 176 males and 137 females, near enough to an equality of sexes to cause no comment. The scouts were instructed to examine flowers carefully, and if the females feed more than the males, the preponderance of the former is explained. Muir

The adults feed very little, and it is possible that what they eat may be consumed for the sake of its moisture content. They are frequently found in rose blossoms, hollyhocks, phlox, dahlias, etc., and we have fed them on roses in the insectary, but the amount of food consumed is rarely enough to injure the flower seriously. We fed adults in captivity on pieces of ripe apple. They will not eat an apple the skin of which is entire, but if the flesh is exposed they eat out a cavity about large enough to hold the body. They will also burrow into a wet sponge and bury their heads in wet cotton. Water seems to be the substance sought in this case. If apple pulp is placed in a receptacle where

noticed the same preponderance of females collected on flowers

in Hawaii.

it cannot be reached except by flight they are not attracted to it and we have never found them on fruit in the field. In the adult stage the feeding habits of this insect are of no economic importance.

A few specimens have been found mating in the field, but most of the observations on the mating habits have been made on adults in captivity. They are both polygamous and polyandrous, mating indiscriminately. One male will mate with more than one female, and one female will mate with more than one male on the same day. No attempt has been made to determine the limit in this direction, but in breeding work in the out-door insectary pairs could be mated at almost any time. In some instances one male has mated with two females successively with no appreciable interval. The reverse has also occurred, and one pair may mate twice the same day. The duration of the act of copulation varies from fifteen minutes to two hours. Mating below the surface of the ground has never been observed in the field or laboratory, and we do not believe it occurs normally.

The intervals between emergence from pupal skin and mating, and between mating and oviposition show much variation. The female may mate and oviposit within one day of the time of shedding the pupal skin, but usually a longer time elapses in captivity, at least. Although as much as five days may elapse between mating and oviposition in captivity, under natural conditions the duration of time may be much less. Whether one mating or more is required for oviposition of the normal number of eggs has not been ascertained. Some females seem to be stimulated to renewed egg-laying activity by a second mating, but oviposition in the laboratory is so irregular that no conclusion

has been drawn as regards this matter.

The period of oviposition is from four to twenty days, usually about one week. During this time eggs are laid during both day and night in small groups placed loosely in the ground usually at a depth of between three and nine inches. Six 1928 diggings taken from field records show that of 437 eggs found, 78 per cent. were between three and nine inches below the surface of the soil, 12 per cent. were in the upper three inches of soil, and 10 per cent. were between nine and twelve inches below the surface. Of those found outside the three to nine inch layer, most were close to the three-inch or nine-inch level. Our experience has been that more eggs are found between four and eight inches below the surface in the field than at all other levels. From one to twelve eggs per day are laid in captivity, the largest total number from one beetle being 39, laid over a period of seven days. The average is much less. (We have secured an average of 26.4 eggs per female from nine individuals). The first eggs were found in the field in 1926 on July 19, and the last on Septem-

ber 10. In 1927, the first egg was found on July 3, and the last in September (day not recorded). In 1928, the first eggs were found July 3. The adults will oviposit in ground covered with sod or bare. No search has been made for eggs in bare ground more than a few feet from sod, but they are frequently found in gardens in yards. In tests made to determine the preference of adults for turf or bare ground three trials were made. A box having inside dimensions 10" x 20" contained earth covered with sod in one half, and earth without sod in the other, the depth of each half being five inches. In the first trial 25 pairs of adults were placed in each half, a thin partition preventing the two lots from intermingling, and left for four days. The side with sod contained 17 eggs, and the side without sod, 42 eggs. The sod, which was cut from a lawn seeded to red top grass in April and maintained in excellent condition by watering until used in July and August, was not compressed when placed in the frame. This was repeated with five pairs of adults on each side over a period of five days. Six eggs were found on the side containing sod and three on the other. In the third trial nine pairs of adults were placed on each side and the partition was removed above ground, permitting free access to both sides by all 18 pairs for three days. The partition was kept intact below the surface to prevent passage from one side to the other under ground. After three days the side with sod contained 26 eggs, and the side without sod, 22. Of the 116 eggs laid in all trials, 49 were laid in the side containing sod and 67 in the side without sod. The preference, if any, was slight. In breeding these insects in captivity, the adults are confined in small (four-inch to six-inch) flower pots or in jelly jars which contain earth without any living organic matter, and they oviposit very readily, although perhaps not to the extent attained in a more nearly normal environment. The infested area in New Haven is a suburban residential district where the properties have fair-sized lawns, and hence it is impossible to tell from field observations to what extent cultivated land would be infested in this region.

The egg is small and oval when laid, but it soon swells to a more nearly spherical shape and increases much in size. Full size is attained after about two weeks at 24° C. (75° F.) in moist soil. The duration of the egg stage at the same temperature and under the same conditions is 17.3 ± 0.1 days (53 eggs). Under out-door conditions of air temperature and in moist soil the duration of the egg stage for 121 eggs laid between July 14 and August 19 in 1927 was 24.7 ± 0.2 days. In 1926, the average was 27.8 ± 0.6 days for 63 eggs held under similar conditions out-doors and laid between August 2 and September 2. The soil temperature in Westville, New Haven, at a depth of six inches fluctuated during August 1926 and 1927 between the extremes of 61° and

84° F. However, the eggs on which data are given were kept in bottles full of earth in the insectary at air temperature, and the mean is much below 75° F. during July, August, and September, being 71.7° F., 71.3° F., and 62.8° F., respectively, in 1926, and 72.4° F., 66.9° F., and 65° F., respectively, in 1927 (U. S. Weather Bureau figures). Moisture seems absolutely essential to the development of the embryo. Lack of moisture retards development, and an exposure to air-dry conditions for the first ten days is fatal. Submergence in water also retards development, but eggs can survive at least seven days' submergence immediately after being laid.

Just before hatching, the brown tips of the mandibles are visible through the egg shell. Some of the brown setae are also visible through the shell, but the body of the larva is white on hatching. The egg-bursters on the metathorax (Fig. 50) aid the hatching process by pressing against the shell from the inside. These do not act as knives, for the shell breaks in what might be called a frontal plane, but simply furnish points for the application of pressure. The function of these and their morphology are very well described by Rittershaus (1925 and 1927). They are cast off at the first molt. The first newly-hatched larvae were found in the field on August 12, 1926, July 29, 1927, and July 17, 1928. First instar larvae occur during the remainder of the summer and fall and a certain per cent. hibernate.

As soon as they break from the egg shell, the young larvae move up to a point near the surface of the soil to feed on the grass roots and dead organic matter found there. This movement may be affected somewhat by the amount of organic matter in the soil, for if organic matter is plentiful, the larvae tend to migrate less. In normal sandy loam occurring just under the sod as found in New Haven, this tendency to move up is quite manifest. If eggs are placed at the bottom of tubes filled with soil, the larvae move up after hatching, but if the eggs are placed at the top of the tube (one centimeter below the surface of the soil) the larvae stay there. Moisture may possibly be an important factor in the movement of the larvae, for a very dry soil is fatal to them, and excess dryness of the top layers might cause them to go down or remain down more deeply.

Although under normal conditions the young larvae apparently feed on both grass roots and dead organic matter, they can maintain themselves and develop on the latter alone. It is not inferred that the dead organic matter is a sterile medium, for bacteria and fungi are present and may be a very important factor in the nutrition of the larvae.

They will live and grow on soil containing much decayed sod, but in this case the rate of development is not so rapid as when the food supply consists of normal growing turf nor do the larvae

grow to normal size. Aside from direct laboratory experimentation to determine this point, good evidence is given by the migration experiments that development is much more rapid in sod than in sandy loam. Of the 200 first instar larvae placed in the frame containing sod, 141 survived, 84 being in the second instar and 57 being in the first after 21-23 days. Of the 200 placed in the frame without sod, 95 survived, 35 being in the second instar and 60 in the first. These 400 larvae were all from miscellaneous insectary-reared material and were not selected for age. The average larval age was the same, as the lot was mixed. In the migration experiment with the small frame, 28 larvae survived in the frame without sod, and only eight of these had reached the second instar after 28-29 days. In the frame with sod, 36 larvae survived and 27 had reached the second instar. It is interesting to note that first instar larvae in the summer feeding season can survive a fairly long period of time and develop somewhat in soil no richer in organic matter than garden sandy loam.

The young larvae migrate laterally to some extent, depending much on the nature of the soil. If sod is present, migration is less than when the soil contains no sod. Figure 52 shows the distribution of larvae when living sod is present or absent. The frames used were two feet square inside, six inches deep, and with 20-mesh copper screen on the bottom. Each frame was filled to within one inch of the top and set in the ground out-doors. One frame contained sandy loam with no sod, and the other contained in the center a circular piece of sod one foot in diameter. The larvae (first instar) were placed with a little earth in a jelly jar having a two and a half-inch mouth, and this was inverted over the exact center of the frame and the larvae allowed to dig in. After 21 to 23 days (August 16 to September 6 to 8) the soil was removed in concentric rings one inch in thickness beginning at the periphery. All larvae found beyond twelve inches from the center were in the corners, and all larvae found in the first four inches from the center are given in one total. Two hundred larvae were placed in each frame. The method of handling accounts for much of the mortality, and the figures represent the survivors. In the frame with no sod, 95 larvae survived, and in the frame with sod, 141 larvae survived. In this latter frame 111 (79 per cent) of the larvae were within six inches of the center, (that is, in the sod itself) and only ten (seven per cent) were more than ten inches from the center, whereas in the frame containing no sod, 11 (11.6 per cent) were within six inches of the center, and 40 (41.9 per cent) were more than ten inches from the center. The presence of living sod very apparently influences migration in the soil, and this is substantiated by similar tests made with third instar larvae as given on page 637 and in Figure 53.

In two similar frames one foot square inside and filled three

inches deep, one frame containing no sod and one being entirely turf, the distribution of the larvae show a similar tendency. One hundred larvae were placed in each frame on August 17, 1927, and an examination was made as before on September 14 and 15. Of the 28 survivors in the frame with no sod, 20 (71 per cent) were over five inches from the center, and in the frame with sod 20 (55 per cent) of the 36 survivors were over five inches from the center. The low survival rate in these last frames was probably due to the method of handling and to drying out. If concentrated in a small space, the larvae bite each other with frequently fatal results from infection.

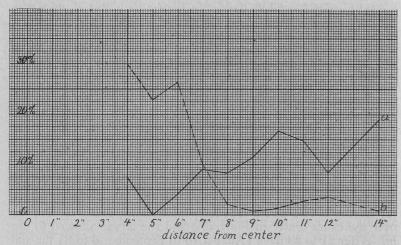


FIG. 52. Migration of first instar larvae in frame. a. 95 lárvae in frame with no living grass. b. 141 larvae in frame containing living turf.

The length of each instar has not been satisfactorily determined owing to the difficulty of obtaining normal growing conditions in the laboratory where the larvae can be observed. Twenty-three larvae in 1927 (August 8 to November 2) under normal outdoor temperature conditions averaged $35.1 \pm .7$ days for the duration of the first instar. When held at a temperature of $23^{\circ}-25^{\circ}$ C., the first instar is completed in less than 30 days. In both cases larvae were kept in living sod. Under the same conditions larvae fed on soil rich in dead organic matter (decayed sod) take about one-third again as long (about 40 days). The second instar apparently takes about as long as the first, and the majority of larvae hibernate in the third instar. The first week in September the second instar larvae become common and injury to lawns becomes noticeable at this time. By the last of September most of the larvae are in the third instar. The second and third instars feed

as does the first, and it is the activity of these later stages which injures the grass so severely (Plate XX). In 1928, the first injury to grass was noted August 17, the larvae being then in the second instar, and by September 15 the injury to lawns was very severe. The roots are cut off close to the crown, and in heavy infestations the dead grass can be rolled off the surface of the soil with ease.

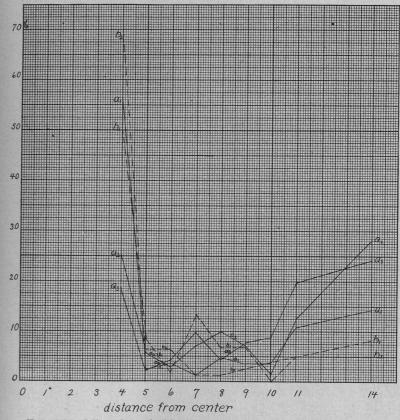


Fig. 53. Migration of third instar larvae in frame. a₁, 84 larvae; a₂, 71 larvae; a₃, 91 larvae—all in frame with no living grass. b₁, 60 larvae; b₂, 80 larvae—all in frame containing living turf.

The larvae are found in the characteristic position just below the surface of the soil. The third instar shows more lateral migration in the absence of grass roots than when in sod, as curves in Figure 53 indicate. One hundred larvae were used in each trial and the figures represent the survivors. The larvae remained in the frames as follows: a_1 , Sept. 21-24: a_2 , Sept. 23-28; a_3 , Sept. 28-30; b_1 ,

Sept. 21-28; b₂, Sept. 29-30. The procedure was the same as with larvae of the first instar (page 635). The difference is not so great as with the larvae of the first instar, but the time was much shorter in every case. Lot a₁ had a higher per cent within the first four inches of the center than b₁, but the larvae were in the frame in the former case three days as against seven days in the latter, and even with this greater length of time the dispersion beyond four inches shows a greater migration when no grass roots are present. The tendency to move farther laterally in the absence of grass may be a factor of some importance in controlling the larvae when arsenate is used in the soil. Although a search for food may be the primary cause of this migration, variations in the temperature and in the moisture content of the soil may have some effect. Grass cover on soil alters both temperature and moisture content when compared with a denuded area.

BULLETIN 304

About the middle of October the larvae begin to move more deeply into the soil to hibernate, and by the time the ground freezes they are well below the surface. Hibernation occurs at a depth of from ten to fifteen inches usually, although the character of the soil seems to be a factor which influences this to a certain extent. In lighter and more easily penetrated soils the tendency is to go more deeply. Most of the larvae are in the third instar when hibernation occurs, but some are in the second and first instars. Figure 54 shows graphically the percentage of different stages found in the field as given in Table 6. In Figure 55 is shown the rate of

TABLE 6—SEASONAL OCCURRENCE OF EGGS, LARVAE AND PUPAE

April 21-30	Eggs	1st instar	2nd instar	3rd instar	Prepupae	Pupae	Total
4-25-28	0	1	36	242	0	0	279
4-26-26	0	5	0	49	Ŏ	ő	54
4-26-28	0	0	0 7	34	0	Ŏ.	34
4-29-27	0	0	7	20	0	0	27
M 110	0	6 2%	43 11%	345 879	% 0	0	394
May 1-10 5-2-27	0	0	0				
5-4-27	0	0	8	7	0	0	15
0-4-21			4	55	0	0	59
	0	0	12 16%	62 849	% 0	0	74
May 11-20							
5-11-28	0	0	14	93	0	0	107
5-12-27	0	0	4	0	0	0	- 4
5-17-28	0	0	0	33	0	0	33
35 01 00	0	0	18 13%	126 879	% O,	0	144
May 21-30 5-24-28	0	0	3 6%	45 949	% 0	0	48
May 31-June 9							
6-4-28	0	2 3%	13 22%	40 709	% 3 5%	0	58
June 10-19							
6-7-28	0	0	1	11	11	0	23
6-13-28	0	0	19	13	13	4	49
6-15-28	0	0	2	9	37	6	54
6-16-28	0	0	3	11	12	4	30
6-17-26	0	0	0	3	31	52	86
6-18-26	0	0	0	8	2 5	7	17
6-18-28		0	5	5	5	25	40
	0	0	30 10%	60 20	0% 111 37%	98 33%	299

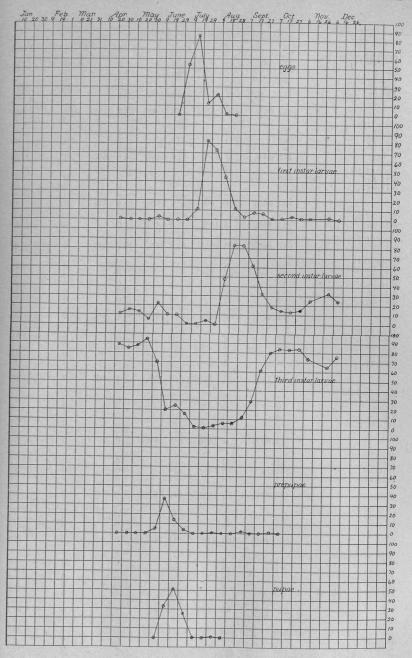
TABLE 6—SEASONAL OCCURRENCE OF EGGS, LARVAE AND PUPAE
—Continued

—Continued							
June 20-29	Eggs	1st instar	2nd instar	3d instar	Prepupae	Pupae	Total
6-25-26 6-25-28 6-26-28 6-27-28	0 0 0 0	0 0 0 0	0 10 2 6	20 9 3 11	12 0 3 2	8 8 35 27	40 27 43 46
6-29-26	0	0 0	$\frac{0}{18}$ 10%	$\frac{5}{48}$ 25%	$\frac{9}{26}$ 14%	$\frac{19}{97}$ 51%	$\frac{33}{189}$
June 30-July 9 6-30-26 7-2-28 7-3-28	0 0 2 60	0 0 0	0 0 1 0	11 1 3 4	4 1 0 0	15 0 12 3	30 2 18 67
	62 53%	0	1 1%	19 16%	5 4%	30 26%	117
July 10-19 7-12-28	45 263 12	0 40 0	0 0 4	2 3 1	0 0 1	0 0 0	47 306 18
	320 86%	40 11%	4 1%	6 2%	1	0	371
July 20-29 7-20-28 7-26-28	11 19	211	10	0 3	1 0	0	26 233
	30 12%	215 83%	10 4%	3 1%	1	0	259
July 30-Aug, 8 7-30-26 7-30-28 7-31-26 8-2-28 8-4-26	50 0 15 0 10 2	1 92 0 165 0	0 0 0 0 0	3 6 0 2 1	2 0 0 0 0 0	0 0 2 0 1	56 98 17 167 12 2
	77 22%	258 73%	0	12 3%	2 1%	3 1%	352
Aug. 9-18 8-15-28 8-16-28 8-17-28	5 0 0	120 32 42	118 3 86	9 5 13	0 0 1	0 1 0	252 41 142
	5 1%	194 45%	207 48%	27 6%	1	1	435
Aug. 19-29 8-20-28 Aug. 29-Sept. 7	0	22 11%	168 83%	13 6%	0	0	203
8-30-28	0	2 3%	53 83%	8 12%	1 2%	0	64
Sept. 8-17 9-8-28 9-9-27 9-10-27 9-11-28 9-12-27 9-14-27 9-16-27 9-16-27 9-17-28	0 0 0 0 0 1 1 0 1	6 0 25 16 14 0 2 1 15 0	76 163 2 141 137 1 0 16 19 30	1 51 0 37 38 0 0 0 3 6 135	0 0 0 2 0 0 0 0 0	0 0 0 0 0 0 0 0	83 214 27 196 189 2 3 20 41 165
	3	79 8%	585 62%	271 299	6 2	0	940
Sept. 18-27 9-19-27 9-20-27 9-21-27 9-21-27 9-23-27 9-23-27 9-24-27 9-26-27 9-27-26	0 0 0 0 0 0	17 9 0 25 13 2 43 1	88 46 0 53 100 96 118 4	67 93 73 281 87 95 247	0 0 0 0 0 0 0	0 0 0 0 0 0	172 148 73 359 200 193 408
	0	110 7%	505 32%	944 61%	0	0	1559

Table 6—Seasonal Occurrence of Eggs, Larvae and Pupae
—Concluded

				-con	ciuae	a					
Sept. 28-Oct. 7	Eggs	1st instar		2nd instan	r	3rd insta	r	Prepupa	ae	Pupae	Total
9-28-28	0	1		9		70		0		0	80
9-29-26	0	0		0		72		Ö		ŏ	72
10-1-26	0	0		15		* 4		Ō		0	19
10-2-28	0	4		40		139		3		Ö	86
10-4-26	0	1		7		27		0		Ö	35
10-5-26	0	0		3	*	6		0		Ō	9
0.1.0.15	0	6	1%	74	18%	318	80%	6 3	1%	0	401
Oct. 8-17 10-8-26	0	2		14		16		0		0	32
10-8-28	Ö	ō		3		46		Ö		ő	49
10-9-28	Ō	Ĭ		16		132		ŏ		ő	149
	0	3	1%	33	14%	194	84%	6 0		0	230
Oct. 18-27											
10-18-28	0	2		1		94		0		0	97
10-20-27	0	11		22		219		0		0	252
10-21-27	0	0		15		199		0		0	214
10-22-27	0	0		0		38		0		0	38
10-24-27	0	17		37		45		0		0	99
10-25-27	0	11		43		176		0		0	230
10-26-27	0	10		36		204		0		0	250
10-27-27	0	5		15		87		0		0.	107
	0	56	4%	169	13%	1062	83%	6 0		0	1287
Oct. 28-Nov. 6											
10-28-27	0	2		21		87		0		0	110
10-29-27	0	0		13		74		0		0	87
10-31-27	0	0		7		39		0		0	46
11-1-27	0	0		4		44		0		0	48
Nov. 7-16	0	2	1%	45	15%	244	84%	6 0		0	291
11-7-27	0	2		4		66		0		0.	72
11-10-27	0	0		4		67		0		0	71
11-15-27	0	4		110		206		0		0	320
	0	6	1%	118	24%	339	73%	6 0		0	463
Nov. 17-26											
Nov. 27-Dec. 6											
11-30-27	0	5	2%	98	33%	194	65%	0	1	0	297
Dec. 7-16											
12-14-27	0	0		10	24%	50	76%	6 0		0	76
** ** **		U		10	21/0	90	1070	0		U	.10

descent into the soil according to Table 7. During the month of October, 1927, the soil temperature in Westville, New Haven, at a depth of three inches fluctuated betwen 78° F. and 39° F, and in November between 58° and 31°, and the descent in the soil occurs in these two months. This movement down into the soil is not necessary for survival of the low temperatures, although it always occurs as winter approaches. In October of 1926, 24 larvae were buried at each of the depths given in Table 8 and allowed to remain until April 1, 1927. The larvae were placed in salve tins 23% inches in diameter and 15% inches deep, two larvae in each tin, and the tins filled with earth. In the cover and bottom of each tin a one-inch hole was cut and copper screen soldered over the openings. The depth was measured from the surface of the soil to the center of the container. Twenty-four larvae were placed at each depth. The differences in survival at



ASIATIC BEETLE IN CONNECTICUT

Fig. 54. Percentages of different stages found in the field in 1926, 1927 and 1928.

ASIATIC BEETLE IN CONNECTICUT

TABLE 7—DEPTH OF LARVAE IN SOIL (Including prepupae)

	(111)	cidding pr	epupac)			
	0-3"	3-6 "	6-9"	9-12" 15	2-15"	Total
April 21-30 4-25-28 4-26-26 4-26-28 4-29-27 4-30-27	237 11 33 9 117	31 17 1 - 13 17	8 15 0 3 22	3 11 0 2 51	0 0 0 0	279 54 34 27 207
	407 68%	79 13%	48 8%	67 11%	0	601
May 1-10 5-2-27	50 62	23 14	9 17	4 7 -11 cc.	0	86 100 186
	112 60%	37 20%	26 14%	11 6%	0	100
May 11-20 5-11-28 5-17-28	95 28	5 2	4 2	3	0	107
	123 88%	7 5%	6 4%	4 3%	0	140
May 21-30 5-24-28	41 85%	5 10%	2 4%	0	.0	48
May 31-June 9 6-4-28	47 58%	23 28%	9 11%	2 2%	0	81
June 10-19 6-13-28 6-15-28 6-16-28 6-17-26 6-18-26	30 21 15 3 3	9 20 8 18 11	7 0 3 1 3	2 0 0 0	0 0 0 0 0	48 41 26 22 17
	72 47%	66 43%	14 10%	2 1%	0	154
June 20-29 6-25-28 6-26-28 6-27-28 6-29-26	17 5 14 11	2 1 4 6	0 1 1 0	0 1 0 0	0 0 0 0	19 8 19 17
	47 75%	13 21%	2 3%	1 2%	0	63
June 30-July 9 6-30-26 7-2-28 7-3-28	7 2 4 2	3 0 0 0	1 0 0 0	0 0 0 0	0 0 0 0	. 11 2 4 2
	15 80%	3 16%	1 5%	0	0	19
July 10-19 7-12-28 7-17-28 7-19-26	$\begin{smallmatrix}2\\21\\4\end{smallmatrix}$	0 8 0	0 14 2	0 0 0	0 0 0	2 43 6
	27 53%	8 16%	16 31%	0	0	51
July 20-29 7-20-28 7-26-28	10 82	2 98	3 28	0 6	0	15 214
	92 40%	100 44%	31 14%	6 3%	0	229
July 30-Aug. 8 7-30-26	$\begin{array}{c} 1 \\ 71 \\ 0 \\ 158 \\ 0 \end{array}$	18 2 9 2	1 9 0 0 0	0 0 0 0 0	0 0 0 0 0	6 98 2 167 2
	230 84%	35 13%	10 4%	0	0	275
Aug. 9-18 8-15-28 8-16-28 8-17-28	236 40 111	10 0 21	1 0 7	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 	$ \begin{array}{r} 247 \\ 40 \\ 142 \\ \hline 429 \end{array} $
	387 90%	31 7%	8 2%	, 3 1%	U	728

TABLE	7—DEPTH	OF	LARVAE	IN	Soi

	(Includi	ng prepup	ae)—Concl	uded		
Aug. 19-28	0-3"	3-6 "	6-9"	9-12"	12-15"	Total
8-20-28	145 71%	42 21%	16 8%	0	0	203
Aug. 29-Sept. 7 8-30-28	62 96%	1 2%	1 2%	0	0	64
Sept. 8-17 9-8-28	83 156 18 135 159 13 114	0 44 6 54 19 25 32	0 14 3 5 1 2	0 0 0 2 0 0	0 0 0 0 0 0	83 214 27 196 179 40 165
Sept 18-97	678 75%	180 20%	41 4%	5 1%	0	904
Sept. 18-27 9-19-27 9-20-27 9-21-27 9-22-27 9-23-27 9-24-27 9-26-27 9-27-26	107 124 230 172 169 154 365 6	50 8 64 7 12 18 33 0	12 2 35 1 7 2 9	2 0 0 0 0 0 0	0 0 0 0 0 0 0	171 134 329 180 188 174 407 6
Sept. 28-Oct 7	1327 84%	192 12%	68 4%	2	0	1589
Sept. 28-Oct. 7 9-28-28	76 70 16 171 32 9	4 1 2 8 1 0	0 0 0 4 2 0	0 1 1 3 0	0 0 0 0 0	80 72 19 186 35 9
	374 93%	16 4%	6 2%	5 1%	0	401
Oct. 8-17 10-8-26	26 35 137	3 13 8	2 1 3	1 0 1	0 0 0	32 49 149
Oct. 18-27	198 86%	24 10%	6 3%	2 1%	0	230
10-18-28 10-20-27 10-21-27 10-22-27 10-24-27 10-25-27 10-26-27 10-27-27	57 197 176 38 74 127 124 53	14 27 28 0 13 26 35	13 19 6 0 5 25 43 22	13 9 2 0 3 13 34 13	0 0 0 0 0 0	97 252 212 38 95 191 236 103
Oct. 28-Nov. 6	846 69%	158 13%	133 11%	87 7%	- 0	1224
10-28-27 10-29-27 10-31-27 11-1-27	71 12 23 22	12 26 16 15	16 30 4 9	11 17 3 2	0 2 0 0	110 87 46 48
Nov. 7-16 11-7-27	128 44%	69 24%	59 20%	33 11%	2 1%	291
11-7-27	12 4 26	37 18 120	12 36 86	4 13 47	0 0 50	65 71 329
Nov. 17-26	42 9%	175 38%	134 29%	64 14%	50 11%	456
Nov. 27-Dec. 6 11-30-27	6 2%	82 27%	104 34%	79 26%	37 12%	307
12-14-27	0	19 25%	12 16%	21 28%	24 32%	76

TABLE 8-SURVIVAL OF LARVAE OVER WINTER

I ADLL O DO	KITTIE OF LIMITIES OF	
Depth (in.)	Recovered alive	Per cent living
3	20	83
6	18	75
9	21	88
12	19	79
15	17	71

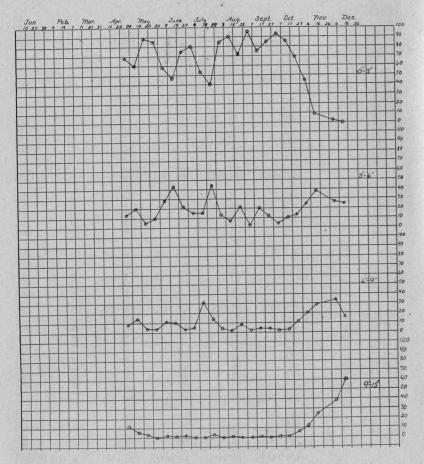


Fig. 55. Percentages of larvae (including prepupae) found at different depths in the soil in 1926, 1927 and 1928.

different depths cannot be considered significant with one experiment on a few animals, but it is quite apparent that the larvae can survive the winter in this locality with no great difficulty. If any larvae should attempt to hibernate within less than three inches of

the surface, the mortality might be greater. A certain mortality is to be expected as a result of handling. The winter mortality under normal field conditions is negligible so far as our digging records indicate.

TABLE 9-SURVIVAL OF LARVAE OVER WINTER

	Instar	Oct. 5	Oct. 31	Nov. 7	Nov. 15.	Nov. 30	Dec. 14	Apr. 25	May 17	May 24
0-3"	1st		0	1	0	0	0	0	0	0
	2d		0	0	1	1	0	10	0	2
	3d		23	11	1	0	0	227	28	39
3-6"	1st		0	1	0	1	0	0	0	0
	2d		6	3	5	5	5	26	0	0
	3d		10	33	47	12	14	14	2	0 5
6-9"	1st		0	0	0	0	0	0	0	0
	2d		$\frac{1}{3}$	0	$\frac{2}{7}$	2	2	0	0	1
	3d	7	3	12	7	14	10	1	2	1
9-12"	1st		0	0	0	0	0	0	0	0
	2d		0	1	2	3	6	0	0	0
	3d		3	3	15	13	15	0	1	Ö
12-15"	1st		0	0	0	0	0	0	0	0
	2d		0	0	1	0	5	0	0	0
	3d	E	0	0	1	4	19	0	0	Ŏ.
Total N						Estate Vivi				
of La	rvae	63	46	65	82	55	76	278	33	48
Digging	gs	1	1	1	1	1	1	4	1	1
Per Dig	gging	63	46	65	82	55	76	69.5	33	48

In Table 9 are given the results of the examination of a small infested area during the fall of 1927 and spring of 1928. The diggings were made very close together, a few inches separating them, and hence any lateral migration in the spring would disperse larvae into previously examined areas from which the larvae had been removed. This would thin the remaining infestation, which probably accounts for the drop in May. According to information received from the Japanese Beetle Laboratory of the Federal Bureau of Entomology there is a high mortality of the larvae of Popillia japonica in May, assigned by investigators to pathogenic bacteria, fungi, and other natural causes. This may also explain the decrease in the number of larvae of Anomala orientalis at this time. April 25 there were as many larvae per unit area as were present the previous November and December. There was no great apparent winter mortality under the conditions described.

With the advent of warm weather in the spring, the larvae come up close to the surface to feed, usually the latter part of April. Here they remain until the first part of June, when they go down a few inches to pupate. In the spring the grass is more vigorous than in the autumn, and the larvae feed less extensively, so the injury to the grass is less evident. A few larvae do no feeding

whatsoever in the spring, and many can go through pupation without living grass roots for food, the dead organic matter in the soil being sufficient. Many of the second and first instar larvae coming from hibernation apparently do not pupate but go through the season as larvae and hibernate in the third instar the following winter. This seems to be the case with the majority of these immature larvae, and many have been carried through two seasons in the insectory. These represent but a small per cent of the total however, and most of the individuals complete development the first spring and summer after hibernation (Fig. 54).

The duration of the second and third instars depends much on environmental conditions. When larvae hatch late in the season the cool weather may delay development. Under similar conditions the first two instars take about the same length of time—one month. Under laboratory conditions and at an incubator temperature of 23° to 25° C. the larvae pass through two instars of growth in less than two months if kept in grass sod, and the entire larval period from hatching to pupation takes about 208.5 days (average of nine larvae which varied from 184 to 254 days).

Development depends on the nature of the food supply and on moisture as well as on temperature. Development takes place in soil containing decaying organic matter alone, and in the laboratory many larvae have been carried through to the prepupal stage on sod compost, although the duration of larval life was longer than that of larvae kept in living sod (at the time of writing these larvae are still in the prepupal stage, 222 days after hatching, the temperature being 23-25° C.* Lack of moisture is very quickly fatal and larvae cannot survive under air-dry conditions. When the soil is moist the first instar will live sometimes two weeks after hatching without any organic matter. In the laboratory newly hatched individuals in a few cases survived 11, 13 and 15 days in moist sand or mixed sand and brickyard clay. Under natural conditions the larvae could avoid excessive dryness by digging more deeply into the soil, but as long as the grass is alive they remain near the surface. In 1928, between May 1 and May 17 at New Haven, the precipitation was only .18 inches, and between May 12 and May 17 there was no rain whatsoever, yet on this latter date larvae were found feeding in the upper three inches of soil. Excessive moisture in the soil has little or no effect except possibly in flooded areas. We have no data on the latter condition, as none of the heavily infested area in New Haven is flooded at any season. Under artificially created conditions when the soil in which larvae were hibernating became so mucky that the cavities in the soil containing larvae were filled and the larvae tightly packed, death resulted in most cases. This condition could hardly

be maintained in a natural environment, for the larvae were in metal containers where it was impossible for them to dig deeply into the soil, and water stood in the containers several weeks. It appears that as long as the larva can maintain freedom of movement in the soil it can survive.

The optimum conditions for larval development appear to be those that are attained in an open lawn exposed to the sun with a good cover of grass and with a fairly rich sandy loam. Any of the lawn grasses and clovers found in the infested area are eaten by the larvae. It is quite apparent that adverse conditions may be largely overcome. Prolonged rain, droughts, and cold weather have little apparent effect on the survival in this region. If no organic matter is present, it may be reached by lateral migration through the soil, for the newly-hatched larvae can survive days without it. Living roots are not absolutely necessary to development. The adults do not fly far in this climate and usually oviposit

in an area favorable to development.

About the first of June the larvae dig into the ground to a depth of three to nine inches and undergo a prepupal quiescent stage. The intestine is emptied of its contents and the larva is yellowish-white in color. The abdomen is bent ventrally on itself in a very characteristic position (see Plate XIX), and the legs are folded up at the coxa-trochanter joint. Power of locomotion is lost, and the only movement is flexing and reflexing of the abdomen. By this movement a hollow space is formed in the soil, and in this space pupation occurs. The prepupal period varies somewhat and has been calculated as the period between loss of the power of locomotion and ecdysis. In 1926 this period was $6.9 \pm .12$ days in length (63 prepupae) and in 1927 the same period was $5.5 \pm .24$ days in length (20 prepupae). These observations in 1926 were made between June 19 and July 21, and in 1927 between July 9 and July 25. In the laboratory at 24° C. seven individuals had a prepupal stage varying from thirteen to six days and averaging 8.3 days. The depth to which the larvae will dig depends much on the nature of the soil. In the field most of the prepupae are found between three and nine inches below the surface, but they occur at a depth of 12 inches, and in tiles used for rearing, where the soil was relatively loose and easily penetrated, they went down 15 inches. When ready to pupate the larva splits the integument along the entire epicranial suture, the mid-dorsal line of the thorax, and the mid-dorsal line of abdominal segments 1-3.

Pupation occurs the last of June and the first of July in the majority of cases. In 1926 the first pupae were found in the field June 17, in 1927, June 15, and in 1928, June 13, and the last pupae were found in 1927 on August 19 and in 1928 on August 16. The pupal stage lasts about two weeks.

^{*}Two adults have since been secured , one 274 and one 254 days after hatching. $\,$

648

40 individuals having an average of $14.8 \pm .75$ days in 1926 (observations made between June 28 and July 25) and in 1927 14 individuals averaged $13.7 \pm .12$ days (observations made between July 14 and August 8). These are insectary records. In the laboratory at 24° C. seven individuals varied from 11 to 13 days and averaged 11.7 days. During the last two weeks in June the temperature of the soil in Westville, New Haven, fluctuated between 56° F. and 82° F. at six inches depth in 1926 and 1927. The pupa remains within the cast larval skin. Plate XIX shows the characteristic position.

As given here, the total life cycle occupies one year, and for most individuals this is true. Figure 54 gives the percentages of different stages (except the imago) found during the year in New Haven. This figure is drawn from Table 6, which gives the results of a large number of diggings made during 1926, 1927, and 1928. Figure 55 shows the depth at which the larvae are found during the year according to Table 7. If the average adult life prior to oviposition be considered four days (this represents the average time from emergence from the pupal stage to the middle of the period of oviposition), then the following table shows the duration of different stages for 1926 and 1927. These figures are for individuals reared in the insectary under conditions as close as possible to normal.

TABLE 10-LENGTH OF DIFFERENT STAGES AT NEW HAVEN.

	1926		1927	
Adult (to oviposition)	4	davs	4	days
Egg	27.8	"	24.7	"
Larva (by difference)	311.5	"	317.1	"
Prepupa	6.9	"	5.5	. "
Pupa	14.8	"	13.7	"

A small percentage of larvae hibernate in the first and second instars, and some of these apparently have a two-year life cycle. In the insectary we carried these through two years, and our observations indicate that this is the case in the field. This extension of the life cycle may be due to a relatively poor food supply, to low temperatures at a critical stage of development, to internal factors, or to a combination of these. A small percentage of larvae do very little, if any, spring feeding, and these are probably the two-year individuals. An examination of Figure 54 shows the peak of prepupal abundance between June 9 and June 19, of pupal between June 19 and 29, of eggs between July 9 and 19, of first instar larvae between July 19 and August 8, of larvae of the second instar between August 18 and September 7. It also shows that one to two per cent of the hibernating larvae are in the first instar

and about twenty per cent in the second instar. Figure 55 gives the depth at which larvae are found during the year. The drop in per cent found in the upper three inches of soil in June is due to the prepupal stage and in July to the hatching of larvae from eggs and their being discovered before they came to the upper layer of soil. A comparison with Figure 54 makes this clear, as well as other facts in the life cycle. Figure 55 also shows the ascent and descent in the soil in the spring and fall. In making these charts the data for all three years have been combined, but the variations due to seasonal differences in these years have been largely eliminated by using the totals of ten-day periods in computing the percentages. All the necessary information may be found in the tables.

CONTROL

NATURAL FACTORS

There is at present in New Haven to the best of our knowledge, no one natural factor or group of such factors which will keep the numbers of this insect down to a harmless level. The effect of climate on the increase and spread of this insect is a matter on which little information is available. The low winter temperatures have no great effect. Hibernation occurs in the larval stages and the larvae go down into the soil to a depth of 10 to 15 inches. As has been previously noted (page 640) they can survive the winter even if as near the surface as three inches. The effect of natural environmental factors has been further discussed on pages 640 to 647 of this bulletin.

Starlings are very frequently seen feeding on larvae in heavily infested areas, but even where this feeding has been extensive, there are enough live larvae left in the soil to injure the grass.

The Federal Bureau of Entomology is at present introducing parasites of the Japanese and Asiatic beetles, and a lot of 290 Tiphia popilliavora, a wasp native to Japan, was released in Westville, September 6, 1928, by Mr. J. L. King of the Bureau. This wasp is known to parasitize the larvae of A. orientalis, but it is too early to state whether or not the parasite will establish itself here. In the Hawaiian Islands the beetle has been eliminated as an economic pest by the introduction of another wasp, Scolia manilae, but attempts to establish this in the United States have failed. It apparently cannot withstand the climate, for its native home is the Philippine Islands, and it is not active at normal summer temperatures in Connecticut according to information received from Mr. Loren B. Smith, of the Japanese Beetle Laboratory at Moorestown, New Jersey.

A small percentage of larvae are destroyed in Hawaii by bacterial and fungous (Metarrhizium) diseases, but not enough to be

of any economic importance. We have never observed any marked mortality due to these causes in Connecticut.

INSECTICIDES

The entomologists of the Hawaiian Sugar Planters' Experiment Station tried to protect sugar-cane from the attacks of the larvae of this insect by means of various insecticides. The injection of cyanide of potassium solution, seven ounces in one quart of water, by the Mamelle process was not successful (Muir, 1912 and Swezey, 1913); 20 cc. per stool of cane gave only 4.25 per cent kill of grubs. Gasoline injected at the rate of 20 cc. on four sides of a hill killed only 20 per cent of the larvae. Carbon disulfide injected at the rate of 10 cc. every ten inches in the row gave 95 per cent kill but was considered too expensive and possibly dangerous to the plants. After the success which accompanied the establishment of *Scolia manilae*, further control experiments were abandoned.

In Connecticut Zappe and Garman (1924) tried calcium cyanide, sodium cyanide, kerosene emulsion, bichloride of mercury, and carbon disulfide emulsion against the larvae. The cyanides killed the grubs but proved toxic to grass at a strength necessary to insure a heavy mortality of larvae, and kerosene emulsion and bichloride of mercury were considered of no value. Carbon disulfide emulsion proved successful. In 1926, Britton and Zappe reported further unsuccessful trials with calcium cyanide. There is no question of the ability of this poison to kill the larvae, but it cannot be safely applied to lawns. In 1926, Johnson, using methods of treatment with carbon disulfide emulsion developed at the Japanese beetle laboratory at Riverton, N. J., treated 43.5 acres of lawns in New Haven with an emulsion containing 70 per cent of CS₂ diluted 200 times with water. He secured a high mortality of larvae, up to 98 per cent in some cases, and did not injure the turf (Johnson 1927). It was found, however, that the use of carbon disulfide emulsion effected but a temporary relief, and that the following season the lawns became reinfested.* This treatment would have to be applied every year to be effective, and some skill is required to avoid injuring the grass. Leach and his collaborators at Riverton developed a means of treating turf with lead arsenate and thereby insuring it against damage by Japanese bettle larvae for some period of time. This method is well described by Leach and Lipp (1927) and by Leach (1928). Arsenate of lead is added to the top layer of soil and the larvae in this layer, eating

the arsenate, are thereby poisoned. A few lawns in New Haven were so treated, the acid lead arsenate being applied at the rate of three pounds to 100 square feet of surface and then worked into the upper two inches of soil with a hand rake. The ground was then seeded with one of the bent grasses, and a good turf resulted. The soil so treated has maintained a good turf for two years without further poisoning, and in New Jersey some of the plots treated by Leach in this manner have remained free of injury eight years.

According to the latest recommendations for grub-proofing golf greens with lead arsenate, the use of so much poison is not necessary against the Japanese beetle, and since the Asiatic beetle is closely related and of similar habits, less poison may possibly be effective against it in lawns. For newly constructed greens Leach

TABLE 11—EFFECT OF LEAD ARSENATE ON LARVAE

Lead Arsenate	No. of Larvae	FIRST INST Absolute Survival 10-11 days	Relative* Survival 10-11 days	No. of Larvae	Second Inst Absolute Survival 12-16 days	Relative Survival 12-16 days
1 g. per liter	60	14 = 23%	48%	40	20 = 50%	77%
1.5 g. " "	60	8=13%	27%	40	14 = 35%	54%
1.75 g. " "	60	15 = 25%	52%	40	12 = 30%	46%
2.00 g. " "	60	8=13%	27%	40	8 = 20 %	31%
2.25 g. " "	60	7=12%	24%	40	14 = 35%	54%
2.50 g. " "	60	1 = 2%	3%	40	6=15%	23%
3.00 g. " "	60	3 = 5%	10%	40	7 = 18 %	27%
None	60	29 = 48%	100%	40	26=65%	100%

(1928) recommends five pounds of lead arsenate to 1000 square feet of surface worked into the soil to a depth of ½ inch. It is necessary to add lead arsenate to future top dressings of soil. However, pot experiments with a limited number of larvae with poisoned soil indicate that 2.5 grams of lead arsenate per liter of soil is the minimum effective amount for the Asiatic beetle, and this is equivalent to 2.6 pounds per 100 square feet mixed into the top 2 inches. These experiments also show that the larvae of the first instar are more susceptible to this poison than are older larvae. The results of these pot experiments are given in Table 11. Flower pots having a diameter of six inches across the top were used, and ten larvae were placed in each pot. One control was kept for each lot, the soil not being poisoned. The mortality in this control was possibly due to handling and change of environ-

^{*}The lawns were treated in the spring and fall of 1926 and in the spring of 1927, and at the present time, fall of 1928, the population of larvae in the treated area, as indicated by the appearance of the lawns, is approximately the same as before treatment, although the infestation is more widely spread.

^{*}The relative survival has been computed by dividing the number of survivals in each test by the number of survivals in the controls.

ment, the larvae being taken from tiles containing growing sod; whereas, the pots contained no living grass. Each experiment was kept the same length of time, and the six lots with first instar larvae and four with second instar larvae were grouped in the compilation of results. There is little difference between the 2.50 grams per liter of soil and 3.00 grams per liter, but a noticeable difference between 2.50 grams and 2.25 grams. Another point worthy of notice is that whereas the larvae of the second instar were kept in the poisoned soil 12-16 days (the same soil was used for first and second instar larvae), they underwent a relative mortality of 77% and an absolute mortality of 85% in the 2.50 gram pots while the larvae of the first instar in the same poisoned soil suffered a relative mortality of 97% and an absolute mortality of 98%. The same general relations between the instars hold throughout the series. The relative mortality is figured on the basis of the survival in the control pots being 100%. The experiments were carried on in August and September, 1927.

CONNECTICUT EXPERIMENT STATION

This method of adding lead arsenate to the top layer of soil involves the rebuilding of the lawn at the expense of much labor, and a means of safe-guarding lawns in good condition was desired. Since the author above quoted has demonstrated the practicability of top-dressing turf with poisoned soil to protect it against Japanese beetle larvae, it was decided to try this method on the lawns in New Haven for protection against the Asiatic beetle. Two infested lawns were selected and a strip ten feet wide and thirty feet long was laid off on each. Each strip was then divided into three squares of 100 square feet each, the two end squares being treated and the center square serving as a check. In order not to mar the appearance of the lawn, it was decided to apply five top dressings of poisoned soil, each top dressing being one-fifth of one inch in depth, over a period of one year. This would give one inch of poisoned top soil applied to the lawn in the course of the experiment and, since the larvae feed close to the surface, should indicate the degree of protection afforded by the lead arsenate. Top dressings were applied November 10, 1927, and April 18. June 11, and August 15 in 1928. The last treatment was doubled, so that the top dressing was actually applied four times. Each application consisted of the lead arsenate mixed with 2880 cubic inches of soil except the last which consisted of the poison in 5760 cubic inches; 2880 cubic inches covers 100 square feet onefifth of one inch deep. In no case was the appearance of the lawn marred. Plots were numbered 1, 2, and 3 in the first strip and 4, 5, and 6 in the second. Plot 1 received three ounces of lead arsenate per application, plot 3 received six ounces, and plots 4 and 6 received nine and 12 ounces respectively. At the close of the experiment the 100-foot plots had been given a top dressing of one inch of soil which contained 15, 30, 45, and 60 ounces of lead

arsenate in the respective cases. The two check plots, numbers 2 and 5, received no treatment whatsoever. In all the treated plots the turf remained firm and in plots 3, 4, and 6, comparatively free of larvae. In both check plots the turf was soft, spongy, and well infested. The grass in plots 1 and 3 remained in good condition, whereas, much of that in 2 was killed. In plots 4, 5, and 6, the turf was mainly crab grass Digitaria (Panicum) sanguinalis, an annual, so that the appearance of the entire lawn was not good after the first of October. Fertilizer was applied to plots 1, 2 and 3 twice during the summer of 1928, the first time Nitrophoska and the second time ammonium sulfate. Plots 4, 5, and 6 were not fertilized.

October 8 and 9, 1928, diggings were made one foot square and one foot deep in the center of each plot and the number of larvae found were counted. The results are given in the table below. The figures in the last column were obtained by making one digging and, due to the spotted nature of infestations in gen-

TABLE 12—Effect of Lead Arsenate Applied in Top-dressing

Plot	Larvae found per sq. ft. Oct. 8, 9, 1928 ot Total lead arsenate 1st 2d 3d in 4 applications Instar Instar Instar				Total Larvae per sq. ft. prior to treatment of lawn		
1	15 ounces	0	6	7	13		
2	none	0	3	46	49	Oct. 11, 1927	
3	30 ounces	0	2	1	3	24	
4	45 ounces	0	0	2	2)		
5	none	0	6	32	38	Oct. 14, 1927	
6	60 ounces	0	0	1	1)	36	

eral, may not be exact for the entire area used in the experiments. This also holds true for Table 13.

Observations in the infested area indicate that good turf will withstand an infestation of about 150 larvae per square yard during one season if weather and soil conditions are favorable. From the above results it would appear that two pounds of lead arsenate to 100 square feet is an effective amount, but that one pound may be too little.

An easier method of protecting lawns against injury was tried, the lead arsenate being applied in water, ten to twelve gallons to one hundred square feet, and then washed in with an equal amount of water alone. The required amount of poison was mixed with water in an iron barrel and the resulting suspension applied slowly to the turf with a garden watering can. Before the suspension dried on the soil and grass, an additional ten to twelve gallons of water was applied in the same manner. This washed the poison off the grass and carried it into the ground. It was necessary to work slowly in order to prevent run-off. Four 100-foot plots were laid out, the first three in a row and each 10 ft. x 10 ft., the fourth

on another lawn and 20 ft. x 5 ft. These were numbered 7, 8, 9, and 10 respectively. Plot 11 was the area in the lawn immediately surrounding plot 10. On plot 7 two pounds of lead arsenate were applied, on plot 9, three pounds, and on plot 10 three pounds of colloidal lead arsenate. Plots 8 and 11 were not treated but were used for check plots. The owner of the lawn in which plots 10 and 11 were located applied an inch of soil and fertilizer on plot 11, April 26, 1928, and seeded it. The arsenate was applied to plots 7 and 9 November 10, 1927, and to plot 10 April 18, 1928. The experiment was allowed to run until October 8-9, 1928, when the plots were examined for larvae in the same manner as were plots 1 to 6 above mentioned. Two ounces of casein-lime were added to the arsenate applied to plots 7 and 9, but this may not be necessary in view of laboratory experiments, and it may conceivably be detrimental. Plots 7, 8 and 9 were in the same lawn as plots 4 to 6 above and the turf was mainly crab grass, so that after October first none of these plots looked well as far as the appearance of the grass was concerned, although they could be easily distinguished from the check plots. The sod in the treated plots was firm, however, and comparatively free from larvae, whereas the sod in plot 8, the check plot, was soft, spongy, and well infested. Plot 10 maintained a fair turf as far as the appearance of the grass was concerned and plot 11 resembled plot 8, being soft and having very little live grass. Diggings made as previously October 8 and 9, 1928, gave the following results:

CONNECTICUT EXPERIMENT STATION

TABLE 13-EFFECT OF LEAD ARSENATE APPLIED IN WATER.

Plot	Larva Lead arsenate applied*	ae found per sq. ft. Oct. 8, 9, 1928 1st 2d 3d Instar Instar Instar			Larvae per sq. ft. Total prior to treatment of lawn		
7 8 9	2 lbs none 3 lbs	0 1 0	1 8 0	9 64 1	$\begin{bmatrix} 10 \\ 73 \\ 1 \end{bmatrix}$ Oct	. 14, 1927 36	
10	3 lbs(colloidal)	0	1	0	1	7	
11	none	0	2	36	38)		

From the above results it seems that two pounds is only fairly effective when applied in this manner, but three pounds is very satisfactory. In none of these plots was the grass visibly injured by the treatment. It should be borne in mind that all the experimental plots, due to previous infestations of larvae, contained much crab grass, and a fair turf was the best result obtainable as regards the *immediate condition* of the lawn. Where the lawn is already in good condition, it will stay so after treatment.

The method of applying lead arsenate in water was checked by a laboratory experiment in which a shallow box was divided into

four compartments each one foot square and five inches deep. Each compartment was filled with soil to a depth of three inches and seeded with red top grass. When the grass was about one inch in height, the required amount of lead arsenate was mixed with 500 cc. of water and applied to the one square foot of surface. No additional water was used to wash in the arsenate because of the danger of flooding and getting an uneven distribution of poison. In each plot 100 first instar larvae collected in the field were placed between one and two weeks prior to the application of the poison. The larva were placed in the plots August 1-2, 1928, the lead arsenate was applied August 8-13, and the soil was sifted and examined for larvae September 18-19, 1928. This experiment was carried on in the laboratory. Three plots were treated with arsenate, 7 grams, 14 grams, and 21 grams respectively, and one plot was treated with tap water only, serving as a check. The results are given in the table below:

TABLE 14—Effect of Lead Arsenate Applied in Water.

Lead		Larvae recovered				ept. 18-19 Survival			
Arsenate	Applied	Larvae in	1st	2d	3d	total	Absolute	Relative	
None:	Aug. 13 (water)	100 Aug. 1	3	23	55	81	81%	100%	
7 grams	Aug. 8	100 Aug. 1	1	6	9	16	16%	20%	
14 grams	Aug. 13	100 Aug. 1	3	0	1	4	4%	5%	
21 grams	Aug. 13	100 Aug. 2	0	1	3	4	4%	5%	

Fourteen grams per square foot is equivalent to 49.4 ounces per 100 square feet, and this appears to be the minimum effective dose. All of the grass in these four plots was affected by damping off, so that the effect of the arsenate on the turf itself could not be determined. In preparing South German creeping bent sod for use on terraces no injury to the grass was visible after treating in the above manner, and at present this appears a safe method. Other lawns in New Haven have also been so treated without visible injury.

It is not known how long the lead arsenate will remain in the soil in effective amounts nor whether or not there will be an accumulation of lead due to these treatments. The field plots 7, 8, 9, 10, and 11 were sampled April 17, 1928, and the soil analyzed for arsenic content, the first three inches of soil being used. The same plots were again sampled in a similar manner October 4, 1928, and again analyzed for arsenic. The determination of the per cent of arsenic should give an indication of the distribution of the poison throughout the top three inches of the soil and of the rate at which the lead arsenate is breaking down and being removed by water from the surface layer. This determination might not be a reliable index of the toxicity of the poisoned soil to the larvae, since this depends somewhat on a number of factors

^{*}See page 656 regarding this column.

657

concerning which there is little available information, nor would it indicate the arsenical compound present in the soil. The results are given below:

TABLE 15—ARSENIC IN SOIL AFTER TREATMENT.

Plot 7	Lead Arsenate 21bs. + 2 oz. casein lime in water	Applied 11-10-27	1" 2" 3"	A ₅₂ O ₅ * A _{pr.} 27, 1928 0.081% 0.008 0.005	As ₂ O ₅ * Oct. 4, 1928 0.087% 0.009 0.010	Ph Oct. 4, 1928 6. 21 6. 02 6. 45
8	none—water only, check on 7 and 9	11-10-27	1" 2" 3"	0.005 0.001 0.000	0.000 0.005 0.000	6.80 6.49 6.09
9	31bs. + 2 oz. casein lime in water		1" .2" 3"	0.070 0.017 0.003	0.070 0.006 0.005	6.31 6.29 6.08
10	3 lbs. colloidal in water**	4-18-28	1" 2" 3"	$0.128 \\ 0.001 \\ 0.012$	$0.035 \\ 0.017 \\ 0.001$	5.40 5.61 6.00
11	none—check on 10		1" 2" 3"	$0.005 \\ 0.001 \\ 0.012$	0.003 0.006 0.000	5.59 5.55 5.65

The analyses were made on an air-dry basis by the Gutzeit method, and the soil samples were all taken from plots which were treated with a suspension of lead arsenate in water. Three samples were taken from each plot and mixed together to get the plot sample. In getting the soil sample, a cylinder of soil was removed and the upper three inches cut into three one-inch slices. The analyses were made for each of the first three inches of soil. The colloidal lead arsenate was procured from a New York agent of the manufacturer and is much more finely ground, although less bulky, than the commercial acid lead arsenate used in the first two plots (7 and 9). The collodial form also stays in suspension in water longer than the other. The reason for the great decrease in arsenic in the soil poisoned by the colloid form of lead arsenate may be due to the nature of the soil or of the arsenate. Plots 10 and 11 were in one lawn and plots 7, 8, and 9 in another, and in the former case the acidity was much greater than in the latter. The analyses also show less arsenic in the plot treated with three pounds (9) than in the plot treated with two (7), a matter for which the explanation cannot be satisfactorily given at present. The important facts of the analyses are, however, that there was no appreciable decrease in the arsenic content of the soil in plots 7 and 9 during one season, and that in the acid soils of the kind

used in the experiment the addition of lead arsenate caused very little permanent increase in acidity.

The results of these experiments indicate that if the lawn is to be treated by lead arsenate suspended in water and applied as indicated, or by mixing the lead arsenate in the top two inches of soil, then three pounds per 100 square feet of lawn is the most efficient amount of poison to be used. For top dressing the lawn with poisoned soil, two-thirds of this amount, or two pounds per 100 square feet in one inch of top dressing, is best. The successful use of less poison in top dressing is probably due to the greater concentration of poison in the top inch of soil where it is most effective. When applied in water, much of the poison probably remains on the surface of the soil and is not there available. No experiments have been carried on wherein the lead arsenate was mixed with the upper inch or half-inch of soil, but in view of the results attained by top dressing, it would seem advisable to reduce the poison to two pounds per 100 square feet and work it into the top inch when the lawn is being rebuilt. An analysis of the soil of a lawn treated by mixing the arsenate in the upper two inches, three pounds to 100 square feet, showed 0.070% As₂ O₅ in the upper inch, 0.046% in the second inch, and 0.017% in the third inch five months after treatment. Granting an equal relative decrease in arsenic in each of the upper two inches of soil, it appears that under field conditions the upper inch receives about three-fifths of the arsenic by this method of treatment. The mechanical difficulties of mixing arsenate in the soil by this method preclude an even distribution in both the upper inches. This lends support to the conclusion that two pounds of lead arsenate mixed in the upper inch are enough. The larvae feed close to the surface of the soil and no poison is necessary below a depth of one

Although it may be possible to still further modify this method according to the recommendations of Leach (1928) given above, since the experiments in New Haven cover one season only, whereas the work of the above author covers a number of years, such modification is not recommended for the Asiatic bettle at present.

Among other chemicals tried against the larvae were potassium xanthate, Semesan*, Uspulun*, Uspulun Nu-Green*, and potassium sulfocarbonate. None of these materials proved effective in the brief experiments carried out, but potassium sulfocarbonate merits further trials.

^{*}Analysis by Mr. H. J. Fisher of the Chemistry Department. **This colloidal lead arsenate contains 27.06% As₂O₅, 2.16% water soluble As₂O₅, 59.96% PbO.

^{*}Semesan and Uspulun contain 30% hydroxymercurichlorophenol sulfate, and Uspulun Nu-Green contains 15% of the same compound. The remainder of each of these three materials is inert matter.

RECOMMENDATIONS FOR CONTROL IN LAWNS

If the lawn is in good condition and it is desired to protect it against future attacks by the larvae, arsenate of lead suspended in water, three pounds to about 12 gallons for each 100 square feet, should be applied before August 1. The lawn should be sprinkled with the suspension slowly and evenly so that it soaks in without puddling or running off. Before the suspension dries on the grass and soil, an additional 12 gallons of water should be applied in the same manner to the same area. If the ground slopes or is uneven so that the suspension runs off or collects in pools, the lead arsenate should be mixed with a small amount of very slightly moist (not wet) earth and spread evenly over the surface. If it is desired to top-dress the lawn, apply the top dressing at the rate of six ounces of lead arsenate to each 2,880 cubic inches (=12.5 gallons or 1.34 bushels) of top-dressing on each 100

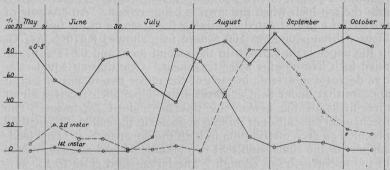


Fig. 56. Larvae in upper three inches of soil and in first and second instars.

square feet. Five applications should be made, and it is advisable to have an inch of top dressing on by August 1. The interval between applications depends on the rapidity with which the grass grows.

In Figure 56 are given the curves showing per cent of larvae above a depth of three inches in the soil throughout the growing season and the percentages of larvae in the first and second instars. These curves are superimposed in order to show the necessity for treating the lawns by August 1. On August 15, or thereabouts, 90 per cent of the larvae are in the upper three inches of soil; between 40 and 44 per cent are in each of the first two instars. This means that practically all the eggs are hatched and the larvae are feeding near the surface of the soil at this time. The younger larvae are much more easily killed than the older larvae, and the treatment should be applied with this fact in mind. Also it is quite evident from field observations that the grass is not severely injured before August 1.

If the grass has been killed by the larvae, it is advisable to spade up the lawn in order to get rid of the weeds and insure a good turf. After spading, smooth the lawn with a rake and apply two pounds of lead arsenate to each 100 square feet. In order to get an even distribution of poison the arsenate should be applied by sifting through a 14-mesh screen, but if a wind is blowing, better results are obtained by thoroughly mixing it with a small amount of slightly moist earth (not wet) and spreading the resulting mixture. After spreading evenly, work the material into the ground to a depth of one inch with an iron rake, smooth over and seed. Where the infestation of larvae is not too heavy, good control might be effected by raking over the infested area in the spring, seeding it, and then, after the grass is growing well, applying lead arsenate in water in the manner described above. There is, however, the likelihood that the larvae will kill off this grass before it gets a good start and that weeds will crowd out the lawn grasses. One treatment with arsenate of lead should last several years, although the experiments with the Asiatic beetle have covered one season only. The soil analyses given on page 656 indicate that the arsenate is removed from the soil very slowly. Any top-dressings applied to the lawn should contain lead arsenate in the proportions given.

Carbon disulfide emulsion, containing 70 per cent carbon disulfide, diluted 200 times with water and applied at the rate of three pints of diluted material per square foot of lawn surface will kill the larvae if they are within two or three inches of the surface when the lawn is treated. This treatment should be applied the latter part of August and the soil should not be extremely dry nor vet full of water. The use of this material has several drawbacks. It is but a temporary treatment at best and its effect is over in a short time. If care is not used it will severely injure the grass, and it cannot be stored near fires or hot pipes, being highly explosive. A miscible carbon disulfide is now on the market and is a very superior product as regards keeping qualities, not being injured by cold weather and long storage. It contains 70 per cent carbon disulfide and is used as above indicated. The use of carbon disulfide is fully described by Leach, Lipp, and Fleming (1927).

If the lawn slopes so steeply that it is not feasible to seed it, poisoned turf should be used to replace that injured. The turf may be poisoned a few weeks prior to the time when it will be used by a suspension of lead arsenate in water applied as described above. Cut the poisoned turf into sections and lay it in the lawn in the usual manner.

FERTILIZATION AND SEEDING

Fertilizer should be applied after the lawn is treated with arsenate, and after the grass is growing well if the lawn has been reseeded, as there is danger of injuring the grass if the fertilizer and arsenate are applied at the same time. A week later should be sufficient. Any of the usual lawn fertilizers should give good results, but those high in phosphoric acid should be avoided. In our experiments we have used both ammonium sulfate and a complete fertilizer.

The grass mixtures commonly sold in New Haven for seeding lawns give a good turf on arsenated soils if the soil is fertile. It is best to seed rather heavily. The germination of the seed may be retarded by the arsenate but no permanently injurious effect will result.

TREATMENT OF NURSERY PLANTS

For the treatment of nursery stock, potted plants, and plants with soil about the roots it is best to follow the procedure for the control of the Japanese beetle as given by Leach and his collaborators, Fleming, and Lipp, reterences to which may be found in the bibliography.

SUMMARY

The Asiatic beetle, first described in 1875 from Japan, was discovered in Connecticut in 1920 and has since been found in parts of New York and New Jersey. The natural spread of this insect is very slow.

A brief review of natural conditions in New Haven is given. The genus Anomala belongs to the Ruteline Scarabaeidae, and the structural characters distinguishing the larva from other related larvae are described. A brief morphological description is given of all stages of the insect.

In New Haven the great majority of individuals of this species go through a complete life cycle in one year, but a few require two years for the completion of development. The adults emerge from the pupal stage late in June and during July and August and oviposit in the soil at a depth of about six inches. The eggs hatch in three to four weeks and the young larvae move up close to the surface of the soil where they feed on grass roots and decayed organic matter. In September and October the lawns in heavily infested areas are severely injured and the grass in spots completely killed. Late in October and during November the larvae descend into the soil to a depth of about one foot to hibernate, most of them being at this time in the third larval instar. The last of April the larvae come up close to the surface and re-

sume feeding, and the first of June they go down again to a depth of about six inches to pupate. After a prepupal period of about six days they molt and the pupal stage begins. This lasts about two weeks.

661

There is at present no effective natural control of this insect in New Haven, and reliance must be placed on insecticides. Lead arsenate and carbon bisulfide have given good control in lawns where properly applied. The latter is used in the form of an emulsion containing 70% CS₂ diluted 200 times with water and applied at the rate of three pints of diluted material per square foot of surface. This insecticide is effective for a short time only, however, and lead arsenate gives a more permanent control. This may be applied to the surface of the lawn at the rate of two pounds per 100 square feet of surface and worked into the soil to a depth of one inch. It may be used in a top-dressing of loam at the same rate, or it may be applied as a suspension in water at the rate of three pounds per 100 square feet of surface.

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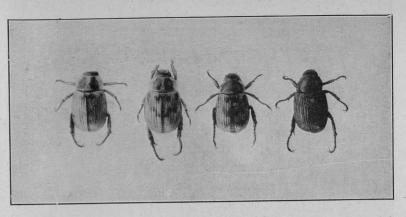
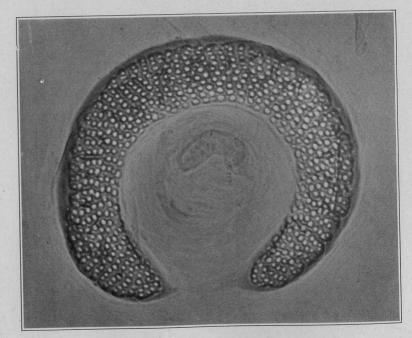
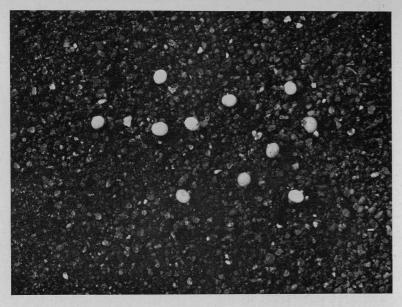


PLATE XVII

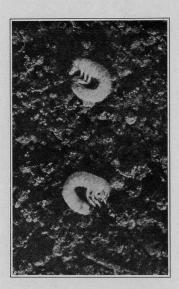
a. Adults of the Asiatic beetle (Anomala orientalis Waterh.). Enlarged



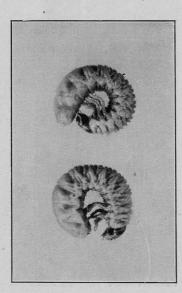
b. Spiracle of larva. Greatly enlarged.



a. Eggs. Enlarged four times.



b. First instar larvae. Enlarged four times.



c. Third instar larvae. Enlarged twice.



a. Prepupa. Enlarged four times.



b. Pupa in cell in earth. Natural size.



c. Pupa in cast larval skin. Enlarged 2.5 times



d. Pupa. Enlarged four times.



a. Lawn injured by larvae.



b. Holes in ground made by adults.

Connecticut Agricultural Experiment Station New Haven, Connecticut

TWENTY-EIGHTH REPORT

OF THE

STATE ENTOMOLOGIST

CONNECTICUT

1928

W. E. BRITTON, Ph.D. State Entomologist

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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CONTENTS

	PAGE
Letter of Submittal	669
Summary of Office and Inspection Work	669
Publications of the Entomological Department, 1928	670
Report of Receipts and Expenditures	671
Department Staff and Work	672
Entomological Features of 1928	674
Fruit Insects	674
Vegetable Insects	677
Shade and Forest Tree Insects	679
Insects Infesting Ornamental Shrubs and Vines	683
Insects Attacking Flowers and Greenhouse Plants	684
Insects Injuring Stored Vegetable Products	685
Miscellaneous Insects	686
Convention of Entomological Workers	686
Inspection of Nurseries in 1928	689
Nursery Firms Receiving Certificates in 1928	694
Inspection of Imported Nursery Stock	701
Inspection of Apiaries in 1928	703
Gipsy Moth Work in Connecticut in 1928	712
Notes on Fruit Insects in 1928	728
Plant Bug Injury to Fruits	729
The Oriental Peach Moth	731
Corn Borer Clean-Up Operations on the 1927 Infestations	
Infestations of 1928	734
Report of Scouting and Quarantine Enforcement for the Japanese	
Beetle and Asiatic Beetle	737
Japanese Beetle	737
Report of Asiatic Beetle Work, 1928	743
The Periodical Cicada or Seventeen-Year Locust in 1928	744
Notes on the Nest Building Habits of the Pipe Organ Wasp	751
Mosquito Control Work in Connecticut in 1928	753
Miscellaneous Insect Notes	762
Larch Sawfly	762
Spruce Epizeuxis Injures Blue Spruce	762
The Horse Radish Flea Beetle on Cabbage	762
Say's Blister Beetle Injuring Peach Trees	762
Weevil on Red Pine	762
Abundance of White Flies	763
Carrion Flies Killed by Fungus	763
Cankerworms in 1928	764
Thrips attacking Cauliflower	764
The Common Red Spider	764
A New Greenhouse Pest	765
Index	767

Soil Research.

Tobacco Sub-station at Windsor,

AUTHORSHIP

For bibliographical purposes all material in this Report (Bulletin 305) should be credited to W. E. Britton, unless otherwise indicated.

ILLUSTRATIONS

The illustrations in this Report (Bulletin 305) are from the following sources: Figs. 57 and 62, prepared from base maps by B. H. Walden; Fig. 63, from Report for 1911, by A. B. Champlain; all other figures by Philip Garman. The Plates are all from photographs. Plate XXII by W. E. Britton; Plate XXIII, a., by J. Kimport; Plate XXIV, b, and c, from Japanese Beetle Laboratory, U. S. Dept. of Agriculture; Plates XXXII—XXXV by R. C. Botsford; Plate XXXVI, a, by Philip Garman; all others by B. H. Walden.

BULLETIN 305

TWENTY-EIGHTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I have the honor to transmit herewith my twenty-eighth report as State Entomologist of Connecticut. Two important projects just completed are not included because the results of each investigation will be published as a separate bulletin. The official inspection and control operations prescribed by statute are given in some detail, and other research work conducted by members of the Department staff is included in this report.

Respectfully submitted,

W. E. Britton, State and Station Entomologist.

SUMMARY OF OFFICE AND INSPECTION WORK

308 samples of insects received for identification.

245 nurseries inspected.

- 243 regular certificates granted.
- 141 duplicate certificates to be filed in other states.

2 special raspberry certificates granted.

- 104 nursery dealer's permits issued.
- 261 shipper's permits issued to nurserymen in other states.

237 parcels of nursery stock inspected and certified.

151 bales of mountain laurel and other decorative material inspected and certified for shipment.

45,500 narcissus bulbs inspected and certified.

- 475 shipments of seed corn inspected and certified.
- 14,287 certificates on nursery and floral stock and 5,204 certificates on farm products issued for shipments from the Japanese beetle quarantined area.
- 4,863 certificates issued covering soil and plants from the Asiatic beetle quarantined area.

43 orchards and gardens examined.

- 26 shipments, containing 277 cases, 2,680,700 plants imported nursery stock inspected.
- 15 shipments, or 58 per cent found infested with insects.

852 apiaries, containing 8,023 colonies inspected.

9 apiaries and 26 colonies found infested with European foul brood. 36 apiaries and 79 colonies found infested with American foul brood.

3,395 letters* written on official work.

^{*} Including 600 written at the Japanese beetle Quarantine station.

717 circular letters sent out.

244 post cards sent out.

26 reports to Federal Horticultural Board.

1.710 bulletins, etc., mailed on request or to answer inquiries.

201 packages sent by mail or express. 54 lectures and addresses at meetings.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPART-MENT. 1928

By W. E. BRITTON:

Twenty-seventh Report of the State Entomologist of Connecticut (Bulletin 294), 116 pages, 11 figures, 36 plates, May 1928.

Regulations Concerning the Transportation of Nursery Stock in the United States and Canada, Bulletin of Immediate Information No. 61, 24 pages; 1300 copies, September 1928.

Report of Committee on Injurious Insects. Proceedings Connecticut Pomological Society, 37th Annual Meeting, page 16, July 1928.

Insects Attacking Vegetable Crops in 1927. Report of Committee on Insects, Connecticut Vegetable Growers Association, page 66. June 1928. The Elm Leaf Beetle, Tree Talk, Vol. 8, No. 4, page 32. March 1928. Some Insect Pests of Cultivated Plants, in Garden Guide, 5th Edition, page 293, July 1928.

Oil Sprays and Oil Injury, Journal of Economic Entomology, Vol. 21, page 418, April 1928. (Also 300 reprints with Middleton's paper.) The Fourth International Congress of Entomology, Journal of Economic

Entomology, Vol. 21, page 651, October 1928.

Book Review: Some Garden Pests, What they are and How to Control Them, by C. T. Gregory and J. J. Davis, Journal of Economic Entomology, Vol. 21, page 793, October 1928,

By W. E. BRITTON AND R. C. BOTSFORD:

Anti-Mosquito Activities in Connecticut in 1927. Proceedings Fifteenth Annual Meeting, New Jersey Mosquito Extermination Association, page 146, 1928.

By W. E. BRITTON AND M. P. ZAPPE:

Some Insect Pests of Nursery Stock in Connecticut, Bulletin 292, 61 pages, 27 figures, 20 plates; 4000 copies, March 1928.

Inspection of Nurseries in 1927, Reprinted from the Report (Bulletin 294) page 210, May 1928.

By M. P. ZAPPE:

Fighting the Apple Maggot and the Control of Aphis, Proceedings Connecticut Pomological Society, 37th Annual Meeting, page 24. July *1928

By PHILIP GARMAN:

Dusting Menaces Fruit Growers; Gleanings in Bee Culture, Vol. LVI.

page 293, May 1928.

The European Red Mite, Peach Moth, and Plum Curculio, Proceedings Connecticut Pomological Society, 37th Annual Meeting, page 28, July 1928.

By R. B. FRIEND:

Book Review: "Shädlings bekämpfung" by Dr. Walter Trapman, Journal of Economic Entomology, Vol. 21, page 794, October 1928.

INSECT PEST ACCOUNT

REPORT OF RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST.

From July 1, 1927 to June 30, 1928

RECEIPTS

Insect Pest Appropriation, biennial period ending June 30, 1929 \$60,000,00 Additions, miscellaneous receipts.....

\$60,027.36

DISBURSEMENTS

Salaries Labor	\$15,450.00 16,709.25	
Stationery and office supplies	125.35	
Scientific supplies (Chemicals)	42.93	
" (Other laboratory supplies)	25.61	
" (Photographic ")	57.38	
" (Photographic ") Insecticides, etc	130.67	
Lumber and small hardware	.73	
Miscellaneous supplies	841.64	
Automobile oil	62.31	
Telegraph and telephone	167.74	
Postage	91.22	
Travel expense (Outlying investigations)	2,219.31	
" (Meetings, Conferences, etc.)	259.53	
(Gasonne for automobiles)	507.06	
Freight, express and parcel post	15.33	
Electricity	45.30	
Furniture and Fixtures (New)	180.65	
" " (Repairs)	19.15	
Library (Books and Periodicals)	201.05	
" (Binding)	82.35	
Scientific equipment (New)	21.48	
Livestock Automobiles (New)	1.35	
Automobiles (New)	544.00	
" (Repairs)	256.90	
Tools, Machinery and Appliances (New)	48.63	
" (Repairs) Tools, Machinery and Appliances (New) " " " (Repairs)	7.10	
New Buildings and Structures	234.24	
Buildings (Repairs and Alterations)	10.58	
Rent of Land and Buildings	314.66	
Insurance (Automobile)	169.47	
Miscellaneous Contingent Expenses	72.44	
Total Disbursements		38,915.41
Balance		21,111.95

673

DEPARTMENT STAFF AND WORK

W. E. BRITTON, PH. D., State and Station Entomologist. B. H. WALDEN, B.AGR., Photographic and General Work. Assistant M. P. ZAPPE, B. S., Inspection and General Work. PHILIP GARMAN, PH.D., Research Work. Entomologists. ROGER B. FRIEND, PH.D., Research Work. F. TOWNSEND Field Technicians. B. W. McFarland J. Peter Johnson, B.S., Deputy in Charge of Asiatic and Japanese Beetle Quarantines. JOHN T. ASHWORTH, Deputy in Charge of Gipsy Moth Work. JAMES A. McEvoy, Assistant in Gipsy Moth Work. ROBERT C. BOTSFORD, Deputy in Charge of Mosquito Work. MISS GRACE A. FOOTE, B.A., Secretary.* MRS. GLADYS BROOKE, B.A., Secretary.† H. W. COLEY, Westport A. W. YATES, Hartford Apiary Inspectors.

Mr Walden has been in charge of the office during the absence of the Entomologist, and has continued to serve as chief photographer of the department. He has also had charge of certain exhibits for the department and has assisted in the inspection, fruit scoring and in the general work of the department. He has also continued his researches on the imported currant worm, *Pteronidea ribesi* Scop.

Mr. Zappe has continued in charge of the inspection of nurseries and of imported nursery stock. He has also been placed in charge of clean-up work around infestations of European corn borer, in cooperation with the Federal Bureau of Entomology. He has worked with Dr. Garman in the study of the plum curculio in apple orchards during the five-year period 1924-1928 and the results are now ready for publication. With Mr. E. M. Stoddard of the Botany Department, he has visited many orchards to observe pest development and to recommend the time and materials for pest control.

Dr. Garman has continued his investigations on the life history and control of the Oriental peach moth, Laspeyresia molesta Busck. He and Mr. Zappe have studied the methods of control for the plum curculio, Conotrachelus nenuphar Hbst., in apple orchards and the results will soon be published as a separate bulletin. Dr. Garman has also devoted considerable time to a study of the European red mite and other mites and to the chemistry of insecticides.

Dr. Friend has devoted a large portion of his time to a study of the life history, habits and means of control of the Asiatic beetle, *Anomala orientalis*, Waterh., the results of which are

being published as a separate bulletin. He has also worked with certain insect pests of vegetable crops and has continued the investigations on the life history and habits of the imported birch leaf miner, *Fenusa pumila* Klug.

Messrs. B. W. McFarland and J. F. Townsend have been employed throughout the year as field technicians, the former on Asiatic beetle investigations and control and the latter on curculio and Oriental peach moth investigations under Dr. Garman.

Mr. John T. Ashworth has continued to serve as Deputy in charge of gipsy moth control work with headquarters at Danielson. He has been assisted by Mr. McEvoy and the work has been carried on vigorously and efficiently in cooperation with the Federal Bureau of Entomology.

Mr. J. P. Johnson has continued in charge of the scouting and enforcement of the quarantines against the Japanese beetle and the Asiatic beetle. Mr. Johnson is an agent of the Federal Bureau of Entomology, and since January 1, 1928, has maintained an office in the Hurley Building, Shelton, with a force of men sufficient to make the necessary inspections, issue the required certificates, patrol the principal highways leading out of the quarantined area, and in summer, to scout in other towns and cities in Connecticut outside the quarantined area.

Mr. Robert C. Botsford has continued to serve as deputy in charge of mosquito elimination work. He has made preliminary surveys and has supervised important ditching projects in Branford, East Haven, East Lyme, Hamden, Old Lyme and Saybrook, and has maintained the ditches in the other areas which have been accepted for State maintenance.

Mr. J. Leslie Rogers was employed from June 12 to September 22, Mr. H. B. Bender from July 1 to October 1, and Mr. A. F. Clark from July 5 to August 31, assisting Mr. Zappe in inspecting the nurseries.

Mr. Chas. R. Biecher was employed as temporary laboratory assistant from June 18 to September 1.

Mr. Neely Turner, who is engaged on a project for the Crop Protection Institute on horticultural oil sprays, began work November 10, 1927. Office and laboratory facilities are furnished by the Station.

Miss Grace A. Foote has served as Secretary to the department, but resigned September 1, much to the regret of all members of the staff. Her place has been filled by the appointment of Mrs. Gladys Brooke, who was formerly engaged in similar work at the Texas Station. During the summer vacation period, Mrs. A. D. McDonnell, was employed for part time in order to attend to the necessary correspondence.

Messrs. A. W. Yates, Hartford, and H. W. Coley, Westport, have served as apiary inspectors as in former seasons, on a per diem basis.

^{*}Resigned September 1 †Beginning September 1

The Entomologist here expresses his thanks and appreciation to all members of the department staff for the faithful and efficient services which they have rendered. The work accomplished

would have been impossible without such help.

The Entomologist has given his personal attention to the office correspondence and has directed the research, inspection, control and quarantine work of the Department. He has also served as chairman of a committee on the project on horticultural oil sprays of the Crop Protection Institute, as Associate Editor of the Journal of Économic Entomology, and as Insect Pest Reporter in Connecticut for the Insect Pest Survey of the Bureau of Entomology. He is also chairman of the Tree Protection Examining Board, and Superintendent of the Geological and Natural History Survey of Connecticut, and has devoted some of his time to these matters.

The principal activities of the department are given in detail in the following pages of this report.

ENTOMOLOGICAL FEATURES OF 1928

Following a rather mild winter with light snow fall and not excessively low temperatures, the growing season opened with cool weather and scanty rainfall and the spring development of most kinds of insect life was later than usual. During June, July and August, precipitation was frequent and abundant and higher temperatures prevailed. Perhaps the most outstanding entomological features of the season were the expected appearance of Brood II of the periodical cicada or 17-year locust, the discovery of additional infestations of the Japanese beetle at Hartford, New Haven, New London, and a much larger one at Springfield. Mass., and the extensive spread of the European corn borer.

The writer is indebted to Mr. M. P. Zappe of the Department staff for some of the notes on fruit insects and to Mr. A. E. Wilkinson, Vegetable Specialist of the Extension Department, Connecticut Agricultural College, Storrs, for much of the information regarding the prevalence of insects attacking vegetable

crops.

FRUIT INSECTS

The Eastern tent-caterpillar, Malacosoma américana Fabr., has now passed the peak of its greatest abundance and is on the wane. Though nests were numerous in some localities, they were less abundant than in 1927 and we expect fewer nests in 1929.

The apple and thorn skeletonizer, Hemerophila pariana Clerck, is still present and evidence of its work could be found in nearly every orchard, but it does no real damage. Apparently natural

enemies are holding it in check.

The grape-vine flea-beetle, Haltica chalybea Ill., caused considerable injury to grape-vines in Glastonbury and Bolton in May by eating off the buds. Cutworms also caused similar injury at Glastonbury May 22, and at Windsor Locks May 14.

A prominent fruit pest in 1928 was the Oriental peach moth, Laspeyresia molesta Busck, which caused great injury to peaches and quinces in the central and southern portions of the State. Specimens in quince were received from Meriden, October 1. Wherever peaches are grown commercially, there is usually damage, and as yet no satisfactory remedy has been discovered.

On June 19, specimens were received from Canaan of the comparatively rare Say's blister beetle, Pomphopoea sayi Fabr., which

was feeding upon peach foliage.

The ever-present codling moth, Carpocapsa pomonella Linn., was moderately abundant in 1928, but good control was obtained in sprayed or dusted orchards.

The only evidence seen of the presence of the lesser apple worm, Laspeyresia prunivora Walsh, were specimens of injury received

from Norwalk, October 29.

The plum curculio, Conotrachelus nenuphar Hbst., was very late in emerging from winter quarters but was present in apple orchards in the usual numbers, and caused the characteristic scars on the fruit. Specimens of injury to apple were received from Beacon Falls, July 2; Bridgeport, July 5, and to pear and apple from Norwalk, September 15. In Hamden, from 18-33 per cent of the early maturing larvae were parasitized by Triaspis curculionis Fitch, but the average parasitism was only five per

The apple maggot or "railroad worm", Rhagoletis pomonella Walsh, was present in about the average numbers and caused some damage, particularly on early maturing sweet and subacid varieties which did not receive the July treatments. Specimens of injury were received from Norwalk, October 29.

The apple budmoth, Tmetocera ocellana Schiff., was apparently

less abundant than usual.

The red-humped caterpillar, Schizura concinna S. and A., feedling on apple foliage was received from Norwich, July 19 and Woodstock, September 18.

The hag moth caterpillar, Phobetron pithecium S. and A., was more prevalent than usual, and specimens on apple were received from Meriden, August 21; Shelton, September 18, and on pear

from Hartford, August 23.

The fall cankerworm, Alsophila pometaria Harris, a pest of orchards, shade and woodland trees, mentioned elsewhere in this report was as usual locally abundant in 1928. Eggs were received from Bridgeport, January 20, and adults from Madison, December 6.

677

Certain noctuid larvae called green fruit worms and usually of the genus Xylina often cause considerable injury by eating into the growing fruit, especially apples. Specimens were received from Bridgeport July 5.

CONNECTICUT EXPERIMENT STATION

A specimen of the larva of Sphinx drupiferarum S. and A., feeding on plum foliage, was received from Torrington, July 27.

The imported currant worm, *Pteronidea ribesi* Scop., though not as abundant as in some seasons, was present, and specimens of larvae were received from New Haven, May 8.

Larvae of the crinkled flannel moth, Lagoa crispata Pack., were received September 17, from Saybrook Point, where they were

feeding upon raspberry.

The European red mite, *Paratetranychus pilosus* C. and F., was present in average numbers, and caused some injury in certain orchards. Eggs of this mite were received from Bantam, April 9, and from Wallingford, February 25.

Another instance of injury to pears by the quince curculio, Conotrachelus crataegi Walsh, was received from Branford, August 6. Probably this pest can be partially controlled by

spraying with lead arsenate.

The pear midge, Contarinia pyrivora Riley caused injury to pears here and there. Specimens were received from Wallingford and New Milford, June 8. No remedy is known other than to gather and destroy the immature pears which will reduce the numbers of the insect the following year.

Leafhoppers, probably *Empoa rosae* Linn., were extremely abundant in apple orchards around Unionville and Southington. Later in the season at Unionville many were killed by a fungous

disease.

The pear *Psylla pyricola* Forst., caused less damage than in 1927, though present throughout the State, and was rather abundant in some orchards around New Haven, Stamford, and Wallingford.

Another insect which was absent from most orchards was the apple redbug, Lygidea mendax Reut. This insect was observed

by our entomologists only at Kensington and Unionville.

An unusual form of injury to peach fruits was observed at the Station, where peach trees are near some oak trees. The fruit was badly punctured by the oak plant bug Lygus quercalbae Knight.

Apple aphids (both green and rosy) were rather scarce and

caused little injury to fruit.

The woolly apple aphid, *Eriosoma lanigerum* Hausm., was present in usual numbers. The characteristic galls caused by this insect were received from Bridgeport, January 20; Wallingford, February 25, and Noank, June 20.

The currant aphid, Myzus ribis Linn., was present as usual and caused the terminal leaves to become blistered or curled. Specimens were received from New Haven, May 10.

The San José scale, Aspidiotus pernicosus Comst., was comparatively scarce, and though found in 30 different nurseries, there seems to be no injury from this insect in well-conducted orchards.

The European fruit scale, *Lecanium corni* Bouché, which may attack a variety of trees and shrubs was received on grape-vine from Bridgeport June 5, and New Haven, August 31.

VEGETABLE INSECTS

Cutworms were prevalent throughout the State and caused injury to vegetable crops. Damage was reported from Norwich, April 11, Brooklyn, Canterbury, Danielson, Hampton and Wauregan, May 14, and Woodstock May 15. Some growers have used a poisoned bran mash, and their plants were not badly damaged.

The corn ear worm, *Heliothis obsoleta* Fabr., was scarce or absent from most fields of late maturing corn. Not a single report of the appearance of this insect was received at the Station.

The stalk borer, *Papaipema nitela* Guen., seems to be present each year. In 1928 it was rather more abundant than usual and was reported in corn from Wethersfield, July 18, Madison, July 24, Meriden July 35, Thomaston, August 21. It was received in pepper from Stafford Springs, July 20. It was very destructive to corn in a small section of Wethersfield.

The asparagus beetle, *Crioceris asparagi* Linn., is also prevalent nearly every season throughout the State. Reports were received as follows: Farmington, May 21; Huntington where one-third of the crop was seriously injured, June 5; Ridgefield and vincinity, June 6; Thompsonville, Bristol and Southington, June 14.

The striped cucumber beetle, *Diabrotica vittata* Fabr., caused the usual amount of injury throughout the State. At the Station farm at Mount Carmel, it was more amundant and destructive than in 1927.

A troublesome pest of potato and tomato plants is the potato or cucumber flea beetle, *Epitrix cucumeris* Harris, and the season of 1928 was no exception in this regard. The following reports of injury were received; Green's Farms District, June 5; Ridgefield and Danbury region, 10 acres inspected, 10,000 plants injured June 6, Litchfield County, Bethlehem, Morris, Northfield, Thomaston, Watertown and Winchester, tomatoes and potatoes, June 7.

Cabbage insects were abundant during the season. The imported or green cabbage worm, *Pontia rapae* Linn., was so

destructive to cauliflower that one of the largest growers discontinued growing the crop for the season.

The cabbage looper, Autographa brassicae Riley, was also

present and also contributed toward the damage.

The diamond-back moth, Plutella maculipennis Curtis, was present in nearly every cabbage field in New London, Tolland, and Hartford Counties, and caused some injury.

In a field at Norwich, investigated May 10 by Dr. Friend, the cabbage plants had been considerably injured by the horseradish flea beetle, Phyllotreta armoraciae Koch. Horseradish had been grown on the field the preceding year. Spraying with lead arsenate will probably control all of the four insects just mentioned.

Specimens of the cabbage curculio Ceutorhynchus rapae Gyll., were in the stems of cabbage plants from Orange, June 21. This insect usually breeds in hedge mustard, Shepherd's purse,

and wild pepper grass.

Probably the most serious injury to cabbage plants was caused by the cabbage maggot, Hylemyia brassicae Bouché. Injury was reported as follows: Mount Carmel, Foxon, and Westville, May 21; Westport, June 6; New London County, June 13; Bristol, Southington and Thompsonville, June 14; Orange, June 21. At Southington 4,000 out of 6,000 plants were destroyed, but the remainder were saved by treating with corrosive sublimate. At Bristol, two applications of corrosive sublimate gave good control, and without the treatment only one plant remained out of fifty.

Cauliflower plants at Southington were injured by a species of thrips, probably the tobacco thrips, Thrips tabaci Linde. Mr. Walden visited the field September 14, and advised dusting with

nicotine dust.

The cabbage aphid, Brevicoryne brassicae Linn., was not generally prevalent during the season, but a few specimens were

received from Orange, June 21.

The carrot rust fly, Psila rosae Fabr., is evidently becoming more prevalent as its work is now frequently observed on carrot and parsnip in the markets. Specimens were received from Norfolk, April 5, and October 1.

The spinach leaf miner, Pegomyia hyoscyami Panz., was not prevalent in 1928. It was present in some fields in June but en-

tirely disappeared later.

The gray field slug, Agriolimax agrestis Linn., was reported as

injuring tobacco plants in seed beds, June 27.

In general aphids were not very troublesome in 1928, on vegetable crops and not a single report was received of injury by the pea aphid, Illinoia pisi Kalt., or by the potato aphid, Macrosiphum solanifolii Ashm.

The European corn borer, Pyrausta nubilalis Hubn., has spread rapidly during the season and was found by Federal scouts in some 25 towns not previously known to be infested. Most of these are in the eastern end of the State and will be described more fully in another place in this report.

SHADE AND FOREST TREE INSECTS

Sawfly larvae were rather abundant on conifers during the season. Cocoons of Diprion simile Hartig were received from New Haven, April 23; larvae on pine from Hamden August 18 and 25, and from Norwichtown, September 5. Neodiprion lecontei Fitch, was more abundant than for several years and was received from Greenwich on two-needled pine September 28. In Branford, Plainville and Unionville, many small pitch trees were completely defoliated but on the larger trees, some leaves remained. Neodiprion pinetum Norton was received from North Stonington October 5.

The elm sawfly, Cimbex americana Leach, was received from Danbury and Watertown, August 27, and from Norfolk, September 20. Spraying with lead arsenate is the remedy if any of the

sawflies mentioned above become injuriously abundant.

The white-marked tussock moth, Hemerocampa leucostigma S. and A., in its larval stage feeds upon various deciduous trees. A larva of this species on maple was received from Litchfield, August 13. The tessellated tussock moth, Halisidota tessellaris S. and A., was received on sugar maple from New Haven, August 31. The former often defoliates trees particularly in towns and cities. Spraying with lead arsenate is the remedy.

The fall cankerworm, Alsophila pometaria Harris, was very abundant in woodland areas in Ridgefield in 1928, and there was an area of several hundred acres just west of the mouth of the Connecticut River, where the woodland trees were almost completely defoliated. Of course, spraying with lead arsenate will

prevent defoliation.

The green elm leaf beetle, Haltica ulmi Woods, was very abundant at Sound Beach late in the season and the adults could be gathered by the pailful. Specimens were received December

6. Spraying with lead arsenate is the remedy.

The pine tube maker, Eulia pinatubana Kearf., has the peculiar habit of fastening together the needles in a cluster to form a protecting case for the larva which devours the distal portion of the needles. This insect was received from New Haven, August 31. In case of severe attacks, the remedy is to spray with lead arsenate.

The fall webworm, Hyphantria cunea Drury, was very abun-

dant in the eastern portion of the State.

A Chrysomelid beetle, *Dichelonyx elongata* Fabr., feeding upon oak was received from Cos Cob, June 1. This is a rather common species, with feeding habits and injury to foliage similar to those of the rose chafer. A spray of lead arsenate is the remedy.

The imported willow leaf beetle, *Plagiodera versicolora* Laich., has now spread over the entire State, and was observed in 27 different nurseries during the summer Both adults and larvae feed upon the foliage of glossy-leaved species of willow and sometimes on poplar. During the season, specimens of this insect were received from Greenwich, two adults, January 12; West Haven, June 30, and Colebrook, July 3. Spraying with lead arsenate is the remedy.

Curious balls of frass are often noticed on pine branches. These balls are often two inches or more in diameter, though sometimes smaller. Inside the ball in silken tubes are light brown larvae with darker brown stripes running lengthwise. The adult of this insect is a brown moth, *Tetralopha robustella* Zeller, a species formerly considered rare, but which now seems to be rather common. Specimens of larvae were received from Hartford, May 7.

During the season several leaf-miners have been brought to our attention. One of the most conspicuous of these is the birch leaf-miner, Fenusa pumila Klug, which forms blotch mines in the tender terminal leaves of gray birch, European white birch, and its cut-leaf variety, and to some extent in paper birch. Specimens were received from Norwalk, June 20, and from New Haven, July 24. It was observed in 58 different nurseries and is now distributed throughout the State and probably throughout New England. No remedy or preventive has been discovered.

The blotch oak leaf-miner, Lithocolletis hamadryadella Clem.,

was received from Cromwell, August 7.

The larch leaf-miner or case bearer, Coleophora laricella Hubn., has caused injury to the native larches in the swamps and to cultivated trees in parks and on home grounds. The larva is a miner inside the leaf. Trees which are severely infested present a very ragged appearance. Specimens of the winter cells were received from Stamford, October 16. These winter cases are fastened to the twigs throughout the winter. The remedy is to spray during the first week of April, using liquid lime-sulphur, diluted at winter strength, one part in nine parts water.

A leaf-miner of spruce, Recurvaria sp. was received from Hart-

ford, February 29.

The arborvitae leaf-miner, Argyresthia thuiella Pack., which caused so much injury around New Haven in 1920-1922 is now present in injurious numbers in a region just South of Waterbury, and specimens were received from Union City, May 24. There is

no good remedy but some measure of control will result in spraying with nicotine solution and soap, the last week of May and the first week of June, when the adults are flying about and depositing

Two species of mites have been prevalent during the season and injured or disfigured trees. The spruce mite, *Paratetrany-chus ununguis* Jacobi, is found on spruce and other conifers, and often causes serious injury. The individuals feed upon the leaves causing them to turn gray or brown and often web together the leaves and twigs. We have been recommending a spray of linseed oil emulsion, but expect to carry on tests of other sprays next season to ascertain a better method of control. Specimens of this mite were received on spruce from Clinton, August 8, and on arborvitae from Bridgeport, October 10; Lyme, October 13, and Newtown, October 16.

The other mite, *Phyllocoptes quadripes* Shimer, forms galls on leaves of silver maple, called the maple bladder gall. Specimens were received from Cromwell, May 23; New Canaan, May 29; Hartford, June 14; Wethersfield, June 19, New Hartford, June 25; Waterford, July 27, and Woodmont, August 10. According to Herrick*, a dormant spray of liquid lime-sulphur 1-8 in April proved to be an effective remedy.

Certain insects form galls on shade and forest trees and may be mentioned here. The horned oak gall, Andricus cornigerus O. S., was received from Woodbridge, June 21. The oak pea gall, Philonix pezomachoides O. S., was received from Cromwell August 7. The oak fig gall, Biorhiza forticornis Walsh, was received from Niantic, August 11. A psyllid gall, Pachypsylla celtidis Riley, on hackberry was received from Fairfield, July 10. A rather large aphid gall, Pemphigus ulmifusus Walsh, on slippery elm was received from Short Beach, Branford, July 11, and the vagabond poplar gall, Pemphigus vagabundus Walsh, on poplar was received from Middletown, July 26.

Other aphid galls which have been common are the spruce gall, Adelges abietis Linn., found in 75 different nurseries, and the blue spruce gall, Gillettea cooleyi Gillette, found in 45 different nurseries. Specimens of the former on Norway spruce were received from Riverside, November 5, and specimens of the latter on Colorado blue spruce were received from New Canaan, June 7, August 6, and September 8; New Haven, June 18; Waterford, July 27; Middletown, August 27; Bridgeport, September 15, and Stamford, October 16. Both these species may be controlled by spraying between April 1-15, with a contact spray such as a miscible oil (1-25) or a nicotine soap solution to kill the over-wintering females on the twigs.

^{*}Journal of Economic Entomology, Vol. 18, p. 632, 1925.

Two aphid galls were received on hickory. The hickory leaf stem gall aphid, *Phylloxera caryaecaulis* Fitch, was received from West Haven and Norwalk, June 20. Another species, *Phylloxera rimosalis* Pergande, was received from New Haven, June 12. Both species make galls on the leaf petioles. Remedies have not been worked out.

The pine bark aphid, Adelges pinicorticis Fitch, which is responsible for the appearance of cotton or wool on the twigs and bark of white pine was received from Lyme, May 10; Bridgeport, August 6, and New Haven, August 31.

A large aphid, Longistigma caryae Harris, was received on

hickory from Norwich, September 12.

The pine spittle bug, Aphrophora parallela Say, was common in midsummer and formed frothy masses or spittle balls on pine twigs. Specimens were received from Bristol, July 7.

A leafhopper, *Idiocerus scurra* Germar, was reported as being very abundant on a Lombardy poplar tree in New Haven, August

10, and specimens were brought to the Station.

Several species of scale insects were common on shade trees in 1928. The oak gall scale, Kermes sp., was received from Cromwell, August 7. The pine leaf scale, Chionaspis pinifoliae Fitch, was received from Southington, May 18. The white elm scale, Chionaspis americana Johnson, on elm was received from New Haven, February 23. The cottony maple scale, Pulvinaria vitis Linn., is rather common on red and silver maple in certain regions. Specimens were received from Hartford, June 29; West Haven, June 30; East Hartford, July 17, and Sound Beach, July 23. The tulip tree scale, Toumeyella liriodendri Gmel., was rather abundant during the season on tulip tree and magnolia. Specimens were received on magnolia from New Haven, July 25, and Hamden, September 13, and on tulip tree from Waterbury, August 28, and Georgetown, October 23.

The white pine weevil, *Pissodes strobi* Peck, continues to cause great injury to specimen trees and forest plantings where the young trees are not shaded. Specimens were received from Portland, June 8; Somers, July 17, and Westport, August 13. A closely related species, *Pissodes approximatus* Hopkins, seemed

to cause the death of red pines planted in Goshen.

A bark borer, *Phloeosinus dentatus* Say., was received in red cedar from Greenwich, March 30, and in red cedar and arborvitae from West Cornwall, September 24.

The hickory bark beetle or bark borer, *Scolytus quadrispinosus* Say., was received from Cos Cob, March 23. The hickory borer, *Cyllene caryae* Gahan, was received from Suffield, May 7.

The twig pruner, *Hypermallus villosum* Fabr., was received from Mystic, August 3, and Watertown, August 15. Another common twig borer, *Phymatodes variabilis* Fabr., was received from Stamford, May 25.

The poplar and willow curculio, Cryptorhynchus lapathi Linn., was received from West Haven, June 30 and July 2.

The pigeon horn-tail, *Tremex columba* Linn., was rather abundant in dying trees in Meriden, and specimens were sent to the Station, September 14.

The leopard moth, Zeuzera pyrina Linn., was received from

East Haven, November 14, 1927.

The European pine shoot moth, Rhyacionia buoliana Schiff., is becoming prevalent in red Scotch, and other pines in various regions of the State. Specimens were received in either Austrian or Caucasian pine from Rainbow, November 23, 1927, in Scotch pine from Hartford, May 7, and from Norfolk, September 17, in red pine from Hampton, August 30, and from Stamford, October 16. A closely related species, Evetria comstockiana Fern., in pine was received from Bristol, July 7.

The periodical cicada or 17-year locust, *Tibicina septemdecim* Linn., appeared in Connecticut as expected and caused some injury to shade and woodland trees where eggs were deposited in the twigs and branches. Some of these twigs break off and there were small areas around Meriden and New Britain and probably in other sections of the State where the hillsides were brown in

July and following, from the broken branches.

INSECTS INFESTING ORNAMENTAL SHRUBS AND VINES.

The juniper webworm, Dichomeris marginellus Fabr., has been very prevalent and the larvae webs together the leaves on a twig and feeds upon the leaves inside the web. It is more apt to injure plants of the low juniper Juniperus communis and the Irish juniper variety hibernica, than the common red cedar Juniperus virginiana. Specimens were received from New Haven, April 23, and Newtown, June 29. An affective remedy consists in thoroughly spraying the foliage with lead arsenate. A similar injury to blue spruce was caused by the larvae of a noctuid moth, Epizeuxis aemula Hubn., at Woodmont, early in July.

The privet leaf roller, *Archips rosana* Linn., was unsually abundant in certain localities around New Haven, and one hedge presented a very ragged appearance where partially defoliated. Specimens were received from New Haven, June 5 and 7. The oblique-banded leaf roller, *Archips rosaceana* Harris, was also very prevalent and caused injury to roses in many gardens. Specimens were received from New Haven, June 14. Spraying with lead arsenate is a remedy for both these leaf-rollers.

The eight-spotted forester, Alypia octomaculata Fabr., feeding upon Virginia creeper was received July 13. Several larvae were nearly full grown. Grapevines and Virginia creeper were nearly stripped in two sections of New Haven. This insect may be controlled by a spray of lead arsenate.

684

The rhododendron borer, Sesia rhododendri Beut., was received from Plantsville, August 30.

The oyster-shell scale, Lepidosaphes ulmi Linn., is commonly found on lilac, often killing certain stems or branches. Specimens were received from New Haven, February 23, and from Hamden, September 13.

One of the mealy flatas, *Ormenis pruinosa* Say., is often rather abundant on privet, Japanese barberry and other ornamental plants, though it is questionable whether it causes much injury. Specimens were received from Norwalk, August 13.

The witch hazel cone-gall aphid, Hormaphis hamamelidis Fitch, is responsible for the cone-shaped galls on the upper surface of the leaves of witch hazel. Specimens were received from Essex, June 21.

The azalea scale, *Eriococcus azaleae* Comst., is rather common at times on azalea and rhododendron around New Haven. Specimens were received from Hartford, June 4, on rhododendron.

The rose weevil, Rhynchites bicolor Fabr., was unusually abundant and injured many rose gardens by eating into the sides of the buds. Specimens were received from New Haven, July 17.

Climbing cutworms, Xylina sp., also injured rose buds by eating into them. The writer observed this type of injury in his own garden and specimens were received from Hartford, June 20.

The rose chafer, Macrodactylus subspinosus Fabr., was present in most gardens though not as abundant as in some seasons. The beetles feed upon grape and other foliage and upon white rose and paeony flowers. Specimens of the grubs were received from Westport, April 27, and adults from New Haven, June 30.

INSECTS ATTACKING FLOWERS AND GREENHOUSES PLANTS.

Two mites are common pests of greenhouse plants. One is the bulb mite, *Rhizoglyphus hyacinthi* Banks, which was received from Hartford, March 14, infesting Bermuda lily. The other is known as the cyclamen mite, *Tarsonemus pallidus* Banks, though it injures a number of other kinds of plants both in the greenhouse and in the garden out-of-doors. Specimens were received on larkspur from Hartford, March 20, and New Haven, June 16, and on snapdragon from New Haven, October 29.

The greenhouse whitefly, Trialeurodes vaporarioum Westwood, is troublesome on certain plants in dwellings, greenhouses, and even out-of-doors in the summer, throughout the state. Specimens were received on Pelargonium from Norwichtown, May 25. The remedy is cyanide fumigation or a contact spray like nicotine solution and soap.

The four-lined leaf-bug, *Poecilocapsus lineatus* Fabr., often injures various garden plants by sucking the sap from the tender

terminal leaves, causing transparent circular spots and later holes to appear in them. Specimens were received on chrysanthemum from New Haven, June 21, on chrysanthemum and dahlia from Bridgeport, July 9, and on aster, ageratum and *Dianthus* from Orange, July 13. The remedy is frequent spraying during June, with nicotine solution and soap.

Dahlias are also injured by the tarnished plant bug, Lygus pratensis Linn., and specimens were received from Eastford, August 14. This bug causes a distortion or dwarfing of the injured shoots, but transparent spots or holes do not follow. The remedy given above should prove effective.

Climbing cutworms were reported as injuring dahlias at Hartford, August 2. One species, *Peridroma margaritosa*, var. *saucia* Hubn., caused considerable injury to carnations in Bridgeport, by eating into the buds. Specimens were received January 20.

The greenhouse leaf-tyer, *Phlyctaenia ferrugalis* Hubn., caused much injury to chrysanthemums in the greenhouse at Elmwood. Specimens were received May 14 and from New Haven, May 24, on heliotrope. Cyanide fumigation of the house or spraying the plants with lead arsenate usually prove effective.

The iris root borer, *Macronoctua onusta* Grote, was received from New Haven, August 13. The larva tunnels in the rootstocks of iris, and should be destroyed whenever found. The adult moth lays late in the fall on the leaves, consequently gathering and burning the iris leaves in early spring is one of the best measures of control.

The zebra caterpillar, Mamestra picta Harris, is often a pest of the flower or vegetable garden. The moth lays eggs on the leaves and the young caterpillars begin feeding upon the foliage. Specimens on gladiolus were received from Meriden, July 3.

INSECTS INJURING STORED VEGETABLE PRODUCTS

Stored seeds, cereals and other products are often injured by various insects, some of which are mentioned below.

The black carpet beetle, Attagenus piceus Oliv., was received from Hartford, December 27, 1927, in seeds, and again from New Haven, March 20. It is usually as a pest of carpets, rugs and clothing that we hear of this insect, and specimens injuring clothing were received from New Haven March 14.

The museum beetle, Anthrenus verbasci Linn., evidently feeds upon both plant and animal products. Specimens were received from Shelton, May 24.. Anthrenus larvae which may have been this species were received from New Haven, March 20, feeding on seeds.

The rice weevil, Calendra oryzae Linn., was received from Middletown, December 30, 1927, infesting stored corn.

The cigarette beetle, Lasioderma testaceum Dufts., was received in bread, from Hartford, January 17.

The cadelle, Tenebroides mauritanica Linn., was received in

cocoa beans from Stamford, February 9.

The saw-toothed grain beetle, Oryzaephilus surinamensiss Linn., and the confused flour beetle Tribolium confusum Duval, were received from Stamford, June 20.

The rice moth, Corcyra cephalonica Stainton, was reared by Dr. Friend from cocoa dust from a chocolate factory at Stamford.

This is the first record of this insect from Connecticut.

MISCELLANEOUS INSECTS

White ants, Reticulitermes flavipes Koll., often infest and injure structural timbers or wood. This insect in the trim of a schoolhouse was received from Suffield, June 5. On August 22, specimens were brought in from the lobby of a theater in New Haven.

The large American cockroach, *Periplaneta americana* Linn., is often found in dwelling houses where it feeds upon the crumbs and waste food materials around kitchen and pantry. Specimens of nymph and adult were received from New Haven, September 27.

The adults of the Asiatic beetle, *Anomala orientalis* Waterh., were more abundant than in 1927, in the infested area, and many lawns were injured by the grubs. In the spring the grubs came to the surface about April 17, two weeks earlier than in 1927. Treating the lawns with lead arsenate, three pounds to 100 square feet, seems to be the best remedy.

The Japanese beetle, *Popillia japonica* Newman, was found to be present in Stamford and Bridgeport in larger numbers than in 1927. Federal scouts found small infestations in New Haven, New London and Hartford, and a larger infestation in Springfield, Mass., only a few miles from the Connecticut line.

According to a report received June 14, wireworms had de-

stroyed three acres of beans at Thompsonville.

The black cutworm, Agrotis ypsilon Rott., was recived from Cromwell, August 28, where it was feeding upon the grass on the golf links.

Some of the most important of these insects are treated at

greater length in other portions of this report.

CONVENTION OF ENTOMOLOGICAL WORKERS

The fifth annual convention of entomologists working in Connecticut was held at the Station on Thursday, October 25, 1928. The program was planned to include subjects of vital interest to

Connecticut entomologists, but the following entomologists from outside the State were invited to present papers: L. H. Worthley, Boston, Mass., Dr. Albert Hartzell, Yonkers, N. Y., A. F. Burgess, Melrose Highlands, Mass., and C. H. Hadley, Camden, N. J. Messrs. Worthley, Hadley, Felt and Johnson could not be present and their papers were read by Messrs. Bartley, Sherman, Spicer and Burke. About 42 attended the meeting. Luncheon was obtained at the Yale Dining Hall. The program was as follows:

PROGRAM

A. M. 10:10 Greetings:

W. L. Slate, Director, Experiment Station, New Haven.

10:15 Progress in Mosquito Ditching in Connecticut in 1928: R. C. Botsford, New Haven.

10:30 Some Entomological Features of the Season of 1928:

Dr. W. E. Britton, New Haven.

10:45 Some Injurious Shade-Tree Insects in 1928:

Dr. E. P. Felt, Stamford.

11:15 New Phases in the Spread and Control of the European Corn Borer L. H. Worthley, Boston, Mass.

11:45 Experiments with Oil Mixtures in Killing the Eggs of the European Red Mite:

Dr. Philip Garman, New Haven.

12:00 General Properties of Oil Sprays:
Neely Turner, New Haven.

P. M.

12:15 Naphthalene Fumigation:

Dr. Albert Hartzell, Yonkers, N. Y.

12:30 Luncheon

2:00 Glimpses of the Fourth International Congress of Entomology held at Ithaca, N. Y., Aug. 12-18:
Prof. J. A. Manter, Storrs.

2:30 The Gipsy Moth and the Satin Moth:
A. F. Burgess, Melrose Highlands, Mass.

3:00 Present Status of the Japanese Beetle in the United States: C. H. Hadley, Camden, N. J.

3:30 Some Aspects of Japanese Beetle Quarantine Enforcement in Conn.:

J. P. Johnson, Shelton.
3:45 Control of the Asiatic Beetle:
Dr. R. B. Friend, New Haven.

4:00 Notes on Nursery Inspection in Connecticut: M. P. Zappe, New Haven.

The following were present: J. T. Ashworth, Danielson, Conn.; Harold L. Bailey, Bradford, Vt.; H. N. Bartley, Bridgeport, Conn.; R. C. Botsford, New Haven, Conn.; W. E. Britton, New Haven, Conn.; A. F. Burgess, Melrose Highlands, Mass.; G. W. Burke, Shelton, Conn.; W. A. Collins, New Milford, Conn.; Harry E. Cooke, Torrington, Conn.; O. B. Cooke, Danielson, Conn.; R. G. Cooper, Colebrook, Conn.; S. S. Crossman, Melrose, Mass.; C. M. Emerson, Hartford, Conn.; R. B. Friend, New Haven, Conn.; Philip Garman, New Haven, Conn.; R. D. Glasgow, Albany, N. Y.; Harold C. Hallock, Westbury, N. Y.; Albert Hartzell, Yonkers, N. Y.; H. C. Helliwell, Shelton, Conn.; J. W. Kelley, Shelton, Conn.; Dolor LaBelle, Danielson, Conn.; C. Wm. Lacaillade, Jr., Storrs.

689

Conn.; J. W. Longo, Danielson, Conn.; J. A. Manter, Storrs, Conn.; J. A. McEvoy, Putnam, Conn.; B. W. McFarland, New Haven, Conn.; H. L. McIntyre, Albany, N. Y.; Saul Phillips, Albany, N. Y.; F. C. Rich, Ansonia, Conn.; John O. Schread, Storrs, Conn.; A. F. Schulze, Storrs, Conn.; R. W. Sherman, Camden, N. J.; Wm. L. Slate, New Haven, Conn.; M. D. Smith, Darien, Conn.; R. A. Spencer, Bloomfield, Conn.; O. W. Spicer, Stamford, Conn.; A. E. Stene, Kingston, R. I.; J. F. Townsend, New Haven, Conn.; Neely Turner, New Haven, Conn.; B. H. Walden, New Haven, Conn.; T. R. Ward, New London, Conn.; M. P. Zappe, New Haven, Conn. Zappe, New Haven, Conn.

BULLETIN 305

CONNECTICUT EXPERIMENT STATION

INSPECTION OF NURSERIES IN 1928

By W. E. BRITTON AND M. P. ZAPPE

The regular annual inspection of nurseries was commenced July 2, and completed October 1, except for a few nurseries registering late in the season. The work was in charge of Mr. Zappe who was assisted by Messrs. J. L. Rogers, J. F. Townsend, H. B. Bender and A. F. Clark. In a few cases assistance was rendered by E. M. Stoddard, B. H. Walden and W. E. Britton.

Mr. Bender is a botanist who was employed on this work for three months in order to pay special attention to such plant

diseases as might be present in the nurseries.

In addition to the examination of the nurseries by the regular nursery inspectors, the gipsy moth scouts were instructed to make extra careful searches for gipsy moth eggs in and around all nurseries within the infested area, and to report immediately to the office in case any were discovered in or near any nursery in 1928. Also, the pine blister rust scouts under Mr. J. E. Rilev, examined all nurseries where the blister rust was reported by the

nursery inspectors.

On the whole, the nurseries were as well cared for and in as good condition as usual. On account of the abundant rain, leaf spots and other plant diseases were perhaps more in evidence than in some seasons—especially dry seasons. More attention was also given to recording them. On the other hand, aphids were much less prevalent than in 1927. The spruce gall aphids, Adelges abietis and Gillettea coolevi are not greatly affected by seasonal or climatic conditions and were present in about the usual numbers: though our records show that each was found in more nurseries than last year; the increase is partly due to the increase in the number of nurseries (37 more than last year). Some nurserymen must make greater efforts to control these pests. Spraying in March or the first half of April, with a contact spray seems to be the best treatment. For this purpose, one may apply either a miscible oil (1-25), or nicotine solution and soap (1-400) equivalent to two teaspoons in a gallon of water with an inch cube of laundry soap dissolved and added as a spreader.

In 18 nurseries no important pests were found. Following is a list of insects and plant diseases found in nurseries during the annual inspection of 1928, together with the number of nurseries

infested by each:

PESTS FOUND IN NURSERIES IN 1928

INSECTS

Name	No. Nurseries	Name	No. Nurseries
Anisota stigma	1	Janus abbreviatus	
Aphids, apple, green	40	Juniper webworm	1 5
woolly		Lace bugs on Az	alea 1
on birch	1		lmia 1
boxwood	2	Rh	ododendron 48
cherry	1	Leafhoppers on a	
Crataegus			cherry 2
Cytisus	1 '		maple 1
elm			Japanese maple 1
fir	1		mountain ash 1
Heliopsis	1		oak 1
mountain ash.		I	pear 2
pear	1	Dark translation	ooplar 1
phlox	1		quince 1
pine	4		rose 11
red pine		Leaf-miner in app	ple 2
plum			prvitae 7
poplar	1		ch 1
quince			h (Fenusa
rose	1		pumila) 58
spirea		box	wood 5
spruce		Cat	alpa bungei 19
willow	6	colu	ımbine 2
spruce gall aphid		locu	ist 3
Adelges abietis	75	tulij	p tree 1
Gillettea cooleyi.	45	pead	ch 1
woolly, on pine bark		sour	r gum 1
woolly, on beech		Leaf roller, privet	2
Apple and thorn skeletonis		Mealy bugs, Catal	
Arctiid larvae	1	Midge on silver	maple 11
Birch bucculatrix	1	Mites, European	red
Borer, ash	1	pear leaf b	olister 47
bronze birch	\dots 2	spruce	
elm	1	on arborvitae	1
Helenium	1	birch	
Iris	3	boxelder .	
Iris (seed pod)	1	fir	
lilac		maple	8
lilac (terminals)	1	oak	3
mountain ash (term	inals) 1	phlox	
peach	2	willow	
poplar (Agrilus)		Mites, galls on b	uttonbush 1
poplar	3	Oriental peach mo	
willow	3	Ormenis pruinoșa	
Bugs on ash (Capsids)	3	Otiorhynchus ovat	us on
Currant worm imported	3		arborvitae 1
Cutworms on rhododendro	n 1	Otiorhynchus sulc	
Elm case bearer		Pear psylla	
Elm leaf beetle		Pear slug	
Epitrix cucumeris		Pistol case bearer	
European pine shoot moth.		Poplar leaf beetle	
Fall webworm	and the second s	Psylla on boxwoo	
Four lined plant bug	1	Red-humped cate	rpillar 4

	Name	No. Nurseries	No. Name Nurseries	
Sawfly	on pinearborvitaedogwood	simile 4 2 3	Scale, on dogwood	
Scale,	elm elm scurfy Euonymus juniper Lecanium on currar oak gall oyster shell. pine leaf rose San José. scurfy tulip tree West Indian Peach.	6 1 1 1 1 2 57 13 6 30 5 1	juniper 3 linden 1 pine 2 Tarnished plant bug 4 Tulip tree leaf gall 3 Tussock moth larvae 1 Tussock moth eggs 1 White pine weevil 19 Willow curculio 5 Willow leaf beetle imported Plagiodera versicolora Yellow-necked caterpillars 5	

PLANT DISEASES

	PL	ANT	DISEASES	
Name	No Nurse		Name	No. Nurseries
Apple scab Apple mosaid Bacterial dise Black knot Black rot, app Botrytis on (Canker, popla sycar Crown gall Exoascus on Exobasidium Fire blight Gnomonia uln Leaf blotch r Leaf spot on		ries 15 18 5 1 8 1 76 18 22 6 6 58 1 7 35 1 4 2 2 5 5 13 1 1 16 99 9 1 1 3 10 1 1 1 1 1 7 4		
	cherry	5		rhododendron 56

BULLETIN 305

Name	No Nurse		Na	ame		Nurse Nurse	o.
Leaf spot on	rhubarbstrawberryViburnum	26	Mildew of Phomops	on Symph is juniper y cane bli	oricarpus		1 2
	Weigelia Yucca	1 1		mosaic Ámelancl			12
	apple			apple			
	azalea			ash			3
	Catalpa			Bechtel's			
	cherry	3		Crataegus			18
	chrysanthemum			hollyhock	,		4
tara ang tarang tar	lowering crab apple	1		juniper .			8
	Howering grape	53		oak			1
\mathbf{f}	lowering honey-			pear			5
	suckle			pine (3 n			1
f	lowering lilac	63		pine need	les		2
f	lowering oak	1		quince			15
f	lowering peach	1	Scab, pea	ir			4
I	pear	1	White pi	ne blister	rust		
	ohlox	55		pine			3
	Platanus	1					5
		1	Yellowing	g of lilacs			10
	ose			5 111405			,

An examination of the preceding list will show that among the insects the spruce gall aphid, Adelges abietis as was the case last year was found in more nurseries (75) than any other insect, followed by apple leafhoppers (72), apple woolly aphid (60), birch leaf-miner, Fenusa pumila (58), oyster-shell scale (57), apple and thorn skeletonizer (49), rhododendron lace bug (48), pear leaf blister mite (47), apple green aphid (40), San José scale (30), spruce mite (27), imported willow leaf beetle (27), pear slug (27), Oriental fruit moth (26), pear psylla (23), pine bark aphid (23), fall webworm (22), catalpa leaf-miner (19), white pine weevil (19), European red mite (15), and pine leaf scale (13), leafhoppers on rose (11), gall midge on silver maple (11).

Among the plant diseases found in nurseries in 1928, leaf blotch of rose headed the list (99), followed by apple scab (76), leaf spot of catalpa (74), apple rust (68), mildew of lilac (63), black rot of apple (58), leaf spot of rhododendron (56), mildew of phlox (55), mildew of catalpa (53), mildew of grape (53), leaf spot of maple (50), mildew of rose (49), leaf spot of iris (48), leaf spot of phlox (46), poplar canker (35), rust on Bechtel's crab (34), leaf spot on Japanese maple (32), leaf spot on horse chestnut (30), leaf spot on grape (30), leaf spot on mountain ash (29), leaf spot on larkspur (28), leaf spot on strawberry (26), mildew on apple (26), bacterial disease of larkspur (22), currant anthracnose (18), apple mosaic (18), leaf spot on boxelder (18), rust on crataegus (18), Gnomonia ulmi on elm (16), cherry anthracnose (15), leaf spot on quince (15), leaf spot on

rhubarb (15), rust on quince (15), leafspot on juglans (13), Exobasidium on honeysuckle (13), raspberry mosaic (12), leaf spot on hollyhock 11, leaf spot on kalmia (11), leaf spot on barberry (10),

As has already been stated, mildews, leaf spots and other plant diseases were favored by the frequent rains, and were probably more abundant than in most seasons.

In order to show the prevalence of certain pests in nurseries in 1928, as compared with 1927, and preceding seasons, a record of them for the past eight years is given in the following table:

EIGHT-YEAR RECORD OF CERTAIN NURSERY PESTS

	1921	1922	1923	1924	1925	1926	1927	1928
Oyster-shell scale	36	44	42	44	38	39	45	57
San José scale	28	19	20	32	32	19	16	30
Spruce gall aphids*	31	21	28	40	27	42	82	120
White pine weevil	1	19	17	5	5	8	17	19
Apple and thorn skeletonizer		1	18	2	8	9	22	49
Poplar canker	21	31	34	25	34	32	39	35
Pine blister rust (on Ribes)	2	9	6	8	7	9	9	5
Nurseries uninfested	36	36	32	33	34	46	37	18
Number of nurseries	0.4	101	106	116	151	169	101	228

It should be understood that the figures in the preceding table are not strictly comparable because of the greater number of nurseries since the new law went into effect in 1925. Thus though the number of infested nurseries is greater, the actual percentage may be considerably less.

NUMBER AND SIZE OF NURSERIES

The number of nurseries in Connecticut has increased each year. The list for 1927 contained 191 names. The list for 1928 contains 228 names. Of the 228 separate nurseries in the State, a classification on account of size may be made as follows:

"	"	50 acres or morebetween 10 and 50 acres	
"	"	" 5 and 10 "	
"	a	" 2 and 5 "	
"	"	1 acre or less	00
		2	28

During the year 1928, 245 nursery inspections were made. The list of nursery firms receiving certificates contains 228 names; nine being new nurseries registered during the winter, and were inspected twice, once in the spring and again in the

^{*}Includes both Adelges abietis and Gillettea cooleyi.

fall. Seven nurseries which were inspected failed to qualify in

BULLETIN 305

time to receive certificates during the year.

The owners of two small nurseries failing to register before July 1, as provided in Section 2, Chapter 265, Public Acts of 1925. a minimum charge of five dollars each was collected and the total amount (\$10.00) was sent to the State Treasurer on January 14, 1929. The cost of inspection would have been greater had it been necessary to make a special trip from New Haven to inspect each nursery instead of making the inspection when working in the vicinity. The total area of Connecticut nurseries in 1928 is about 3,194 acres. The figures were taken from the owner's estimates indicated on the registration cards, except in cases where the acreage was not given on the cards, it was estimated by the inspector. Each nursery of less than an acre in extent is listed as one acre, and where fractions are given, the next whole number is recorded. The list of nursery firms receiving certificates in 1928 is as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1928

			Certific		No. of
Name of Firm	Address	Acreage	Issued	care.	tificate
Alius, Adolf	Stamford	1	Dec.		760
Allen, Henry L	North Stonington	î	Aug.		598
Amelunxen & DeWyn	Yalesville	3	July.		549
Anderson, E. H	Bloomfield	3	Dec.		773
Austin, M. E. (2)	Clinton	1	Sept.		638
Barnes Bros. Nursery Co	Yalesville	160	July		547
Barnes Eastern Nursery	Wallingford	15	Sept.		669
Barnes Nursery & Orchard		10	Dept.	1,	009
_ Co	Wallingford	75	Oct.	11	727
Barton, Robert	Hamden	1	Sept.	5	644
Beattie, W. H	New Haven	1	Aug.	28	618
Beerbaum, Wm. F	Waterbury	3	Oct.	9	725
Benbow, A	Norfolk	1	Oct.	2	708
Bertana, Louis	Glenbrook	2	Aug.	2	563
Bertolf Bros., Inc	Greenwich	45	Aug.	2	564
Birchell, George A	Stonington	2	Dec.	26	772
Booy, H. W	Yalesville	3	July	26	550
Botsford, R. C	East Haven	1	Sept.	27	698
Brainard Nursery & Seed Co.	Thompsonville	15	Sept.	4	634
Braley & Co., S. A	Burnside	4	Aug.	16	582
Branford Nurseries	Branford	4	Sept.		662
Bretschneider, A	Danielson	1	Sept.		674
Bridgeport Hydraulic Co	Bridgeport	200	Oct.	19	735
Brimfield Gardens Nursery	Wethersfield	2	Sept.	22	684
Bristol Nurseries, Inc	Bristol	40	Sept.	5	636
Brooklawn Conservatories	Bridgeport	1	Oct.	5	719
Brooklawn Nursery (2)	Fairfield	2	Oct.	14	718
Brouwer and Hancock	New London	13	Aug.	15	600
Brown, Edgar M	Hartford	1	Sept.	12	664
Bubenicek, Joseph (2)	Woodmont	1	Oct.	1	706
Buckley, Walter E	Groton	1	Aug.	17	586
Bulpitt, Henry F	Darien	5	Sept.	4	635
Bunting's Nurseries, Inc	Groton	5	Aug.	23	609

			Contifica	No. of ce Cer-
Name of Firm	Address	Acreage	Certifica: Issued	tificate
Burke, P. I.	Rockville		Aug.	
Burr, Morris L	Westport		Aug. 30	625
Burr & Co., Inc., C. R	Manchester		Aug. 13	580
Burroughs, Thomas E	Deep River		Aug. 8	
Burwell, E. E	New Haven	î	Oct. 1	
Byram Evergreen Nursery	Greenwich	î	Aug. 8	
Candee, Hollis S	Wethersfield	6	Oct. 1	
Cant, Alexander	Springdale	1	Aug. 2	
Cardarelli, E. J	Cromwell	2	Sept.	
Case, Louis L	Simsbury	1		
Chapman, C. B	Groton		Sept. 2	691
Chippendale Nurseries	Old Lyme	1 4	Aug. 28	619
Clark, Raymond H		S 1/1	Sept. 2	
Clinton Nurseries	Milford	1	Dec. 26	
Clyne, George A	Clinton	10	Nov. 8	
Coning Nursery Co	Middlebury	7	Oct. 25	
Conine Nursery Co	Stratford	50	Aug. 2	562
Conn. Agr. College (Prof. S.	Ct		D 01	
P. Hollister)	Storrs	1	Dec. 20	765
Conn. Agr. Expt. Station	N		MARK	
(W. O. Filley, Forester)	New Haven	2	Dec. 10	763
Conn. Valley Nurseries	Manchester	10	Aug. 6	567
Corrigan, James J	West Haven	1	Sept. 5	640
Cragholme Nurseries	Greenwich	8	July 28	558
Cromie, G. A	New Haven	1	Oct. 26	738
Dallas, Inc., Alexander	Waterbury	3	Sept. 17	671
Darien Nursery	Darien	2	Aug. 16	584
Dawson, William A	Willimantic	2	Aug. 22	607
Dunlap, Daniel S	Cromwell	3	Aug. 22	
Dunn, James F	Stamford	2	Aug. 8	
Dougherty, James	Yalesville	1	Aug. 21	
Eager, Edward M	Bridgeport	1	Aug. 31	
East Rock Park Nurserv	New Haven	1	Sept. 28	705
Eells and Sons	Manchester	1	Aug. (
Elfgren and Sons, I. P	East Killingly	1	Aug. 17	
Elm City Nursery Co. (Wood-				000
mont Nurseries, Inc.)	Woodmont	120	Sept. 4	633
Elm Grove Cemetery Assoc.	Mystic	1	Oct. 8	
Ensign-Bickford Co. (S. W.				. 20
Eddy, Supt.)	Avon	5	Nov. 26	751
Evergreen Nursery Co	Wilton	15	July 28	557
Fairty, C. H	New Canaan	2	Aug. 16	
Farmington Valley Nursery	2.000 Canadan		11ug. 10	000
(Harry D. Wilcox, Prop.).	Avon	2	Sept. 28	702
Flower City Rose Co	Manchester	20	Aug. 6	
Fraser's Nurseries & Dahlia.	manufacture of the second of t	20	mug.	000
Gardens	Willimantic	3	Oct. 2	714
Gardner's Nurseries	Rocky Hill	75	Sept. 11	
Geduldig's Greenhouses	Norwich			
Giandomenico, R. Di	Middletown	8	Aug. 29	
Gilbert and Bruce	Williams	1	July 26	
Giuliano, J. S	Killingly	1	Aug. 17	
Glen Terrace Nurseries (Jas.	Wethersfield	1	Sept. 25	692
H. Everett, Prop.)	Mount Carmel	95	D	761
Golden Hill Namony (Andrew	Mount Carmer	25	Dec. 3	761
Golden Hill Nursery (Andrew	Chaltan	9	NT - 15	715
Johnson, Prop.)	Shelton	$\frac{2}{7}$	Nov. 15	
Goodwin Nurseries	Bloomfield	7	Oct. 8	
Grillo, N	Milldale	1	Aug. 29	624

			Contification	No. of
Name of Firm	Address	Acreage	Certificate Issued	Cer- tificate
Hamden Nursery (John Ca-				· · · · · · · · · · · · · · · · · · ·
rolla, Prop.)	Hamden	1	Oct. 9	723
	Fairfield	7		673
Hansen, Peter		1	Sept. 18	
Hawes, Frank M	West Hartford	1000	Sept. 12	663
Hearn, Thomas H	Washington	$\frac{2}{7}$	Aug. 25	612
Heath and Co	Manchester	7	Aug. 6	568
Henninger, Christ	New Britain	1	Sept. 24	689
Hilliard, H. J	Sound View	1	Sept. 22	686
Hiti Nurseries	Pomfret Center	8	Aug. 23	608
Holcomb, H. Parks	Winsted	1	Nov. 27	754
Holcomb, Irving	Granby	1	Aug. 6	575
Holdridge, S. E	Ledyard	3	Aug. 21	597
Horan, James F	Hartford	3	Dec. 1	759
Horan and Son, James	Bridgeport	1	Nov. 26	749
Houston, Byron D	Mansfield	15	Oct. 16	732
		2	Sept. 5	642
Hoyt, Chas. E. (2)	Danbury	500		565
Hoyt's Sons Co., Inc., Stephen	New Canaan			696
Hull, Curtis M	Wallingford	3	Sept. 27	
Hunt and Co., W. W	Hartford	8	Sept. 10	656
Huntoon, Gerald W	Rocky Hill	1	Sept. 12	665
Innes, William	Milford	2	Nov. 15	744
Intravaia, Joseph	Middletown	1	July 26	554
Jankovich, Joseph	Plantsville	1	Sept. 7	650
Jennings, G. S	Southport	1	Aug. 28	621
Joel Nursery Co	Wallingford	5	Nov. 27	755
	Stratford	1	Aug. 31	629
Johnson, Tom	Danbury	1	Dec. 13	764
Kauser, Alice	Norwalk	1	July 28	560
Kelley & Son, James J	Darien	5	Sept. 10	653
Kennedy, Mary H. (2)	East Hartford	ĺ	Aug. 6	571
Kerner, Eugene	Woodbury	î	Dec. 22	768
Keystone Nurseries (H. H.	Woodbary	-	DC0. 22	.00
	Donbury	1	Sept. 5	643
Kellner, Prop.)	Danbury	4	Aug. 3	626
Langstroth Conifer Nursery.	Danbury	4. 220	Aug. 22	605
Leghorn, John J	Cromwell	10		591
Lewis & Valentine, Inc	Darien	11	Aug. 18	588
Liljenstein, Carl	New London	1	Aug. 17	
Lundberg, E. A	Darien	1	Aug. 8	577
MacKeever, Frank C	Rowayton	1	Aug. 28	620
Malavasi, Sam	Woodbridge	3	Oct. 3	717
Mallett, George A	Bridgeport	5	Sept. 20	681
Maplewood Nursery Co. (F.				
M. Oat, Mgr.)	Norwich	3	Dec. 24	770
M. Oat, Mgr.)				
ley, Prop.)	New Canaan	10	Sept. 13	667
Mars, F. H. De (2)	Winsted	1	Oct. 2	709
Mason, Warren S	Farmington	1	Sept. 5	645
Mayapple Nurseries (Paul	1 6111111111111111111111111111111111111	BAT.	F	
	Stamford	1	Aug. 24	611
M. Barrows, Prop.) Maynard and Gadbois	Old Lyme	î	Dec. 21	766
	Manchester	î	Aug. 6	575
McConville, John		1	Oct. 1	707
Meachen, George C	Stratford	1	Nov. 28	757
Meier, A. R	West Hartford			661
Merwin Lane Nursery	Greenfield Hill	6	Sept. 12	704
Meyer, Ludwig	Bridgeport	1	Sept. 28	
Middeleer, Inc	Darien	20	Sept. 19	675
Millane Nurseries	Cromwell	20	Sept. 27	695

			C .:C .	No. of
Name of Firm	Address	Acreage	Certificate Issued	tificate
Minge, C. H	Rocky Hill	1	Oct. 9	724
Moraio Bros	Stamford	5	Aug. 29	622
Moulthrop, William	Watertown	3	Sept. 7	651
Mount Airy Gardens (R. L.	N (1 C) C 1		T 1 00	701
Wilson, Prop.)	North Stamford	1	July 28	561
Mount Carmel Nursery	Mount Carmel	1	Sept. 27	697
New Britain Board of Water Commissioners	New Britain	50	Sept. 24	688
New Haven Nurseries (L. A.	New Biltain	00	Dept. 24	000
Soldan, Mgr.)	New Haven	1	Oct. 31	741
New Haven Park Commission	Tien Haven			
(G. X. Amrhyn, Supt.)	New Haven	20	Sept. 17	670
New London Cemetery Asso-				
ciation	New London	1	Oct. 17	734
New London County Nurseries				
eries	New London	8	Oct. 3	716
New York, New Haven and				
Hartford Railroad Co. (C.			0 . 0	
H. Haggerty)	Stamford	5	Oct. 3	715
Nicholson & Thurston	Litchfield	1	Aug. 28	617
Northeastern Forestry Co	Cheshire	66	July 26	546 652
Norwood Nursery Oakland Nurseries	Hamden	20	Sept. 7 Aug. 18	590
Old Orchard Nursery (R. G.	Wallchester	20	Aug. 10	990
Hanford, Prop.)	Norwalk	-3	Nov. 26	750
Ostergren, Herbert	Cromwell	2	Aug. 22	604
Outpost Nurseries	Ridgefield	90	Sept. 10	657
Ouwerkerk, D. K	Yalesville	10	July 26	552
Park Gardens	Bridgeport	1	Sept. 24	687
Park Place Nurseries (R. E.				
Upson, Prop.)	Marion	5	Sept. 25	693
Patrick, Charles	Bridgeport	1	Nov. 26	752
Pedersen, Anthon	Stamford	2	Sept. 22	683
Pequod Nursery Co	Yalesville	15	July 26 Aug. 30	548
Peschko, Robert	Danbury	1	Aug. 30	627
Phelps and V. T. Hammer Co., The J. W	Branford	3	Sept. 27	700
Phillips, Alice G	Milton	1	Oct. 2	711
Pierrepont, Seth L	Ridgefield	12	Dec. 22	769
Pierson, Inc., A. N	Cromwell	150	Aug. 24	610
Pinatello, Michael	East Hartford	2	Nov. 26	748
Pinchbeck Bros., Inc	Ridgefield		Sept. 17	668
Polish Orphanage Farm	New Britain	1	Oct. 29	739
Pomeroy Blue Spruce Gardens	New Milford	5	Aug. 25	613
Prospect Nurseries (S. C.				
Hubbard, Prop.)	Cromwell	5	Sept. 6	646
Prudence Seymour Gardens	NT - NC1101		A 00	011
(Mary T. Parfitt, Prop.)	New Milford		Aug. 28	614
Rabinak, Louis	Deep River		Oct. 8 Sept. 10	721 655
Rengerman, A. B	Granby South Norwalk		July 27	556
Reynolds, Stephen Richmond, Gordon L	New Milford		Aug. 28	615
Rockfall Nursery Co	Rockfall		Sept. 6	648
Rottenberg, Julius	Newington		Sept. 28	703
Russell, C. B	Newington		Sept. 19	678
Sage, Hollister	Woodbury	1	Sept. 7	649
Sargeant, Mrs. A. R	Tolland	1	Aug. 6	566

BULLETIN 305

Name of Firm	Address	Acreag	Certificate E Issued	No. of Cer- tificate
Saxe-FlotoSchaeffer Bros	Waterbury Ledyard	1	Oct. 31	740
Scheepers, Inc., John	Stamford	3 10	Aug. 21 July 26	596 555
Schulze, Charles T	Bethel	2	Nov. 27	753
Scott's Nurseries	Bloomheld	4	Nov. 27	756
Seltsam, George	Bridgeport	1	Sept. 19	680 ·
Seymour, Fred R	Riverton :	2	Oct. 2	710
Shelton, Philo S	Fairfield	$\frac{1}{4}$	July 28 Sept. 19	559 677
Sterman, C. H	Hartford	8	Oct. 2	713
Simonsen, H. C	Plainville	3	Dec. 10	762
Snelgrove, S. J	Windsor	2	Aug. 31	632
Soltes, Martin	Shelton	1	Nov. 13	743
Southport Nursery (Coari & Sons, Props.)	Southport	20	Sept. 12	666
South Wilton Nurseries (I. C.	Southport	20	Dept. 12	000
Van Heiningen, Prop.)	South Wilton	4	Aug. 14	581
Spencer, W. L. L. (2)	Columbia	1	Aug. 22	603
Spring Nurseries (H. C.	D-:-4-1	0		
Barnes, Prop.) State of Connecticut (A. F.	Bristol	2	Sept. 5	639
Hawes, State Forester)	Simsbury	5	Sept. 10	654
State Street Nursery (John		3	ocpt. 10	004
Natyzon, Prop.)	New Haven	2	Sept. 12	660
Steck, Charles A	Newtown	8	Sept. 6	647
Steck, Jr., Charles A Steck, Harold W	Bethel	2	Oct. 15	730
Steck, Sarah B	Farmington Bethel	10	Oct. 11 Sept. 10	729 658
Stratheld Nurseries (Geo. R.	Domor	1	Dept. 10	000
Godfrey, Prop.)	Bridgeport	35	Oct. 17	733
Stratford Rose Nurseries				
(John Barrows, Prop.) Szirbik & Co., George	Stratford	1	Aug. 31	631
Tanner, E. G.	New Haven Manchester	1 1	Sept. 18 Aug. 6	672 573
Thomas Nursery	Hamden	2	Dec. 22	767
Tryon, George W	North Stonington	1.	Aug. 21	599
Van Der Bom Nursery	Bethel	1	Aug. 30	628
Vanderbrook & Son, Charles L	Manahaatan	01	A 00	-00
Vanderstam, C. L.	Manchester Yalesville	$\frac{21}{2}$	Aug. 20 July 26	592 551
Vanderstam, C. L Van Wilgen Nurseries	Branford	8	Nov. 23	746
Vasileff, Nicholas	Greenwich	2	Sept. 22	682
Verkades' Nurseries	New London	37	Aug. 20	593
Vernik, John	Fairfield	2	Nov. 26	747
Wayside Farm Gardens (Miss	Wallingford	7	Sept. 27	699
I. E. Aldrich, Prop.).	Thomaston	2	Aug. 28	616
Wegner, C. F	Noroton Heights	3	Nov. 28	758
Weirether, Leo (2)	West Haven	1	Sept. 22	685
Wheeler, C. B	North Stonington	1	Aug. 21	595
wind, Henry	Greenwich and Norwalk	30	Sept 27	694
Williams, Carl C	Southport	1	Sept. 27 Oct. 15	731
Williams, Harry (†	Shelton	î	Sept. 19	676
Wilcox, Elmer E Wilson & Co., C. E	Guilford	1	Aug. 21	594
Woodruff, Carleton V	Manchester	110	Aug. 16	583
" oodrain, Carreton v	Orange	1	Oct. 2	712

Name of Firm	Address	Acreage	Certificates Issued	Cer- tificate
Wyllie, David	Whitneyville	1	Sept. 5	641
Yale Landscape Department	New Haven		Oct. 26	737
Yale School of Forestry	New Haven	2	Sept. 19	679
Zack Co., H. J	Deep River	12	Sept. 27	701
Total acres		3,194		

INSPECTION OF RASPBERRY PLANTATIONS

Each year for several years, certain nurserymen and raspberry growers have applied for special inspections and certificates in order to permit them to sell plants, free from the so-called mosaic diseases. Without these special certificates they are unable to ship raspberry plants into the five states of Michigan, Minnesota, New York, Vermont and Wisconsin. In 1928, two nursery firms duly applied for the special inspection and certificates. The inspections were made at the proper time and the diseased plants removed. After the second inspection two certificates were granted. Certain varieties contained too much mosaic to be covered by the certificates, which include only the varieties indicated as follows:

SPECIAL CERTIFICATES ON RASPBERRY PLANTS

Name of Firm Barnes Nursery & Orchard Co Conine Nursery Co	Address o.,Wallingford Stratford	Variety Latham Cuthbert La France St. Regis	Date of Issue Oct. 18 Oct. 17	
		White Oneen		

NURSERY DEALERS

Chapter 265, Public Acts of 1925, provides that dealers in nursery stock must register each year, on or before March 1, with the State Entomologist, and cite the principal sources of their nursery stock. All dealers' permits are for the remainder of the calendar year and expire on December 31. During the year 104 such dealers have registered and received permits. The list of dealers is on file in the office of the State Entomologist but is not printed in this Report.

OUT-OF-STATE NURSERYMEN

Nurserymen in other states wishing to ship stock into Connecticut are required to file with the State Entomologist signed copies of their nursery inspection certificates and make application for

permits to ship stock into the State. These permits are valid only for the periods covered by the certificates placed on file. During the year 261 permits have been issued to nurserymen in other states, but the list of firms receiving them is not printed in this Report.

BULLETIN 305

PARCEL CERTIFICATES

In addition to the regular inspection and certification of nursery stock, occasionally individuals wish to send shrubs and plants to their friends, and sometimes nurserymen need to ship packages before receiving their regular certificates. Consequently 237 separate parcels of nursery stock have been inspected and package certificates furnished.

INSPECTION OF NARCISSUS BULBS

On account of Federal quarantine No. 62, narcissus bulbs grown in Connecticut cannot be shipped into other states unless given two inspections, one in the field in May, and the other after the bulbs have been dug for shipment. In case they are found to be infested with bulb flies or eelworms, they must then be treated. During the year 45,500 such bulbs were inspected and certified.

INSPECTON OF LAUREL AND DECORATIVE MATERIALS

Considerable decorative material is gathered each year in Connecticut woodlands and shipped into New York City. This is mostly mountain laurel, *Kalmia latifolia*. If gathered within the gipsy moth quarantined area, it is examined by Federal inspectors, and if found clean, is certified for shipment. Much of it is collected outside the quarantined area and yet cannot enter New York without being certified. During the year 151 such certificates were issued.

INSPECTION OF SHELLED SEED CORN

On account of the European corn borer having been found in a small portion of Connecticut, certain states would not allow shelled sweet corn for seed to enter unless it had been inspected and certified to be free from bits of cob large enough to carry borers. Therefore a large quantity of such seed corn was inspected as it came through the cleaning mill, and 475 certificate tags were issued.

INSPECTION OF IMPORTED NURSERY STOCK

W. E. BRITTON AND M. P. ZAPPE

Beginning with the year 1920, only rose and fruit tree seedlings have been allowed to enter Connecticut from foreign countries. All other nursery stock is prohibited, except new varieties for propagation which must enter through Washington, D. C., where the material is inspected and if infested, treated and held under quarantine or destroyed. Even the rose and fruit seedlings enter the country under regulations prescribed by the Federal Horticultural Board, now called the Plant Ouarantine and Control Administration. The system requires applications, permits, proper marking, releases at ports of entry, inspection at points of destination and reports of the inspection sent to Washington. The ispection is usually made by the State officers. The imported nursery stock entering Connecticut in 1928 has been inspected by Mr. Zappe with the assistance at rush periods of Messrs. B. H. Walden, B. W. McFarland and R. C. Botsford. In number of shipments, number of cases and number of plants, the importations of 1928 were somewhat less than those of the preceding four years, as the following table shows:

Year	No. of shipments	No. of cases	No. of plants
1920	17	87	814,491
1921		126	1,228,560
1922	30	159	1,997,595
1923	35	179	1,981,895
1924		313	3,489,170
1925		277	2,977,346
1926		347	3,443,357
1927	31	321	3,229,915
1928	36	277	2,680,700

Sources of Imported Nursery Stock, 1927-1928

As in preceding years the greatest number of shipments came from Holland, but from France came the greatest number of cases and plants. The record for the year is as follows:

Country	No. of shipments	No. of cases	No. of plants
Holland	13	132	1.019.500
France	10	142	1,643,200
England	3	3	18,000
	-		
Total	26	277	2,680,700

These 26 shipments were imported by nine different firms of Connecticut nurserymen and florists, 15 shipments being con-

signed to two firms. Nine shipments were composed of fruit stock and 17 shipments of rose stock.

KINDS OF STOCK IMPORTED

Of this plant material inspected, 1,273,500, or about 48 per cent were rose plants, and 1,407,200, or nearly 52 per cent were fruit tree seedlings. The number of each kind is shown in the following table:

FRUIT	STOCKS	
Variety Apple (all kinds) Cherry (all kinds)	No. of plants 486,000 671,700	Total
Pear	134,500 105,000 10,000	1,407,200
ROSE	STOCKS	
Variety	No. of plants	Total
Manetti rose	1,109,500 $42,000$	
Rugosa rose	122,000	1,273,500
Grand total fruit stock	s and rose stocks	2,680,700

The following table shows the quantities of stock inspected by months:

Month	No. of shipments	No. of cases	No. of plants
December	6	28	253,000
January	9	145	1,626,200
February	6	27	262,000
March	3	34	315,500
April	2	43	224,000
Total	26	277	2,680,700

The time required to inspect this imported plant material is equivalent to one man working 27 days and his time, traveling and other necessary expenses amounts to about \$400.00.

In addition to the inspected material enumerated and tabulated above, there were 37 shipments of tree seeds which were not inspected in Connecticut, but which were fumigated at the port of entry. Of all shipments of imported stock 26 reports were made to the Federal Horticultural Board at Washington. There were also 11 shipments of new varieties for propagation, which were inspected at Washington, D. C.

Of the 26 shipments inspected, 15 shipments or about 58 percent were found infested with insects, some of which are well-known pests. Detailed information regarding them follows:

PESTS FOUND ON IMPORTED NURSERY STOCK

15 Shipments Infested

- Acronycta auricoma Schiff. (2 shipments). On quince, pear and plum, A. Fermaud, Angers, France; on apple and cherry, Andre Choplin, Maze, France.
- Aporia crataegi Linn. (1 shipment). On apple, 5 nests, A. Fermaud, Angers, France.
- Blaps mucronata Latr. (1 shipment). On cherry, A. Fermaud, Angers, France.
- Emphytus cinctus Linn. (9 shipments). On manetti rose, Association Flora, C. Klyn & Co., Otto & Sons, Boskoop, H. H. Woldering, Veendam, Holland; Andre Choplin, Maze, France; Geo. I. Adamds, Tunbridge Wells, W. C. Slocock, Surrey, England.
- Lampyrid eggs (1 shipment). In gallery of *Emphytus cinctus* in manetti rose, Geo. I. Adamds, Tunbridge Wells, England.
- Lepidopterous pupae (2 shipments). Dead crushed specimens on cherry, Andre Choplin, Maze, France; Hemeray-Aubert, Orleans, France.
- Mamestra dissimilis Kn. (1 shipment). Cocoon on rose, Andre Choplin, Maze, France.
- Notolophus antiqua Linn. (5 shipments). One egg-mass on apple, 1 on rose, Andre Choplin, Maze, France; 3 egg-masses on apple, A. Fermaud, Angers, France; 1 egg-mass on apple, V. Lebreton, La Pyramide, France.
- Papilio podalirius Linn. (1 shipment). On cherry, Andre Choplin, Maze, France.
- Paratetranychus pilosus C. and F. (1 shipment). On apple, V. Lebreton, La Pyramide, France.
- Woolly aphid (3 shipments). On apple, A. Fermaud, Angers, France, V. Lebreton, La Pyramide, France.

INSPECTION OF APIARIES IN 1928

In 1928, as in preceding years, the apiaries, of Connecticut have been inspected by Messrs. H. W. Coley, of Westport, and A. W. Yates, of Hartford, who have worked on a per diem basis. Mr. Coley has covered the southern half of the State, (Fairfield, New Haven, Middlesex and New London Counties), and Mr. Yates the northern half (Litchfield, Hartford, Tolland, and Windham Counties).

This inspection work in 1928 required 138 man days and together with traveling expenses cost \$1,805.05. In all, 852 apiaries, containing 8,023 colonies, were inspected in 1928 as against 803 apiaries containing 8,133 colonies in 1927. The apiaries averaged 9.41 colonies each in 1928 and 10.1 each in 1927.

The following table shows the number of apiaries and colonies inspected and the average number of colonies per apiary, as well as the cost per apiary and colony for each year since the inspection work originated in 1910:

NINETEEN YEAR RECORD OF APIARY INSPECTION IN CONNECTICUT

	No. of	No. of	Average No. Colonies	Cost of 1	rerage inspection
Year	Apiaries	Colonies	Per Apiary	Per Apiary	Per Colony
1910	208	1,595	7.6	\$2.40	.28
1911	162	1,571	9:7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918.	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8,007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25
1925	766	8,257	10.7	2.45	.22
1926	814	7,923	9.7	2.35	.24
1927	803	8,133	10.1	2.37	.234
1928	852	8,023	9.41	2.12	.225

In 1928, apiaries were inspected in 149 towns as against 135 towns in 1927, and 137 towns in 1926.

Inspections were made in the following towns in 1928 which were not visited in 1927: Fairfield County—New Fairfield, Sherman; New Haven County—Bethany, Branford, Cheshire, East Haven, Hamden, Meriden, Middlebury, New Haven, North Branford, Orange, Southbury, Wolcott, Woodbridge; Middlesex County—Killingworth, Saybrook; New London County—East Lyme, Old Lyme, Preston, Sprague; Litchfield County—Cornwall, Goshen; Hartford County—Enfield, Southington, South Windsor; Windham County—Pomfret, Sterling.

On the other hand, the following 15 towns, where inspections were made in 1927, were not visited by the inspectors in 1928: Fairfield County—Trumbull, Weston, Shelton, Monroe; New Haven County—Ansonia, Beacon Falls, Prospect; New London County—Lisbon; Litchfield County—Barkhamsted; Tolland County—Willington; Windham County—Ashford, Chaplin, Eastford, Hampton, Thompson.

There are several towns where no recent inspections have been made. In Warren (Litchfield County) no apiaries have been inspected since 1919, though the inspector has made inquiries and failed to learn of any beekeepers in the town. Bridgeport (Fairfield County) has not been inspected since 1926. No inspection has been made in Eastford (Windham County) since 1924.

EUROPEAN FOUL BROOD

This is a disease of the young larvae, caused by a bacterial germ known as *Bacillus pluton*, and commonly called European foul

brood. Usually it is more troublesome in early summer than at other times during the year, the cell contents are not ropy or gelatinous, and though often with the odor of fermentation, it is not very offensive. Requeening with Italian queens and uniting two or more weak colonies to make them strong are common methods of control.

Of the 852 apiaries and 8,023 colonies inspected in 1928, 9 apiaries and 26 colonies were found infested with European foul brood. This infestation amounts to 1.05 per cent of the apiaries and .324 per cent of the whole number of colonies inspected during the season.

The following table gives a complete record of percentages of infestation of European foul brood in Connecticut since the inspection work begain in 1910:

RECORD OF EUROPEAN FOUL BROOD

	Percentage of	f Infestation		Percentage o	f Infestation
Year	Apiaries	Colonies	Year	Apiaries	Colonies
1910	75.9	49.7	1919	6.6	1.2
1911	51.8	27.4	1920	4.3	1.5
1912	47.7	23.5	1921	3.91	1.26
1913	44.4	24.5	1922	4.14	.85
1914	32.6	13.9	1923	2.34	.36
1915	26.1	10.3	1924	1.78	.526
1916	18.8	7.05	1925	2.48	.507
1917	16.7	4.86	1926	3.19	.858
1918	9.8	3.3	1927	1.12	.282
			1928	1.05	.324

During 1928, European foul brood was discovered only in the following 7 towns: Old Saybrook in Middlesex County; Bristol, Marlborough, New Britain, Newington, and Wethersfield in Hartford County; Brooklyn in Windham County. No apiaries infested with this disease were found in Fairfield, New Haven, New London, Litchfield or Tolland Counties.

AMERICAN FOUL BROOD

American foul brood is also a disease of the larvae caused by the bacterial organism known to science as *Bacillus larvae*, but it attacks the brood at a later stage of development than does the European foul brood. It usually shows when the larvae are nearly mature or pupating after the cells are sealed. The diseased cells are shrunken, and if broken open, the contents have a peculiar ropy or stringy consistency and give off a very offensive odor. Formerly the treatment was to shake the bees into clean hives, destroy the infected combs, and disinfect the old hives. Now the diseased combs may be sterilized by soaking them in an alcoholformalin solution containing twenty per cent of formalin, after which they may be used with safety.

Of the 852 apiaries and 8,023 colonies inspected in 1928, 36 apiaries and 79 colonies were infested with American foul brood. This infestation is equivalent to 4.213 per cent of the apiaries and .98 per cent of the colonies inspected in 1928. This record for 1928 is a greater percentage of infested apiaries than is usually found. It is the highest percentage of apiaries ever found and in only one year (1919) has the percentage of colonies infested with this disease been greater in Connecticut since the inspection work started in Connecticut.

The following table shows a complete record regarding American foul brood since apiary inspection was started in Connecticut in 1910.

RECORD OF AMERICAN FOUL BROOD

	Percentage of	f Infestation		Percentage o	f Infestation
Year	Apiaries	Colonies	Year	Apiaries	Colonies
1910	0	0	1919	3	1.1
1911	0	0	1920	1.18	.25
1912	0	0	1921	2.5	.56
1913	0	0	1922	1.38	.27
1914	1.07	.7	1923	.985	.323
1915	.8	.18	1924	1.04	.22
1916	1.07	.15	1925	3.26	.424
1917	.42	.17	1926	1.72	.29
1918	1.01	.32	1927	3.11	.70
			1928	4.213	.98

During 1928, American foul brood was found in the following 22 towns: Ridgefield and Wilton in Fairfield County; Branford, Cheshire, Hamden, Prospect, and Wallingford in New Haven County; Chester and Middlefield in Middlesex County; East Lyme in New London County; Bethlehem, Thomaston, Watertown and Winchester in Litchfield County; Bristol, Hartland, Manchester, West Hartford and Windsor in Hartford County; Andover and Ellington in Tolland County, and Brooklyn in Windham County.

SACBROOD

Sacbrood or pickled brood is a disease often mistaken for American or European foul brood. The cause is considered to be a filterable virus. The larvae die about the time the cells are capped and lie on their backs with heads turned upward. The body is swollen and contents watery, but there is no ropiness, and the entire cell contents may easily be removed intact as if enclosed in a sac. The color is variable, though often light yellow or brown, with head nearly black. The usual treatment is to make strong colonies by uniting the weak ones. In certain rare cases where whole apiaries become infected, new queens should be supplied to all the colonies.

The following table shows the record of sacbrood since apiary inspection in Connecticut started in 1910:

RECORD OF SACBROOD

	Percentage of	Infestation		Percentage o	f Infestation
Year	Apiaries	Colonies	Year	Apiaries	Colonies
1910	0	0	1919	1.24	.19
1911		.51	1920	1.18	.229
1912		Several	1921	1.06	.157
1913		2.8	1922	1.37	.187
1914	2.59	.721	1923	.53	.086
1915	2.02	.47	1924	1.78	.52
1916	.428	.051	1925	3.39	.836
1917	1.48	.199	1926	1.1	.138
1918	.253	.032	1927	.03	.0036
			1928	.035	.087

During the year Sacbrood was found in the following 2 towns: Wallingford in New Haven County and Killingworth in Middlesex County.

STATISTICS OF INSPECTION

The statistics of apiary inspection by towns and counties are given in the following pages with summary on page 711.

. Inspection of Apiaries, 1928

		aries		onies	Foul!		
Town	In- spected	Dis- eased	In- spected	Dis- eased	Ameri- can	Euro- pean	Sac- brood
Fairfield County:	opecied	cased	specied	caseu	can	pean	brood
Bethel	. 6	0	44	0	0	0	0
Bridgeport		Õ	0	Õ	ő	0	0
Brookfield		Õ	62	Õ	ő	Õ	ñ
Danbury		Ö	16	0	Õ	0	ŏ
Darien	1	Ŏ	28	ő	Õ	Õ	Õ
Easton	. 1	0	70	0	Ö	Ö	Õ
Fairfield		0	46	0	Ö	Ŏ	Ŏ
Greenwich	. 6	0	34	Ö	Ö	0	0
Monroe	. 0	0	0	0	0	0	0
New Canaan	. 2	0	28	0	0	0	0
New Fairfield	. 3	0	27	0	0	0	0
Newtown	. 0	0	0	0	0	0	0
Norwalk	. 1	0	16	0	0	0	0
Redding	. 2	0	40	0	0	0	0
Ridgefield	. 5	4	32	14	14	0	0
Shelton	. 0	0	0	0	0	0	0
Sherman		0	5	0	0	0 -	0
Stamford		0	57	0	0	0	0
Stratford		0 .	28	0	0	0	0
Trumbull		0	0	0	0	0	0
Weston		0	0	0	0	0	0
Westport		0 .	32	0	0	0	0
Wilton	. 12	3	147	11	11	0	0
	54	7	712	25	25	0 -	0

Town	Apia In- spected	aries Dis- eased	Color In- spected	nies · Dis- eased	Foul American	Brood Euro- pean	Sac- brood
New Haven County Ansonia Beacon Falls Bethany Branford Cheshire Derby East Haven Guilford Hamden Madison Meriden Middlebury Milford Naugatuck New Haven North Branford North Haven Orange Oxford Prospect Seymour Southbury Wallingford Waterbury West Haven Wolcott Woodbridge	$\begin{array}{c} :: \\ 0 \\ 0 \\ 5 \\ 2 \\ 6 \\ 1 \\ 2 \\ 8 \\ 7 \\ 3 \\ 4 \\ 4 \\ 2 \\ 5 \\ 2 \\ 1 \\ 1 \\ 4 \\ 0 \\ 4 \\ 1 \\ 1 \\ 1 \\ 3 \\ 5 \\ 0 \\ 2 \\ 2 \end{array}$	0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 14 14 108 5 15 44 73 14 56 30 33 60 10 12 26 25 0 34 27 14 83 26 0 12 28	0 0 0 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
woodbridge	85	8	763	17	12		
Middlesex County: Chester Clinton Cromwell Durham East Haddam East Hampton Essex Haddam Killingworth Middlefield Middletown Old Saybrook Portland Saybrook Westbrook	0 4 9 4 5 7 2 4 5 6	0 1 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0	50 59 55 0 154 115 37 63 17 36 56 74 44 16 8	0 2 0 0 0 0 0 0 0 2 8 0 14 0 0 0	0 2 0 0 0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
New London County Bozrah Colchester East Lyme Franklin Griswold Groton Lebanon	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 1 0 0 0	9 143 98 89 72 82 132	. 0 0 1 0 0 0	0 0 1 0 0 0	0. 0 0 0 0	0 0 0 0 0 0

	Apia In-	ries Dis-	In-	lonies Dis-	Foul :	Brood Euro-	Sac-
	spected	eased	spected	eased	ican	pean	brood
New London Count Ledyard	y—cont. 5	0	61	0	0	0	0
Lisbon	0	Ö	0	ő	. 0	0	Ö
Lyme	2	0	86	0	0	0	0
Montville New London	7 3	0	64 15	0	0	0	0
North Stonington	1	0	15	0	0	0	0
Norwich	14	0 .	459	0	0	0	0
Old Lyme	1 4	0	14 95	0	0	0	0
Preston	1	0	99	0	0	0	0
Sprague	2	0	62	Ŏ	ő	ŏ	ő
Stonington	$\frac{5}{2}$	0	68	0	0	0	0
Voluntown Waterford	$\frac{2}{2}$	0	$\frac{12}{34}$	0	0	0	0
	84	1	1,619	1	1	0	0
Litchfield County:	0	0					
Barkhamsted Bethlehem*	0 11	$\frac{0}{2}$	$\begin{array}{c} 0 \\ 43 \end{array}$	$\frac{0}{3}$	0 3	0	0
Bridgewater	5	õ	87	ő	0	0	0
Canaan	3	0	15	. 0	0	0	0
Colebrook Cornwall	$\frac{2}{4}$	0	$\begin{array}{c} 27 \\ 20 \end{array}$	0	0	0	0
Goshen	4	0	35	Ů.	0	ő	ő
Harwinton	7 5	0	17	0	0	0	0
Kent Litchfield	9	0	$\begin{array}{c} 99 \\ 122 \end{array}$	0	0	0	0
Morris	5	0	27	0	0	ő	ő
New Hartford New Milford	9	0	29	0	0 .	0	0
Norfolk	3	0	111 16	0	0	0	0
North Canaan	2	0	63	ŏ	ő	0	Ö
Plymouth	8 5	0	34	0	0	0	0
Roxbury	7	0	38 80	0	0	0	0
Sharon	5	0	71	0	0	0	Ö
Thomaston	$\frac{8}{12}$	$\frac{2}{0}$	32 89	3	3	0	0
Warren	0	0	0	0	0	0	0
Washington	8	0	140	0	0	ŏ	ő
www.	11 14	1	53 68	$\frac{3}{1}$	3	0	0
Woodbury	5	0	86	0	$\begin{array}{c} 1 \\ 0 \end{array}$	0	0
1		6	1,402	10	10		0
Hartford County:							
Avon	5	0	19	0	0	0	0
	12	0	227	0	0	0	0
	10 17	$\frac{0}{2}$	159 93	0 3	$\frac{0}{2}$	0	0
Burlington	4	0	26	0	0	0	0
Canton	10	0	48	0	0	0	0
East Granby	3	0	20	0	0	0	0

^{*}One colony inspected twice.

In-	iaries Dis-	Colo In-	nies Dis-	Foul I	Brood Euro-	Sa c-
Town spected Hartford County—cont.	eased	spected	eased	ican	pean	brood
East Hartford 8 East Windsor 15 Enfield 9 Farmington 12 Glastonbury 8 Granby 9 Hartford 2 Hartland 2 Manchester 11 Marlborough 2 New Britain 9 Newington† 9 Plainville 14 Rocky Hill 4 Simsbury 10 Southington 7 South Windsor 7 Suffield 12 West Hartford 15 Wethersfield 15 Windsor* 18 Windsor Locks 2	0 0 0 0 0 0 0 0 2 2 2 1 0 0 0 0 0 0 0 0	38 83 51 75 91 65 22 98 63 29 79 65 46 32 51 35 40 76 96 71 94 8	0 0 0 0 0 0 0 0 3 2 2 2 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
261	16	1,900	24	13	11	0
Tolland County: 6 Andover. 6 Bolton. 4 Columbia. 7 Coventry. 13 Ellington. 9 Hebron. 6 Mansfield. 8 Somers. 2 Stafford. 13 Tolland. 8 Union. 3 Vernon. 3 Willington. 0	1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	17 17 27 74 41 25 34 9 40 42 2 19	7 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	7 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
82	2	347	8	8	0	0
Windham County: Ashford 0 Brooklyn 3 Canterbury 4 Chaplin 0 Eastford 0 Hampton 0 Killingly 6 Plainfield 12 Pomfret 5 Putnam 5 Scotland 7 Sterling 3 Thompson 0 Windham 12 Woodstock 6	0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 109 56 0 0 40 47 29 36 33 16 0 70 60	0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0
63	1	496	1	0	1	0

^{*}One apiary inspected twice. †One bee paralysis.

			SI	UMMARY				
County	No. Towns	Apiaries In- spected	Dis- eased	Colonies In- spected	Dis- eased	Foul Amer- ican	Brood Euro- pean	Sac- brood
Fairfield	17	54	7	712	25	25	. 0	0
New Haven.		85	8	763	17	12	Ö	5
Middlesex	14	65	4	784	26	10	14	2
New London		84	1	1,619	1	1	0	0
Litchfield		158*	6	1,402	10	10	0	0
Hartford		261	17*	1,900	25*	13	11	0
Tolland	12	82	2	347	8	8	0	0
Windham	10	63	1	496	1	0	1	0
	149	852	46	8,023	113	79	26	7

	No. Apiaries	No. Colonies
Inspected	852	8,023
Intested with European foul brood	9	26
Per cent infested	1 05	.324
Infested with American foul brood	36	79
Per cent infested	4.213	. 98
Infested with Sacbrood	3	7
Intested with bee paralysis	1	1
Average number of colonies per apiary		9.41
Cost of inspection		\$1,805.05
Average cost per apiary		\$2.12
Average cost per colony		. 225

REGISTRATION OF BEES

Though Chapter 129, Public Acts of 1923, provides that all bee-keepers shall register with the town clerk of the town in which the bees are kept, on or before October 1 of each year, the law is not enforced and only a portion of the apiaries are registered. In Stafford in 1924, one beekeeper was prosecuted and fined for failing to register, but I have not learned of any other case in Connecticut where the law has been enforced. In one town in 1928, the town clerk (a woman) telephoned to certain persons known to keep bees, with the result that all of them registered.

The law also provides that the town clerks shall report all such registrations to the State Entomologist on or before February 1, but does not require them to report in case no registrations have been made. Consequently, without investigating the matter, it is impossible to know whether the town clerk has failed to report the names registered or whether no bees have been registered in the town. Probably the General Assembly of 1929 will be asked to change this provision of the law.

The law as it now stands is as follows:

"Section 1. Every person owning one or more hives of bees shall, annually, on or before the first day of October, make application to the town clerk of the town in which such bees are kept, for the registration of such bees, and such town clerk shall issue to such applicant a certificate

^{*}One colony had bee paralysis.

of registration upon the payment of a recording fee of twenty-five cents, which certificate shall be in the form prescribed and upon blanks furnished by the commissioner of domestic animals and shall be recorded in the office of such town clerk.

CONNECTICUT EXPERIMENT STATION

Sec. 2. A record of such registration and of the name and place of residence of the registrant and the definite location in the town where bees are kept by him shall be kept in a separate book in the office of the town clerk, which record shall be accessible to the public. Each town clerk shall file with the state entomologist of the Connecticut Agricultural Experiment Station a complete list of such registrations and locations on or before the first day of February of the year succeeding such registrations. Any town clerk failing to perform such duty shall be fined not more than top deliber.

Sec. 3. Any owner of bees who shall fail to register as required by the provisions of this act shall be fined not more than five dollars."

All beekeepers should each year on or before October 1, register with the town clerk in the towns where the bees are kept.

All town clerks after October 1, should report complete data regarding such registration to the State Entomologist.

GIPSY MOTH WORK IN CONNECTICUT IN 1928

By W. E. Britton and John T. Ashworth

The work of suppressing the gipsy moth has been continued on the same plan as adopted in former years, by the State of Connecticut in cooperation with the Federal Bureau of Entomology. As the Federal forces have ever been chiefly interested in preventing the further spread of the insect, they have operated in the territory along the western border of the infested area. The State forces for the most part have worked in the territory further eastward which is known to be infested. We are greatly indebted to Messrs. A. F. Burgess and H. L. Blaisdell, in charge of the Federal work, for their hearty cooperation and we here express to them our thanks and appreciation.

FINANCIAL STATEMENT

RECEIPTS

Appropriation for biennial period ending June 30, Rebate on automobile insurance	1929	\$100,000.0 199.0
Total		\$100,199.0
EXPENDITURES		
Salaries	\$4,840.00	
Labor	39,174.67	
Stationery and office supplies	32.00	
Sundry supplies	13.94	
Communication service		
Telephone		
Postage 11.24		
	76.04	

Travel expenses Gasoline Oil Transportation of things Printing (warning signs) Heat, Light, Water and Power: Fuel Fuel	\$144.10	\$270.36 1,571.22 730.72 60.86 27.50	
Electricity	20.00	164.10	
Tools, machinery and appliances		663.75	
Spray materials		1,111.77	
Buildings and land Office rent	\$ 12.00 300.00 328.50	640.50	
Contingent expenses		040.50	
Purchase of new Buick car Medical services Insurance (liability):	\$1,262.00 2.00		
on autos	625.54		
fire and theft	81.39		
stock and fixtures	131.50		
Spray damage to auto	25.00	9 197 49	
Automobile repairs and supplies		2,127.43 1,538.53	
	Alie Jelije		\$53,043.39
Balance			\$47,155.65

EQUIPMENT

The Buick touring car used for the past three years, having reached the point of requiring frequent repairs, was exchanged for a new Buick sedan early in July, 1927. A Dodge touring car has nearly outlived its usefulness, and authorization has already been granted to exchange it for a Chevrolet sedan. Nine Ford light delivery trucks are used in transporting the scouts from their boarding places to the field, each crew having a truck in charge of the foreman. Two Netco trucks with Fitzhenry-Guptill pumps and 400-gallon tanks are used in spraying, and a horse-drawn power sprayer is available if needed.

During the year, 1,000 feet of new spray hose was purchased. This gives us about 3,500 feet of one-inch high pressure spray hose and 150 feet of suction hose.

The storehouse rented on North Main Street, Danielson, is provided with gasoline tank and pump, and is well equipped with small tools, Ford parts, tires and tubes, so that most of the repair work can be done by our own men.

DETAILS OF WORK BY COUNTIES AND TOWNS

The following pages contain a detailed account of the scouting, spraying and other control measures in the infested towns.

When egg-clusters are found, they are always saturated with creosote to kill the eggs. Complete statistics are given in the tables beginning on page 723 and are summarized on page 725.

WINDHAM COUNTY

The only scouting in Windham County this year was done in training men, with a little additional work in late spring, and was all confined to the three following towns:

Killingly—54 Infestations—2,437 Egg-clusters

Killingly was used as a training school this year, and the southern two-thirds of the town was scouted. The infestations found were not so large as in preceding years, but were closer together, indicating a more general infestation especially at the eastern end of the town near the Rhode Island State line. The largest colony found was in white oak woodland owned by G. E. Paine, situated on the Green Hollow road just south of Danielson; 598 egg-clusters were found and treated here. On the south side of the Providence pike just east of the village of South Killingly, 345 egg-clusters were found on six trees and in a stone wall. These were the only large colonies found in the town and spraying was done by State men in June.

Scotland—2 Infestations—6 Egg-clusters

Scouting in this town was started May 5, and two small infestations of three egg-clusters each were found, one in the southwestern corner of the town and the other about one mile north of the post office.

Sterling—8 Infestations—405 Egg-clusters

It was late in May before scouting was started in Sterling, and the eggs were hatching when the men found them. Before the town was completed, scouting had to be stopped, and spraying was started. Two large colonies were found just north of the Providence road near the Rhode Island line, one of 146 egg-clusters was on land owned by J. H. Brown and the other of 100 egg-clusters was a short distance southward on land owned by Henry Esklinen. Three places were sprayed by State men in June.

NEW LONDON COUNTY

New London—15 Infestations—660 Egg-clusters

Two large colonies were found in New London by a State crew this year, one of 230 egg-clusters on a white oak and in a stone

wall on Roosevelt Street, on land owned by Mr. McMahon, and the other of 211 egg-clusters on Glenwood Avenue, in the southern end of the town. These two infestations were the only large ones and the other colonies were distributed rather evenly throughout the town. Spraying was done by State men.

North Stonington

Before scouting could be started in North Stonington, the egg masses were hatching and the men had to start spraying; however, after the spraying was over men were sent to scout around locations where the pest had been found in former years. Altogether 342 pupae and larvae were found and destroyed.

Norwich—8 Infestations—1,007 Egg-clusters

Seven of the eight infestations found this year in Norwich were situated in the Greenville district, and two of them were large colonies. One of 760 egg-clusters was found to extend over several blocks west of North Main Street, and the other of 145 egg-clusters was on land owned by C. E. Jennings at 201 Hamilton Avenue. A large amount of spraying was done in Norwich by State men.

Old Lyme

In the season of 1922 three small infestations were discovered and treated in Old Lyme. As the territory around these places had since been scouted several times and nothing found, the work this year consisted of summer scouting around the old infestations; no larvae or pupae were found.

Stonington—39 Infestations—5,791 Egg-clusters

Fifty-seven egg-clusters were found this year in the village of Stonington where in the same territory 1,159 were found last year. This year 4,958 egg-clusters were found in the village of Pawcatuck where conditions were worse than in Stonington village last year. The trees of the entire village were sprayed, and it is hoped that the results will be as successful as in Stonington village last year. A large colony was found in woodland owned by H. C. Davis located on the east side of Quiambog Cove but the other infestations were small, most of them containing less than ten egg-clusters. Spraying was done by State men.

Bozrah—1 Infestation—970 Egg-clusters

One large colony was found in Bozrah on the west side of Bear Hill on two white oaks and in a stone wall on land owned by E. A.

BULLETIN 305 CONNECTICUT EXPERIMENT STATION

Bishop about one-eighth of a mile back from the road. A majority of the 970 egg-clusters were in the stone wall. This infestation was sprayed by State men.

East Lyme

The work in East Lyme this year consisted of scouting for larvae around the places where the gipsy moth had occurred before: 16 pupae were found and destroyed by State men.

The towns of Franklin and Ledvard were also scouted but

nothing found.

Groton—9 Infestations—76 Egg-clusters

None of the infestations found in Groton this year were large; two of 20 egg-clusters each were located in the southwestern end of the town, one on apple trees in Schnescotte Park, the other on maple, cherry and apple trees and in a stone wall at Branford Farms. The spraying was done by State men.

Lebanon—14 Infestations—3,216 Egg-clusters

All but one of the infestations in this town were situated in the northern half; in fact, ten of the fourteen were in the extreme northern end, and it looks as if the entire spread had come from a woodland colony on land owned by Mr. Lieberman between Sweet Hill and Lebanon Village. Altogether 2,209 egg-clusters were found in this colony. A colony of 317 egg-clusters was found in the margin of a woodland owned by Mr. Blakesly just east of Lebanon Street, and the next largest colony was one of 211 egg-clusters found in woodland owned by the Boston Club. These three infestations contained more than 80 per cent of the total number of egg-clusters found in the town. State men sprayed around these infestations.

MIDDLESEX COUNTY

East Haddam

East Haddam was the only town scouted in Middlesex County this year and no trace of gipsy moth was found.

TOLLAND COUNTY

Columbia—11 Infestations—3,106 Egg-clusters

The infestations in Columbia were all situated in the southwestern part of the town and all but two of them occurred in wooded areas. The largest infestation contained 1,815 egg-clusters scat-

ered throughout a large block situated on both sides of the State road leading from Hebron to Columbia, near the Hebron town line. A colony of 514 egg-clusters was found just east of the one mentioned, in woodland and orchard owned by Mr. Bailey and Mr. Topple. These were the largest colonies although four others of 100 or more egg-clusters each were found in the town. Spraying was done by State men.

Coventry—6 Infestations—515 Egg-clusters

Two large colonies were found in Coventry this year by a State crew, one of 215 egg-clusters in woodland owned by B. Hyde, and situated about a mile south of Coventry village. The other was in an oak grove owned by E. A. White, just across the Willimantic River from Eagleville where 215 egg-clusters were found. The spraying was done by State men.

Ellington—25 Infestations—704 Egg-clusters

Most of the infested territory in Ellington lies in the northern part of the town between the State road leading to Somers and Crystal Lake, and most of the colonies were small. Two woodland colonies are mentioned here as they are stituated on the high ridge extending south from Soapstone Mountain and are open to windspread, one containing 204 egg-clusters on land owned by Joe Witiuk, and the other of 101 egg-clusters on land owned by F. L. Worthington. State men did the spraying.

Hebron—8 Infestations—813 Egg-clusters

Six of the eight infestations found this year were located in the southwestern end of the town. Two of the largest were woodland colonies, one of 353 egg-clusters on land owned by Messrs. Adler and Staba, and the other of 242 egg-clusters on land owned by Mrs. Adela White. The spraying was done by State men.

Mansfield—34 Infestations—2,772 Egg-clusters

Mansfield was scouted this year for the first time since 1924, and the degree of infestation has greatly increased since that time. The infestations were found scattered over the whole town, the largest colonies occurring in the northeastern or Wormwood Hill section. Colonies of 536, 269, 255, and 241 egg-clusters were discovered in woodlands owned respectively by Messrs. Sulkowski. Feingold and Smith. Though these colonies were the largest found in the town, there were several of 100 or more egg-clusters each. The spraying in this town was done by State men.

Somers—19 Infestations—1,431 Egg-clusters

Two large colonies were found in Somers this year by a State crew, both situated nearly on the Massachusetts State line north of North Somers. One of 477 egg-clusters on apple, maple and pine trees also in a stone wall, the owner of which could not be found; the other was in apple, maple and oak trees on land owned by Anthony Joonelas. The rest of the infestations, although spread separately over the town, were all small. State men did the spraying.

Stafford—113 Infestations—4,353 Egg-clusters

Stafford is generally infested throughout the entire township; in fact, it is in about the same condition as Thompson, Woodstock and Union. Only two really large colonies were discovered, the others being of medium size. Both colonies mentioned above were located in the Stafford Springs district, one of 279 egg-clusters on land owned by Malone Moore and Fred Ruby, and the other of 258 egg-clusters was on the Cyril Johnson Woolen Company's property on High Street. Spraying was done by State men.

Tolland—3 Infestations—119 Egg-clusters

In Tolland, 110 of the 119 egg-clusters found this year were in white oaks just north of Tolland Village on land owned by E. Ewald; the other nine egg-clusters were in two colonies of five and four egg-clusters each found on land owned by J. D. Cohen, near the Ellington town line. The spraying was done by a State crew.

Vernon—2 Infestations—120 Egg-clusters

A colony of 117 egg-clusters was discovered by a State crew in Vernon this year about one mile north of Vernon Center, in pasture oaks owned by Mr. Dougherty. About the same distance east of the village, another of three egg-clusters was found in oak woodland. Both places were sprayed by a State crew.

Willington—34 Infestations—1,104 Egg-clusters

All but three of the infestations in Willington were in the northern half of the township; these were small and found from East Willington southward along the Ashford town line. There were two large colonies found in the northwestern part of the town, one on apple trees and in a woodland owned by P. Figura, containing 285 egg-clusters, and one of 264 egg-clusters on 14 trees around Mr. P. Halchek's house. The rest of the colonies were small and of one year's standing. State men did the spraying in this town.

HARTFORD COUNTY

East Windsor—1 Infestation—1 Egg-cluster

A single egg-cluster was found in a maple tree owned by Mrs. Cushman, situated about one and one-half miles west of Windsorville on the north side of Keach Brook, this being the only trace of the gipsy moth found by the State scouts in this town. No spraying was thought necessary.

Enfield—1 Infestation—6 Egg-clusters

A small colony of six egg-clusters was found in one white oak tree in a field owned by Mrs. Elizabeth Pierce, about two miles south of Hazardville. One egg-cluster was found at this place in 1922. This colony was sprayed July 2 by State men.

Granby—24 Infestations—1,580 Egg-clusters

This town was used by the Federal forces to train men before sending them into the outside territory. In addition to the road-side scouting, 280 acres of woodland were scouted, divided into eight separate blocks. The bulk of the infestations are still confined to the southwestern corner of the town where the largest colonies were found. There were two of them, one of 870 egg-clusters in the woodland owned by Max Shinder, and the other of 262 egg-clusters in woodland owned by Mr. Lapion. Just north of these colonies was found an infestation of 108 egg-clusters in an orchard owned by Andrew Boris. The spraying was done by State men and over three-quarters of a ton of dry arsenate of lead was used.

Hartford—4 Infestations—151 Egg-clusters

One colony of 124 egg-clusters was found on property owned by Professor Paton, at No. 50 Forest Street, and another of 18 egg-clusters on roadside trees at the corner of Farmington Avenue and South Marshall Street. Both of these infestations were sprayed on July 3 by State men.

Hartland—5 Infestations—583 Egg-clusters

The Federal forces used Hartland for training men the same as Granby. The two largest colonies were found on property owned by Mr. Lichdi, in the northeast corner of the town. One was in woodland and contained 209 egg-clusters, and the other was a colony of 144 egg-clusters in an orchard. Both these colonies and another small infestation of seven egg-clusters in Mr. Eddy's orchard were sprayed by State men.

Suffield—9 Infestations—259 Egg-clusters

Only one colony of considerable size was found this year in Suffield. This was in woodland owned by the Berkshire Ice Co., of Southwick, Mass., situated on the western side of the town near Lake Congamond. This and a small infestation in a pasture were sprayed on July 2 by State men.

Wethersfield—1 Infestation—715 Egg-clusters

A large colony of 715 egg-clusters was found this year in Wethersfield on meadow land owned by E. Isaacson, near the bend of the Connecticut River. When the crew scouted this territory a lot of the land was covered with water so the ground work could not be done. In June, the spraying machines were sent there in an attempt to spray the trees but on account of two days of rain, the land was flooded and the sprayers had to be removed. They were sent to other parts of the state to continue the work, but later they returned and had sprayed about four and one-half acres of woodland when similar conditions arose and the work had to be abandoned for this season.

In the following towns—Bloomfield, Bristol, Burlington, Canton, New Britain, Simsbury, South Windsor and West Hartford—work was confined to scouting the territory around last year's infestations, and no re-infestations were found in any of these towns. The towns of Rocky Hill, Windsor and Windsor Locks were completely scouted and no infestations found.

LITCHFIELD COUNTY

The only work done by State men in Litchfield County consisted in scouting around last year's infestations in the three towns of Harwinton, New Hartford and Plymouth. One egg-cluster was found near an old infestation in Harwinton, but nothing was discovered in the other two towns. All other work in Litchfield County reported in this paper was done by Federal men. Without their help it would have been impossible to have covered so much territory. More towns were scouted in this section of the State in 1927-1928 than has been covered in one season for several years.

Barkhamsted—4 Infestations—748 Egg-clusters

Of the total number of egg-clusters discovered in Barkhamsted this year, 722 were found in woodland owned by C. LeGeyt, situated on the eastern edge of the town near the Granby line. This colony seemed to have spread from the large colony on Mr. Shinder's property in the southwestern corner of Granby. The

three other infestations were all in woodland and all very small. Spraying was done at two of the colonies by State men.

Canaan

Federal men scouted 1,082 acres of woodland this year in Canaan; this was territory in and around old infestations and no trace of the gipsy moth was found.

Colebrook—1 Infestation—46 Egg-clusters

One colony of 46 egg-clusters was found on fruit and shade trees owned by Frank Williams, situated about two miles west of the Colebrook Post Office.

Cornwall—9 Infestations—280 Egg-clusters

All nine infestations found in Cornwall this year were situated in a cluster around and on South Mountain, which is in the southwestern part of the town near Cornwall Bridge. The two largest were woodland colonies on land owned by Dr. W. C. Clark and contained 83 and 61 egg-clusters respectively; two other colonies were found on Dr. Clark's property. One colony of 60 egg-clusters and three smaller ones were on property owned by Mr. Patterson. About 180 acres of woodland were sprayed at these infestations, nearly a half ton of lead arsenate being used.

Goshen—1 Infestation—1,626 Egg-clusters

A large colony of 1,626 egg-clusters was found in Goshen in woodland owned by the Waterbury Water Company, situated directly south of the West Goshen Post Office, near the Litchfield line. Twenty-five and one-half acres of woodland were sprayed by Federal men.

New Milford

The scouting in New Milford this year was confined to the territory around last year's infestation, in southern end of the town, where about 1,518 acres of woodland were scouted and nothing found.

Norfolk—7 Infestations—162 Egg-clusters

The infestations (as in the case of Cornwall) were all grouped in the northeastern corner of the town, all in woodland and the two largest were colonies of 52 and 49 egg-clusters, on land owned by Mr. Laitinen and the Doolittle Lake Company, respectively. A Federal crew sprayed five of the colonies, and over one and one-

quarter tons of dry arsenate of lead were used in spraying 101 acres of woodland. In one place nearly a mile of hose was necessary to reach the infested trees.

North Canaan—3 Infestations—68 Egg-clusters

Three small colonies were found about one mile east of East Canaan, in woodlands owned by James Rosier, Max Sivan and B. Stevens, where 32, 31 and five egg-clusters were found in the order named. The spraying was done by Federal men on June 11 and 12.

Salisbury—1 Infestation—16 Egg-clusters

One small colony of 16 egg-clusters was found in woodland owned by F. C. Hood, located west of Falls Village and just south of Mount Prospect. Eleven acres were sprayed between July 3 and July 7 by a Federal crew.

Sharon—2 Infestations—22 Egg-clusters

Two colonies, one of 13 egg-clusters in woodland owned by Fred Gobilot and one of nine egg-clusters in woodland owned by A. B. Curtis were the only infestations of gipsy moth found in Sharon this year. Both colonies were located in the southwestern end of the town near Skiff Mountain. Altogether fifteen and one-half acres of woodland were sprayed at both places by Federal men.

The towns of Litchfield and Winchester were also scouted and no infestations found.

FAIRFIELD COUNTY

The only town in this county where any gipsy moth work was done this year was Greenwich. In 1926 a large infestation was discovered there; clean-up work was carried out and when the town was scouted again in 1927, nothing was found. This year the work was confined to the area around the old infestation and again nothing was found so it is hoped that the colony has been eradicated. This work was done by Federal men.

NEW HAVEN COUNTY

Wallingford—1 Infestation—4,505 Egg-clusters

Wallingford was again found to be infested with the gipsy moth when a Federal crew scouted the town this year, a woodland colony of 4,505 egg-clusters was discovered in the north-

western corner of the town near the Meriden and Cheshire lines. This was the only infestation found in the county this year although 17 other towns were scouted by Federal men. At the colony in Wallingford the dead wood and brush was cut and burned during the late winter and spring to make it easier to spray and thus eradicate this isolated colony. Altogether, 92,800 gallons of spray liquid were used in 130 acres of woodland and a small orchard of 10 apple trees, and it is hoped that the colony has been eradicated.

The seventeen towns scouted in the county were Ansonia, Beacon Falls, Bethany, Cheshire, Derby, East Haven, Hamden, Middlebury, Milford, Naugatuck, New Haven, Orange, Oxford, Prospect, Seymour, Wolcott and Woodbridge.

STATISTICS OF INFESTATIONS 1927-1928.

	No.	No. Egg- clusters	No. Colonies	No. Lbs. Poison	No. Larvae and Pupae	No. Miles Roadway
Towns Fo	ound	Creosoted	Sprayed	Used	Killed	Scouted
Windham County:						
Killingly	54	2,437	4	45	590	29
Scotland			0	0	0	34
Sterling	8	405	3	45	0	11
	62	2,848	7	90	590	74
	02	2,010		90	390	14
New London County:						
Bozrah		970	1	12	25	42
East Lyme†		0	0	0	16	
Franklin		0	0	0	0	53
Groton	9	76	1	19	412	56
Lebanon	14	3,216	3	42	135	130
Ledyard	0	0	0	0	0	45
New London	15	660	9	70	234	23
North Stonington†.		0	0	0	342	
Norwich		1,007	6	585	0	73
Old Lyme†	0	0	0	0	0	0
Preston	3	157	1	175	0	33
Salem		42	1	25	0	46
Stonington	39	5,791	10	1,750	252	52
	90	11,919	32	2,678	1,840	553
Tolland County:						
Columbia	11	3,106	3	150	709	65
Coventry	6	515	2	87	6	102
Ellington	25	704	1	438	11	98
Hebron	8	813	2	850	260	100
Mansfield	34	2,772	3	75	190	99
Somers	19	1,431	9	502	124	69
Stafford		4,353	51	1,124	0	159
Tolland	3	119	2	62	5	104
Vernon	2	120	2	112	0	67
Willington	34	1,104	14	110	0	129
	255	15,037	89	3,510	1,305	992

†Scouted by State men around old infestations,

	No	No. Egg-	No.	No. Lbs.	No Larvae	No Miles
Towns	No. Infestation Found	ons clusters	Colonies Sprayed	Poison Used	No. Larvae and Pupae Killed	Roadway
Middlesex County:	Pound	Creosoted	oprayed	Osca	Trined	Decared
East Haddam	0	0	0	0	0	165
Hartford County:						
Bloomfield†	0	0	0	0	0	
Bristol	0	0	0	0	Ö	5
Burlington		0	0	0	$\begin{array}{c} 0 \\ 22 \end{array}$	9
Canton† East Windsor	0	0	0	0	0	79
Enfield		6	1	12	4	96
Granby*	24	1,587	9	1,555	545	95
Hartford	4	151	$\frac{2}{3}$	50	$\frac{95}{39}$	167 64
Hartland* New Britain†		385	0	560	0	04
Rocky Hill		ő	ő	ő	ő	38
Simsbury†		0	0	0	0	
South Windsor		0	0	0	0	9
Suffield West Hartford	9	$\begin{array}{c} 259 \\ 0 \end{array}$	$\frac{2}{0}$	550	94	85 6
West Harmord Wethersfield		715	1	270	318	45
Windsor		0	$\bar{0}$	0	0	81
Windsor Locks	0	0	0	0	. 0	30
	45	3,104	18	2,997	1,117	809
New Haven County	7.					
Ansonia*	0	0	0	0	0	43
Beacon Falls*		0	0	0	0	23
Bethany*	$\begin{array}{ccc} & 0 \\ & 0 \end{array}$	0	0	0	0	62 93
Cheshire* Derby*	0	0	0	0	0	32
East Haven*	0	0	0	0	0	65
Hamden*	0	0	0	0	0	102
Middlebury*		0	0	0	0	61 86
Milford* Naugatuck*		0	0	0	ő	66
New Haven*	0	ŏ	ŏ	Ö	0	210
Orange*	0	0	0	0	0	57
()xtord*	()	0	0	0	0	77 41
Prospect* Seymour*	0	0	0	0	0	55
Wallingford*	1	4,505	1	4,640	Ō	131
Wolcott*	0	0	0	0	0	51
Woodbridge*	0	0	0	0	0	55
	1	4,505	1	4,640	0	1,310
Litchfield County:	1					
Barkhamsted*		748	2	450	0	(1.082
Canaan*	0	0	. 0	0	U	(1,082 acres)
Colebrook*	1	46	0	0	0	70
Cornwall*	9	280	9	9,650	0	104
Goshen*	1	1,626	1	1,825	0	90
Harwinton† Litchfield*	0	$\begin{array}{c} 1 \\ 0 \end{array}$	0	0	0	140
Contraction (Contraction Contraction Contr						

*Scouted by Federal Men. †Scouted by State men around old infestations.

Towns Litchfield County-	No. Infestation Found	No. Egg- clusters Creosoted	No. Colonies Sprayed			e No. Miles Roadway Scouted
New Hartford†.	0	0	0	0	0	
New Milford*	0	0	ŏ	Ö	ő	(1,518
Norfolk*	7	162	5	2,595	0	acres) 85
North Canaan*.	3	68	1	100	0	56
Plymouth† Salisbury*	1	$\begin{array}{c} 0 \\ 16 \end{array}$	0	$\frac{0}{920}$	0	110
Sharon*	2	22	2	1,120	Ô	140
Winchester*	0	0	0	0	0	100
	28	2,969	21	16,660	0	979
Fairfield County: Greenwich‡	0	0	0	0	0 (1	2 acres)

			CMMAKI	OF STATIST	1102		
County	No. Towns Covered	No. Infestations Found	No. Egg- clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Windham.		62	2.848	7	90	590	74
New Londo		90	11,919	32	2,678	1,840	553
Tolland		255	15,037	89	3,510	1,305	992
Middlesex.		0	0	0	0	0	165
Hartford		45	3,104	18	2,997	1.117	809
New Haven	. 18	1	4,505	1	4,640	0	1,310
Litchfield.	. 15	28-	2,969	21	16,660	. 0	879
Fairfield	. 1	0	0	0	0	0	0
	79	481	40,382	168	30,575	4,852	4,882

CITALIANT OF COLUMNOMY

PARASITE WORK

This branch of the work is carried on year after year in cooperation with the Federal laboratory at Melrose Highlands, Mass. In the Report of the Connecticut Agricultural Experiment Station for 1922, page 313, will be found brief accounts of the different species of parasites and the matter need not be repeated here. This year, the egg parasite, Anastatus bifasciatus, only was liberated, and the following table gives the towns and number of individuals liberated in each town. The method previously followed in trying to get these enemies of the gipsy moth established has been to put them out at places where the moths are abundant and a year after make collections of egg-clusters if they could be found, to see if any of the parasites could be recovered. A large number of the towns in the eastern end of the State have been so treated and but few recoveries have been made, so this year another method is being tried. Thus in Thompson, two plots of woodland, one of 84 acres, the other of 48 acres, and in Eastford

^{*}Scouted by Federal men. †Scouted by State men around old infestations. ‡Scouted by Federal men around old infestatoins.

a plot of 50 acres, were laid out in one and two-acre sections. There was also a check plot laid out in each town, and all plots were then scouted for egg-clusters and the average number in each plot estimated. Then the parasites were planted according to the degree of infestation. Collections have been made at the different plots this winter but as the results have not been fully tabulated at this time, a more complete report will be made at a later date.

BULLETIN 305

LIST OF TOWNS AND NUMBER OF ANASTATUS PARASITES LIBERATED IN Each Town During Season, 1927-1928

Towns											1	N	0.	of Individual
Thompson	*													104,000
Eastford*.														50,000
Mansfield.														99,000
Willington														41,000
Coventry.														25,000
Hebron														35,000
Columbia.														71,000
Lebanon														40,000
Stonington														35,000
														500 000

DEFOLIATION

Up to this time there has never been any noticeable defoliation of trees in Connecticut by gipsy moth caterpillars. Yet we are confident that hundreds of acres would have been defoliated long before this had the insect not been kept in check by the suppression work conducted by the State. In 1924 we were very optimistic regarding the parasites which seemed to be making themselves felt in many localities where they apparently caused an actual reduction of the gipsy moths. But something has happened to the parasites since 1924. In 1925 they were much less abundant and the gipsy moth became more prevalent, and the following year there were large stripped areas of woodland in Massachusetts. In 1924, about 825 acres were defoliated in Massachusetts, this being considered the minimum for 20 years. In 1928, occurred the most severe defoliation in recent years, estimated at 262,000 acres, about half of the area being in Massachusetts and the other half in New Hampshire and Maine.

Present conditions are very grave and there should be no reduction in suppression work for the next few years.

QUARANTINE

No new towns have been placed in the quarantined area in Connecticut during the past year, but 31 towns shown in Fig. 57,

formerly in the lightly infested quarantined area (colored green on the Federal map) have been placed in the generally infested area (colored red on the Federal map). These towns are as follows: Barkhamsted, Litchfield County; Bloomfield, Canton, East Granby, Glastonbury, Granby, Hartford, Hartland, Simsbury, Suffield, Wethersfield, Windsor and Windsor Locks, Hartford County; Andover, Columbia and Hebron, Tolland County; Bozrah, Colchester, Franklin, Griswold, Groton, Lebanon, Ledyard, Lisbon, New London, North Stonington, Norwich, Preston, Sprague, Stonington, and Voluntown, New London County.

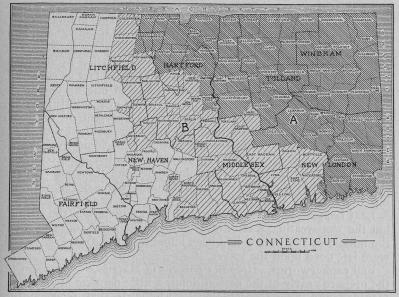


Fig. 57. Map of Connecticut showing present quarantined areas.
A, generally infested; B, lightly infested.

RECOMMENDATIONS

In view of the present situation, we felt like requesting an increased appropriation for gipsy moth work for the biennial period ending June 30, 1931, but later decided to ask for the same amount as granted for the present biennium, but in doing so to also file a statement calling attention to the gravity of gipsy moth conditions at the present time. We therefore recommend that an appropriation of \$100,000.00 be granted for the next two years, by the General Assembly of 1929. We believe this to be inadequate and that some noticeable defoliation may occur in 1929 or 1930.

^{*}Thompson and Eastford were used for re-colonization experimental plots.

NOTES ON FRUIT INSECTS IN 1928

By M. P. ZAPPE

During the spring and early summer of 1928, some observations were made on fruit insects while visiting orchards throughout the State. At harvest time some fruit in each of a few orchards was scored to check up on the early observations and to see how successful the fruit growers had been in carrying out their spray

programs.

The European red mite, Paratetranychus pilosus C. and F., was quite abundant early in the season. Many eggs were seen at Bantam, Cheshire, East Hampton, Guilford, Hamden, Madison, Milford, New Canaan, South Glastonbury, Southington, Unionville, Wallingford and Wilton. From the numbers of eggs present, it looked as though there would be a heavy infestation by the middle of summer, but the mites did not reproduce as fast as expected, probably due to weather conditions. Only in one or two cases were mites present in large enough numbers to cause injury. Late in the fall, however, there were many eggs present on the trees and many apples at harvest time had mite eggs in the calyx cup.

Aphids were very scarce in the spring. On some trees where counts were made, only about one aphid per ten buds could be seen. Many of these had been killed by the delayed dormant spray applied by the orchardist. Not many aphids developed during the summer and practically no injury to fruit resulted.

Leaf hoppers hatched in about the usual numbers in the spring, but the wet weather was unfavorable for their development. By the middle of July, many had been killed by a fungous disease and were left dead upon the leaves.

Fall cankerworms, Alsophila pometaria Harris, were present in the orchards early in the season doing a little damage in Durham, Hamden and South Glastonbury. Orchards that received the prepink and pink sprays showed very little cankerworm injury.

The plum curculio, Conotrachelus nenuphar Hbst., did the usual amount of damage this year. Apple orchards near peach orchards always show the largest amount of damage nearest the peach orchard. Many curculios are produced in the early dropped peaches and these often come into the apple orchard. Wild apple trees that are never sprayed are another source of infestation. Fruit scored from several orchards during the fall showed that there was considerable injury caused by curculios. Most of this injury, however, would not be so great as to reduce the value of the fruit. In most cases where the infestation is very heavy, some of the fruit is worthless and is thrown into the culls.

In Cheshire, Baldwin apples from four orchards were scored and 12, 16, 17 and 22 per cent of the fruit was marked by cur-

culios. In Branford two orchards showed three and eleven per cent injured, and in East Wallingford three, seven, and 14 per cent. All fruit scored was from sprayed trees.

Several vineyards in South Glastonbury were severely injured by the grapevine flea-beetle, *Haltica chalybea* Ill. The injury is done by the adult insect which eats out the swelling buds in early spring, thus destroying the embryonic fruit clusters. The injury is usually most apparent on the outside rows of the vineyard and on the ends of the rows. When the vines leaf out, both adults and larvae feed on the leaves. This insect also feeds on wild grapes and Virginia creeper. The remedy is either hand picking of the early adults, or spraying with a heavy dose of arsenate of lead, two pounds of dry poison per 50 gallons of water. This should be applied when the first beetles appear. After the vines have leafed out, another application of arsenate of lead will kill the young larvae. This will reduce their numbers so that fewer adults will be present the following year.

PLANT BUG INJURY TO FRUITS

By PHILIP GARMAN

During June, 1928, peaches on several trees growing on the Experiment Station grounds in New Haven were noticed to be injured severely by a kind of puncture which caused small sunken areas from which gum exuded. As a result of this attack, practically all of these peaches either dropped from the trees or were so deformed as to be worthless. The peach trees are situated near the west boundary of the Station grounds and nearby on the adjoining premises are several black oak trees of medium size. On investigation, it was found that plant bugs of the family Miridae, had migrated from the oak trees to the peach trees and were responsible for the injury to the fruit. The main migration from the oaks which were not over 50 feet away came in June when an examination of the fruit showed the bugs present and sucking the juices. On these peach trees 100 per cent of the fruit was affected.

Preliminary tests were made with nicotine dust as a control and it was found that the bugs could be brought down from the trees with this material though not all were killed. Numerous applications would probably have to be made to keep the trees free at the time when the insects are migrating. According to observations made by Caesar and Ross, there is little danger to trees planted a hundred yards or more from oaks. This fact should be considered in laying out a new orchard of peach trees, and has important bearing in case removal or treatment of the nearby oaks is thought expedient.

The species involved are Lygus quercalbae Knight and Lygus omnivagus Knight, both of which were found infesting the

BULLETIN 305

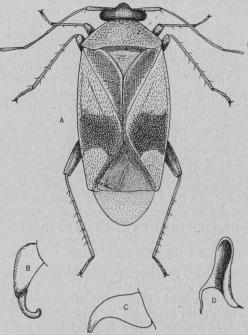


Fig. 58. A plant bug, Lygus omnivagus Knight which injured peaches. A, adult bug; B, right clasper, ventral aspect; C, left clasper, lateral aspect; D, left clasper, dorsal aspect.

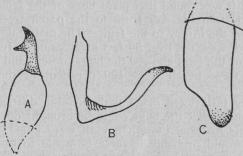


Fig. 59. Genitalia of Lygus quercalbae Knight. A, right clasper, ventral aspect; B, left clasper, dorsal aspect; C, left clasper, lateral aspect.

peaches at New Haven. They are closely related species and similar in general appearance, the species *L. omnivagus* being represented in Fig. 58, and the damage to the fruit on Plate XXI.

Injury of the type described is also credited to *L. caryae*, Knight, a species normally developing on hickory, and of course, the common tarnished plant bug, *L. pratensis* Linn., developing on weeds of various kinds, sometimes causes trouble. The injury by these pests is known as "cat-facing" in some sections due to the peculiar formation of the peach sometime after the damage has been done. On pears, damage appears to result in deformed fruits rather than the "cat-faced" condition, and in some orchards appears to be worse with the Bosc variety than others.

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THE ORIENTAL PEACH MOTH

By PHILIP GARMAN

The Oriental peach moth, *Grapholitha (Laspeyresia) molesta* Busck, was active in Connecticut in 1928, becoming very destructive in some orchards where little damage was done heretofore. In a few orchards it decreased in abundance, due probably to continued action of parasites and certain orchard practices of the growers. It has now been present in some orchards of East Wallingford for four years, causing a percentage of wormy fruit variously estimated at 50-100 per cent. In a few orchards within the heavily infested district, the pest has been slow in establishing itself, not having as yet become commercially important.

The areas where commercial damage was done in Connecticut are shown on the map (Fig. 60), the shaded portions indicating limits of commercial damage. The greatest damage last year was done in the south central district indicated by the heavy black. Orchards in this area varied in their degree of infestation, but the worst affected ranged from 50-100 per cent in Hileys and Elbertas. The pest was reported this year for the first time to be doing commercial damage in New London County. In Hartford County the infestation is still uneven, but some orchardists experienced severe losses. Fairfield and New Haven counties seem to be about the same as last year with perhaps more orchards on the whole infested. The infestation was particularly severe in quinces, practically every quince orchard in New Haven county

being infested, with much wormy fruit appearing on the local market. Quinces seem to be particularly attractive to the moths as indicated by the number of larvae obtained from a single bushel of discarded fruits. Over 600 were obtained from this bushel and it was estimated that fully 1,000 were originally present because of the number of exit holes found in the fruit when obtained.

CONNECTICUT EXPERIMENT STATION

At our suggestion, one orchardist, Mr. S. R. MacDonald kindly dusted his quinces four times at weekly intervals beginning August 10. Another grower, Mr. J. H. R. Bishop, alternated sprays

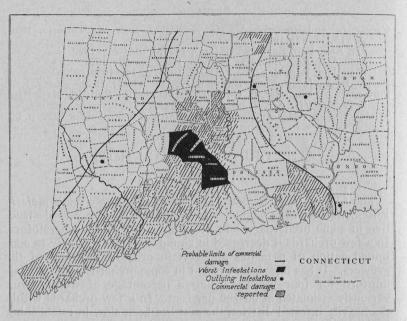


Fig. 60. Map of Connecticut showing distribution of the oriental peach moth in 1928.

with dusts beginning about the same date and making four applications in all. Both treatments failed to control the peach moth. In addition, two trees at the Experiment Station were used, one receiving five sprays of lead arsenate (1 oz.-2 gals.) on the following dates—August 9, 15, 25, 31 and September 8. Fiftytwo per cent of the fruit was found to be wormy on examination and 111 larvae were obtained from the sprayed tree, whereas 96.1 per cent of the check fruit was infested and a total of 146 larvae found on examination. The latter test indicates some reduction, but inasmuch as it involves only two trees cannot be considered significant until confirmed by further experiments.

During 1928, tests were begun with ovicides and repellents and it was found that a materially increased kill could be obtained with one per cent white oil emulsions combined with various contact poisons, over that previously reported for nicotine-soap combinations. The most successful this year was a combination of white oil emulsion and pyrethrum soap, it being noted that many of the young larvae walking over the material were killed. The re-

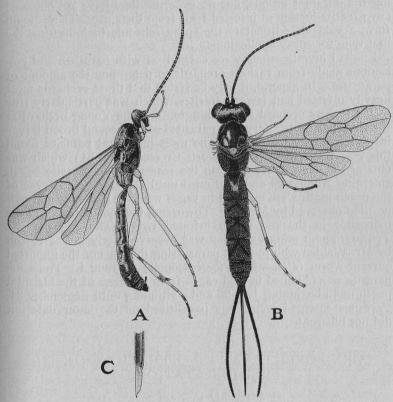


Fig. 61. Glypta rufiscutellaris Cresson, a parasite of the oriental peach moth. A, adult male, side view; B, adult female dorsal view; C, tip of female ovipositor.

sults of several years' tests with lead arsenate and fluosilicates and some of the fluorides indicate that these are effective killing agents for the recently hatched larvae. Perhaps the most promising yet discovered, however, has been reported by Dr. Driggers of the New Jersey Experiment Station, who reports the successful use of talc and mica dusts. Since these are very cheap and non-injurious, they should prove valuable in combatting the peach moth. Dr. Stearns of Ohio has experimented with heavy lime sprays and finds them successful in reducing the infestation. He uses as much as 25 pounds of lime in 50 gallons of water. About 12 different dilute combinations were tried on the overwintering larvae in 1928 without success. Mr. Ross of Canada, however, reports a very good kill of these larvae with certain tar acid oils used at 10-15 per cent strength. Bait pans continue to be used in indicating the different broods, but no experimenters have yet obtained any great reduction in infested fruit from their use. They should form a valuable adjunct to the spray schedule in indicating the best time for spray applications.

Limited investigations were carried on with parasites and collections made from various orchards to determine the amount of parasitism. In general, it may be stated that those orchards most heavily infested had fewer parasites, which was particularly true of the Rogers orchard at Southington and the Young orchard at East Wallingford. Very few parasites of the second brood larvae infesting twigs yere found. The most important parasite found this year was Glypta rufiscutellaris Cresson (Fig. 61) which was obtained at New Haven late in the season. The parasite began emerging August 29 and continued until October 18. Larvae of the peach moth were exposed in cages with the parasites and oviposition observed by Mr. J. F. Townsend, the female inserting the ovipositor in the end of an infested twig. The egg parasite Trichogramma minutum Riley was observed early in the season by Mr. Walden who found it parasitising the eggs of the imported currant worm (Pteronidea ribesi Scopoli) on June 4. The same parasite was obtained in field cages from the eggs of the Oriental peach moth beginning July 26 and continuing until September 24. Parasites emerged from eggs parasitized on the latter date but did not hibernate.

CORN BORER CLEAN-UP OPERATIONS ON THE 1927 INFESTATIONS

By M. P. ZAPPE

The work of cleaning up the infestations of the European corn borer found in 1927 was begun in the fall of 1927 when the infested corn and weed areas in the towns of Milford and Oxford were burned. During 1928 no infestations were found in either of these towns.

The other 1927 infestations were all in the southeastern part of the State in the shore towns of Stonington, Groton, and East Lyme. These towns have been infested for several years, but no spread has been found outside their borders.

Actual burning work started in East Lyme on March 15, and, though machinery and men were ready to work a few days earlier, weather conditions prevented it. Work in East Lyme was completed on March 26. In this town the village of Niantic was generally infested and a few infestations were on the Crescent Beach road south and west of the village. The infestations were mostly in backyard gardens and in some small fields of corn just outside the village. Most of the work was done with hand burners. A machine burner was used in some of the larger fields, but was not very satisfactory because the fields were too small to make its use economical. The machine burner consists of a battery of nozzles on a long pipe through which the oil is forced. Just behind the nozzles is a large metal shield to protect the men from the heat. This is all mounted on wheels and is drawn very slowly over the fields of infested material by several men. About 35 acres of corn and weed areas were burned in Niantic, requiring 231 man days to complete the work.

From Niantic the burning crew was shifted to the town of Groton where there were two centers of infestation. One was on the top of Fort Hill and the other in the village of Noank. At Fort Hill the machine burner was used in one large field. Other fields had been plowed. The corn that was not completely plowed under was picked up and burned. There was much corn in a pasture, which had been partly eaten by cows. The uneaten portions were raked and picked up and were burned without the aid of any oil. At Noank all infestations were in backyard gardens and all clean-up work was done with hand burners. Approximately 12 acres of gardens were either cleaned by raking and picking up infested material or burned without any preliminary raking. It required about 133 man days to clean up the town and the work was done between April 14 and April 21. In the town of Stonington, there were five centers of infestation. One was south of Mystic railroad station in a small market gardening section. The largest fields were machine burned and smaller areas were burned with hand burners as were the edges of the larger fields. Another infested section was north of Mystic about half way between Mystic and Old Mystic. This area consisted of fairly large fields of corn and weeds and was burned by the carriage burners except for a few small areas and around the edges of the fields. This section was infested in 1925 but no infestations were found in 1926.

One infested area was at the Industrial Place, Mystic, where the infestations were found in small gardens and in one large cornfield near the infested gardens. This area was also infested in 1926. Small backyard gardens were burned over with hand burners and the large fields with machine burners.

Another infested section was just north of Stonington borough and was mostly in small back yards. Both machine and hand burners were used here. This area was almost continuous with the next which was at Wequetequock. These were only about one mile apart. At the Wequetequock section machine burners were used almost entirely except for the edges of the fields. About 70 acres of land were burned over in the town of Stonington, requiring 288 man days to complete the clean-up.

CONNECTICUT EXPERIMENT STATION

During the spring clean-up work, the United States Department of Agriculture paid for all the oil used and furnished all burning equipment. The State paid for all labor with the exception of the last week's work which was paid for by the Federal Government. All clean-up work was completed on April 21.

Plates XXII and XXIII show the burning apparatus and how it is operated.

Infestations of 1928

During the summer nearly the entire State was scouted for the European corn borer by scouts employed by the United States Department of Agriculture. Of the 169 towns in the State only 44 were not scouted and these were located in the center of the State. All the towns around the edge of the State were scouted with the exception of Kent in Litchfield County. A total of 30 towns were found infested, most of them in New London and Windham Counties.

The following towns were scouted and found to be infested with the European corn borer in 1928. Suffield in Hartford County; Clinton, East Haddam, Essex, Old Saybrook, Saybrook, and Westbrook in Middlesex County; Bozrah, Griswold, Ledyard, Lisbon, Montville, North Stonington, Norwich, Preston, Salem, and Voluntown in New London County; Canterbury, Killingly, Plainfield, Putnam, Scotland, Sterling, Thompson and Windham in Windham County; East Lyme, Groton, New London, Stonington, and Waterford in New London County were not scouted, but have been infested for several years, and it is safe to say that they are infested now.

The scouting showed that there was a large spread westward from Rhode Island of the double-brooded strain of the European corn borer. The general spread westward from infested towns in Massachusetts and New Hampshire was very slight as only one new town was added in Massachusetts and two in New Hampshire but the spread from Rhode Island into Connecticut was very great.

The eastward spread of the single-brooded strain in New York, western Massachusetts and Vermont was quite general and in some cases covered as much as 40 miles.

The town of Suffield in Hartford county was found infested by the one-brooded strain of the European corn borer apparently coming into the state from Massachusetts. The other infested towns are of the double-brooded strain. All towns along the Rhode Island boundary were found infested and in some cases several towns west of the State line were also infested.

737

It will be necessary to revise the present quarantine area before the next growing season.

REPORT OF SCOUTING AND QUARANTINE ENFORCE-MENT FOR THE JAPANESE BEETLE AND ASIATIC BEETLE

J. Peter Johnson*

JAPANESE BEETLE

During the summer season of 1927, Japanese beetles were found in New Canaan and Bridgeport. This caused an extension of the quarantine area eastward from Greenwich and Stamford, to include Darien, New Canaan, Wilton, Norwalk, Westport, Weston, Easton, Fairfield, Bridgeport, Trumbull, Stratford and Shelton. No further extensions were made and the area remained the same throughout the year of 1928.

The general procedure followed in carrying on the work was the same as that carried on during the past year. The infestations in Bridgeport and Stamford had increased considerably and beetles were found there more readily and in larger numbers. Only three beetles were found in New Canaan in the same location where one was found during 1927.

Below, a concise report is given of the work performed during the past year.

SCOUTING

On July 5, 1928, twenty-two men reported for scouting work, at the Shelton office. These men were divided into five field crews of four men each, and one greenhouse scouting crew of three men, one of whom reported earlier for training. The supervisor in charge of the field scouts, who had also reported earlier, took all the men to Bridgeport, where he and one of the permanent men gave them a schooling for ten or twelve days. Individual crews were assigned to their territories outside of the quarantined area, as their proficiency in scouting warranted.

^{*}Mr. Johnson has had general charge of this work for the State of Connecticut and for the Federal Plant Quarantine and Control Administration. He has been authorized to employ and discharge men as needed for the benefit of the Service. For the most part, the scouts and patrolmen have been carried on the Federal payroll. [W.E.B.]

The State was divided into scouting areas, to be covered by crews assigned to them. These areas in a few cases overlapped, to enable another crew to assist, if necessary. The divisions were made according to the number and size of towns surrounding a given point, also upon the movement of traffic and the distribution of farm products. This enabled us to approximate the territory that could be covered by a crew or crews, during the entire season. In some cases one crew covered two or more areas; for example, the crew assigned to the Danbury area upon completion of the work was moved to Waterbury. It was necessary to place two crews in New Haven, in order to complete the area in good season.

Upon completion of the schooling, the crews were placed as follows: one in Danbury, two in New Haven, one in Meriden and one in Hartford. Some time after these crews were assigned, additional funds were available and two more crews of four men each were employed. One was assigned to New London and the other to Manchester. The procedure then followed was to the effect that the larger towns were first scouted and then all surrounding smaller towns in the vicinity. Changes in location were made as soon as that particular area was completed. This method enabled us to scout practically all towns of large size, with the exception of Putnam, Thompsonville and Norfolk.

The supervisor in charge of the field scouts, visited the crews daily, assigning and checking their work and aiding when possible. He was also in close contact with the office concerning all phases of the work.

The crew of three greenhouse scouts, including the foreman, scouted all classified concerns, within the quarantine area. A car was assigned to this crew and this enabled them to cover their area twice a week, meaning that each classified concern was scouted twice a week during the entire season.

Contact scouting for the purpose of keeping informed of the conditions of old infestations for the increase of numbers and possible spread, was performed in Bridgeport, Stamford and New Canaan. This was done by the farm products inspectors, when their work was slack, and by other members of the force when possible.

The area scouted during the season of 1928, included the following towns:

Ansonia, Bethel, Branford, Bridgeport, Bristol, Cheshire, Cromwell, Danbury, Danielson, Derby, Devon, East Hartford, East Haven, East Norwalk, Guilford, Hartford, Madison, Manchester, Meriden, Middletown, Milford, Milldale, Newtown, Norwalk, Norwich, New Britain, New Canaan, New Haven, New London, New Milford, Plainville, Plantsville, Ridgefield, Rockville, Sev-

mour, Southington, South Manchester, Stamford, Stonington, Stratford, Thomaston, Torrington, Wallingford, Waterbury, Watertown, West Haven, Westport, Westville, Willimantic, and Westerly, R. I.

The locations of Japanese beetles found outside of the quarantined area of 1928, were as follows:

NEW	HAVEN	
	Beetles	found

	eetles found	Date found
Mapledale Section, Evergreen Cemetery	. 14	July 21, 1928
Mapledale Section, Evergreen Cemetery	. 4	July 23, 1928 July 24, 1928
260 Howard Avenue	. 1	July 24, 1928
Total	. 19	

HARTFORD

Address	Beetles found	Date found
38 Sumner Street	4	Aug. 4, 1928 Aug. 4, 1928 Aug. 4, 1928
Total	10	

NEW LONDON

	HONDON	
Address	Beetles found	Date found
29 Brainard Street	11	Aug. 6, 1928
29 Brainard Street	11	Aug. 10, 1928
29 Brainard Street	2	Aug. 13, 1928
25 Brainard Street		Aug. 13, 1928
29 Brainard Street	2	Sept. 4, 1928
Total	$\dots \overline{27}$	

The total number of beetles found outside the generally infested area was 58.

In conjunction with the field scouting, there was a total of 52 classified establishments scouted. There were not any beetles found.

There were also 12 sand, soil and manure establishments scouted and no beetles found.

The first beetle was found July 5, while the last one was found on October 13, 1928.

There were seven crews of four men each, one crew of three men under the direction of a supervisor, employed in the scouting.

FARM PRODUCTS QUARANTINE

1. General Survey and Discussion.

Just prior to June 15, 1928, a platform, ten by thirty feet, with a roof to provide shelter, was erected at the foot of Wall Street,

BULLETIN 305

JAPANESE BEETLE QUARANTINE ENFORCEMENT

Bridgeport, Conn., near the railroad tracks and the Bridgeport market, as a center for all farm products inspections in Bridgeport and the surrounding towns. Shortly after June 15, when the farm products quarantine went into effect, there were three inspectors assigned to it. It was open from 5:00 a. m. to 5:00 p. m. with the exception of Saturday afternoons and Sundays. The three inspectors began work at different hours and worked eight straight hours, eating their lunch at the platform. Two men reported at 5:00 a. m. leaving at 1:00 p. m. while the third inspector reported at 9:00 a. m. leaving at 5:00 p. m. This gave the service of three inspectors at the peak of the rush hour and left one man after 1:00 p. m. when things were slow.

Arrangements were made with a commission house in Norwalk and also one in Stamford at each of which an inspector was available during the morning. These inspectors took care of all farm products inspection from their respective areas and all in-

dividual requests for inspection were referred to them.

Inspection was also carried out from the Shelton office. As a man was always assigned to the office besides the clerk, the in-

spections were made promptly.

The assigning to these four inspection points certain parts of the area enabled inspections to be given rather efficiently. In the majority of cases people desiring inspection were referred to the inspectors within their area and in some cases inspections were made at the point of shipment when they could be made there more efficiently.

The farm products supervisor visited the points of inspection daily and assisted in inspection during busy hours. He also scouted farm territories to find whether or not beetles were present in the areas from which products were shipped directly from

the farm to points outside the quarantined area.

In conjunction with the farm products inspection, we had eleven road inspectors and one supervisor. Three crews of two men each were on duty at the Milford-Stratford bridge, Devon, Conn., twenty-four hours a day, seven days a week, on the Boston Post Road. At the Shelton-Derby bridge on the road from Bridge-port to Waterbury, there were three crews of one man each on duty twenty-four hours, six days a week, excluding Sunday. One road inspector on a mortorcycle patroled the Bridgeport-Newtown road and the Bridgeport-Bethel road, both of which led to Danbury, while another inspector on a motorcycle patroled the Norwalk-Danbury road and the New Canaan-Danbury road.

The road patrol covered all main lines of traffic leading out of the quarantined area into Connecticut, while all other roads led into back country and were more or less impassable and were not

subject to daily traffic.

The supervisor of the road patrol visited the crews daily and also checked them at night. He substituted for men when necessary for them to be off duty.

2. Number of men employed in connection with the inspection, and certification of fruit and vegetables, cut flowers and hay and straw.

Location	Adminis- trative	Super- visor	Fore- men	Inspec- tors	Total
Bridgeport		1		3	4
Norwalk				1	1
Stamford				1	1
Shelton	3			office	
Total					-6

3. Inspection points, number of packages certified, and number of beetles removed.

Place	Period operated	Hours per day open	Num- ber of men	Pack- ages certi- fied	Beet- les re- moved
Bridgeport	June 15-Oct. 1	12	4	110,125	6
Norwalk	June 15-Oct. 1	8	1	$16,831\frac{1}{2}$	1
Stamford	June 15-Oct. 1	8	1	4,490	6
Shelton	June 15-Oct. 1	8		$27,513\frac{1}{2}$	0
			-		- ()
Total			. 6	158,960	13

- 4. There were 353 boxes of cut flowers certified for shipment outside of the quarantined area.
- 5. Total Certificates Used in State Regulated Area

Issued for	Total
Fruit and Vegetables	5,313
Cut flowers	353
Hay and straw	37
Total	5 703

6. Roads posted with quarantined signs in 1928......33

There was a total of six roads patroled by eleven road inspectors working under one supervisor.

1. Number of vehicles bearing quarantined articles intercepted at the quarantine line, each month and the season total.

Month	Devon	Shelton	Stepney Bethel	Wilton Ridgefield	Total
June 16 to 3	80 601	270	66	39	976
July 1 to 31		741	216	100	2,217
Aug. 1 to 31	1,195	742	120	98	2,155
Sept. 1 to 30	0 692	175			867
Oct. 1 to 15	55				55
Total	3,703	1,928	402	237	6,270

SUMMARY

743

1. Average number of men employed in each different branch of the quarantine work at each office, each month, during the year, 1928.

		SH	ELTO	DN C	FFIC	CE							
J.	an.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Scouting	0	0	0	0	0	2	25	29	5	0	0	0	
Farm Products	0	0	0	0	0	17	21	16	9	1	0	0	
Nursery and Greenhouse	e 0	2	2	2	2	2	2	2	2	3	3	3	
Administrative	2	1	1	2	2	2	2	2	2	2	3	3	
Total	2	9	9	1	- 1	22	=0	10	10	C	c	G	

2. Total number of each kind of certificates used on shipments of products listed below:

Farm Products	Cut Flowers	Hay and Straw	Nursery and Ornamental	Sand Soil	Peat etc.	Manure	Total
5,313	353	37	11,030	1,179	0	292	18,204

- 3. Total number of certificates lost or unaccounted for.....23
- 4. There were no state violations of Japanese beetle quarantine prosecuted during 1928.

REPORT OF ASIATIC BEETLE WORK, 1928

`The quarantine enforcement and inspection has been in immediate charge of Mr. Benjamin W. McFarland.

The scouting for the Asiatic beetle, was carried on in conjunction with that of the Japanese beetle. No beetles were found outside of the quarantined area in Westville and none in West Haven, on or around the known infested area. Diggings made in West Haven in the spring showed only two lawns infested. The infestation was much less than when first discovered and was of such a nature that unless a man was stationed there throughout the scouting period, there would be only a slight chance of finding any adults.

The infestation as a whole in Westville, is stronger than that of the spring of 1926, when treatment and control work was started by the State. The control work was carried on during the spring and fall of 1926 and the spring of 1927, which resulted in a check of the degree of infestation. However, during the fall of 1927 and the year of 1928, because of the fact that no extensive control work was carried on, the infestation increased each year and the infestations gained considerably in population, while the lightly infested area assumed proportions which resulted in much lawn injury, which appeared this last fall. This condition existed mainly west of Edgewood Park. However, lawn injury appeared

2. Total number of men employed in connection with farm products at all offices (Inspection, certification and enforcement).

	Adminis- trative	Super- visors	Fore- men	Inspec- tors	Total
Inspection and certification	. 3	1		5	9
Road Patrol		1		11	. 12
	2				
Total	. 3	2		16	21

NURSERY AND ORNAMENTAL STOCK.

1. Japanese Beetle Quarantine Office in the State of Connecticut and area of jurisdiction under same.

SHELTON (State Headquarters) Hurley Building, Shelton, Connecticut Townships in Fairfield County:

Bridgeport Darien Easton	Fairfield Greenwich New Canaan	Norwalk Shelton Stamford	Stratford Trumbull	Westport Wilton
Daston	New Canaan	Stailliord	Weston	

- 2. There were 58 Nursery and Greenhouse establishments having 1,203½ acres of stock and 473,380 sq. feet of glass, classified for making shipments out of the quarantined area.
- 3. During the year, 389,914 plants were certified for shipment outside of the quarantined area.
- 4. A total of 11,030 certificates were used in inspection and certifying plants for shipment.
- 5. There were 3,663 shipments reported to the 10 states requiring notice of them.
- 6. Four establishments dropped their classification for shipping out of the area because they found their business was confined within the quarantined limits, or else went out of business.

SAND, SOIL, EARTH, PEAT, COMPOST AND MANURE.

- 1. A total of 193½ car loads of sand and 60 car loads of manure were certified for shipment outside of the quarantined area.
- 2. Certificates, totaling 1,469 in all, were used in certifying sand and manure.

in the Park rose garden and on a strip of lawn (part of the park system) on Edgewood Avenue between Brownell Street and the Boulevard.

Adults were readily found during the peak of the season in the heavily infested area. The first beetle was found, June 26, 1928, at 304 Yale Avenue, Westville, New Haven, Conn., while the last was found August 29, 1928. There was no record of the exact location at which the last beetle was found.

During 1927 and 1928, rather extensive control experiments were carried on by Dr. R. B. Friend, of this Station, with lead arsenate. The report of his work is published in Bulletin No. 304.

Altogether 55 requests were received during the year from individuals for investigations to determine whether or not their properties were infested and for information regarding control measures. These requests were fulfilled and in many cases control work was instigated.

The quarantined area was patrolled regularly throughout the year, warnings issued to all making excavations of any kind, and information given regarding the quarantine and regulations. In general, as in 1926 and 1927, hearty cooperation was received from those who found it necessary to operate under quarantine regulations.

There were 1,194 plants inspected for shipment during the entire year, and 4,368 package certificates were issued for other plants which were free to move under certificates without inspection.

Approximately 3,281 cubic yards of soil and sand were certified for shipment. The soil came from excavations made in the area and was taken two feet below the surface. The sand was shipped from a certified sand-bank. A total of 4,863 certificates was issued during the entire year.

THE PERIODICAL CICADA OR SEVENTEEN-YEAR LOCUST IN 1928.

Tibicina septemdecim Linn.

Brood No. II of the periodical cicada or Seventeen-year locust appeared in Connecticut in 1928 according to expectations. This insect has one of the strangest and most interesting of all insect life histories. It is also one of the most difficult to study and follow through to its end—a period of seventeen years. It appeared in Connecticut in June 1894, the first summer that the writer lived in Connecticut. No particular attempt was made in 1894 to gather distribution data, but specimens were collected in Branford by Dr. Wm. C. Sturgis, then Botanist of the Station. In 1911, the insect appeared in large numbers, and a fairly complete ac-

count was published in the Report of this Station for 1911, page 296. In 1911, the insect was reported from three counties and 21 towns, shown on the map (Fig. 62), as follows: Hartford County: Avon, Berlin, Farmington, New Britain, Plainville, Rocky Hill, Southington and West Hartford; Middlesex County: Cromwell, Durham, Killingworth, Middlefield and Middletown; New Haven County: Branford, Cheshire, East Haven, Guilford, Hamden, Meriden, New Haven, North Branford, North Haven and Wallingford.

DISTRIBUTION IN 1928

In 1928, this insect appeared in about the same localities as in 1911, though no attempt was made to obtain reports from all of the towns where it appeared in 1911. The members of the Department staff in traveling about the State in the course of their work brought in a number of observations.

The first notification of the appearance of this insect in the State in 1928, was received in a letter from Branford the first week in June. Messrs. Friend, Walden, Zappe and the writer visited the spot on the afternoon of June 5. The insects had begun to emerge along the sides of a road leading from Sagal-lou Farm to the head of Lake Saltonstall. There were no treees in the particular area though trees were not far distant. The adults and pupa shells were resting on grass, weeds and sumac sprouts, none of which were more than two feet tall. This area from which the insect emerged was probably not more than 100 feet long, and considerably less in width. Material was collected and brought to the laboratory.

On June 11, in response to a telephone call from Gaylord Farm Sanitarium in Wallingford, Dr. Friend, Mr. Turner and the writer visited the place in the afternoon. The manager feared that the insect might cause severe damage to the orchards. We found the adults and pupa shells rather common around the farm house and grounds, even on pine trees but could find none in the nearby apple orchard. Workmen reported that pupae were abundant underneath stones in an adjoining pasture a few days before. We therefore turned over hundreds of stones along the pasture fence and collected many pupae, showing that only a portion had emerged. On June 13, a telephone call from Gaylord Farm informed us that the cicadas were much more abundant on trees around the farm buildings than on the date of our visit, two days before.

On June 12, Messrs. Friend, Turner, and Walden visited Rocky Top ridge west of the Station Farm, in the town of Hamden, and collected some adults. The insects were making a great racket there but flew away into the trees when disturbed. A goodly number were collected and brought to the Station.

Some of the insects were found on the ridge north of Lake Wintergreen, on or near the farm of Mr. H. F. Baumgardt, but appeared to be much less abundant in this locality than in 1911.

County Agricultural Agent, Raymond K. Clapp, reported the insect as being present on his farm about two miles northeast of Ive's Corner in Cheshire, and also from C. O. Young's orchard in East Wallingford, and Frank Snow's orchard in North Branford.

On June 17, while driving for pleasure, the writer observed, heard, and collected adults on the road between Clintonville and

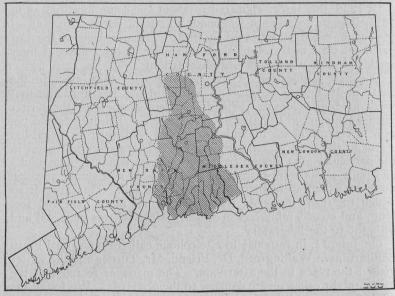


Fig. 62. Map of Connecticut showing area occupied by Brood II of the periodical cicada in 1911.

Northford, probably in the town of North Haven but near the North Branford line. They were making a great racket in a clump of oak trees on a hillside. He also heard them at two places in Guilford east of the Guilford-Durham State road.

Mr. Zappe heard or observed the insects, or afterwards saw the broken twigs caused by their egg-laying habits, on the ridge from Meriden West Peak, Hubbard Park, north to Kensington where considerable injury was caused in one apple orchard; also in Farmington, Southington, North Branford, Middletown, East Berlin, on Higby Mountain, and on the south side of Mount Carmel in Hamden.

Professor J. A. Manter, of the Connecticut Agricultural College, reports that he and Mr. A. F. Schulze saw the cicadas in large numbers in Berlin, New Britain and Southington. One of his students, Mr. C. J. Anderson, reported that he saw them in Haddam and Middletown.

Newspapers reported the periodical cicada as being present around New Britain and Middletown. Thus it is apparent that the insect in 1928 occurred in about the same area as in 1911, as shown in Fig. 62, but in some localities at least it was less abundant than in 1911.

From these locality records, it will be seen that the insect occurred chiefly along the trap-rock ridges in the southern central portion of the State, and all of these localities are in Hartford, Middlesex and New Haven Counties.

HABITS AND LIFE HISTORY

The females splinter the twigs of trees in depositing their eggs, usually on the under side of the lower branches, as shown on Plate XXV, b. About six or seven weeks after the eggs are laid, the young cicadas as they hatch, drop to the ground and work their way into it twelve to eighteen inches beneath the surface. For seventeen years they live in the ground, burrowing with their forelegs, and for food they suck the sap from small roots between one-eighth and one-fourth of an inch in diameter. During this time, the larvae molt four times, the fourth molt usually occurring about the tenth year. It is very difficult to follow their development and movements, yet this has been done in a few cases by the Bureau of Entomology. When the larvae become mature during the seventeenth year, they work their way toward the surface of the ground, often remaining for days under stones. During this time they are not quiescent, but are quite active and often descend into their burrows out of sight, if one turns over the stone and tries to catch them. When they finally emerge, they do so through circular holes, about three-eighths of an inch in diameter. Sometimes these holes are in hard, well-packed soil such as a walk or the side of a road, and are often close together. In some cases they build up a pyramid or cone two or three inches high around the hole, but none of these were observed in Connecticut in 1911 or 1928. On emerging from the ground, the insect crawls up the trunk of a tree or upon twigs, leaves, stems of weeds, or upon fences or buildings, and soon the skin splits lengthwise along the back and the adult cicada comes forth. At first it is greenish white with soft limp body and wings. It clings to the surface with wings hanging downward, and soon becomes firmer and darker and assumes its normal appearance. The period of emergence extends over about six weeks, and within a week or so after

emergence the adults have mated and the females have commenced to deposit eggs. The old shells remain on the trees or fences for a long time. Sometimes a hundred or more may be counted upon the trunk of a tree. One of these shells is shown in Fig 63, and others on Plate XXVI. As with other species of cicadas, the rattling noise or "song" is made only by the males which have curious diaphragms or drums at the base of the abdomen on the under side of the body. These organs vibrate rapidly, to make the rattling noise.

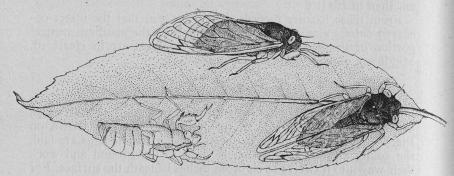


Fig. 63. Periodical cicada, adults and pupa shell on leaf. Natural size.

DESCRIPTION OF VARIOUS STAGES

Egg. About 2 mm. long, white or pale yellow, transparent. slender, curved and pointed at both ends.

Larva. Dirty white, light brown or yellowish color. A wingless grub, with forelegs modified for burrowing, and with sucking mouth; resembling pupa. More or less hairy.

Pupa. About one inch long, nearly three-eighths inch thick, light brown or tan in color, with prominent legs, the fore pair fitted for burrowing. Head and eyes prominent, antennæ relatively small and inconspicuous. Abdomen large. Thorax and abdomen smooth and shiny. Head and legs hairy.

Adult. Wingspread of about three inches. Body from one to one and one-fourth inches long, about three-eighths of an inch thick. Wings transparent, shiny. Costa bright orange-yellow, other veins fuscous shading to orange at base of wings. Margins and marginal cells more or less fuscous-shaded, the shading and venation at base of marginal cells forming a W near the apex of each forewing. Body dark brown or black above, waxy. Ventral surface of body and legs brown shading to orange. Eyes bright coral red in life, color mostly disappearing in death. Antennæ filamentous, inconspicuous, tapering, 6-jointed, black. The female has a sharp-pointed abdomen with a horny ovipositor folded

up on the ventral surface near the tip. The male has a larger and more blunt abdomen, with a pair of sound boxes or drums on the under side at the base, just back of the rear legs.

PERIODICAL CICADA

The appearance of the adults and pupal shells may be seen on Plates XXV, a, and XXVI, b, and in Figure 63.

INJURY TO TREES

The effect upon trees caused by hordes of immature cicadas sucking sap from the roots is not well known and consequently cannot be evaluated here. Probably it injures them, but the injury is usually considered as slight, or is disregarded altogether.

The adult cicadas rest upon the bark and leaves of trees, and the stems and leaves of succulent plants, and probably puncture the tissues and suck out a little of the sap, but this is not a serious injury. The chief injury is caused by the females which splinter the twigs with their ovipositors in depositing eggs, as shown on Plate XXV, b. Some of these twigs are weakened to such an extent, that they break off during storms or in a strong wind. The eggs are usually laid in longitudinal rows of punctures along the under side of the twigs of the preceding season's growth, having a diameter of from one-fourth to one-half an inch. Though some of these twigs break off completely and drop to the ground many of them hang and the leaves become dry and turn brown. Sometimes a wooded hillside presents a brown appearance in midsummer from the great number of broken twigs.

In case a young orchard is established on land from which cicadas emerged seventeen years before, or adjoints infested woodland, serious injury may result from the splintered and broken branches. The writer saw such injury to young peach trees in an orchard in Guilford in 1911. Some of the branches do not break and though the scars gradually heal over (see Plate XXVII, a), they are unusually prominent for several years and the branches will always be weaker than uninjured ones. A young orchard injured in this manner should be pruned heavily the following winter or spring in order to remove most of the injured wood and to promote a vigorous growth of new and stronger branches.

NATURAL ENEMIES

In Connecticut, no parasites have been recorded from the periodical cicada. The larvae of four species of Diptera or twowinged flies are known to feed upon cicada eggs in the United States. Four species of Hymenoptera or four-winged flies are known to parasitize the eggs, and certain mites feed upon them, but none of these egg-parasites have been observed in Connecticut.

The large digger wasp or cicada killer, Sphecius speciosus Dru., kills many cicadas. The adult wasp stings the cicada and carries it away to its subterranean nest to serve as food for the young wasps. The sting paralyzes the cicada but does not kill it, and the wasp lays an egg on the body of the cicada, upon which the young wasp larva feeds.

Probably birds are the most important natural enemies of the cicadas. Members of the Department staff have observed in several places, large numbers of cicada wings upon the ground where birds had devoured the bodies of the insects and discarded the wings. It is commonly recognized by Connecticut farmers that crows do not pull corn during those seasons when cicadas are abundant. Mr. A. W. Butler found 31 species of birds that fed upon the periodical cicada in Southeastern Indiana in 1885; the more important were English sparrow, robin, blackbird, catbird, flicker, red-headed woodpecker, towhee, crow, Baltimore and orchard orioles, and several species each of fly catchers and sparrows.

A fungus described in 1851 as Massospora cicadina by Peck, appears on the bodies as a greenish mold, and destroys many adult cicadas, especially males, in some parts of the country, but has not been observed in Connecticut.

CONTROL MEASURES

In general, preventive or control measures are scarcely practicable against the periodical cicada. If the insect appeared each year in the same localities possibly something might be done, but it comes only once in seventeen years, and is usually forgotten before it comes again.

Small and choice trees may be protected from injury by covering

them with mosquito netting.

Applications of insect powder or pyrethrum are fatal to the adults, and this remedy has been mentioned in publications dealing with this insect. It is usually recommended that it be dusted upon the newly emerged adults in the early morning when covered with dew. Dr. R. B. Friend, of this Department, on June 12 counted out 60 well-hardened adult cicadas, placed 20 in each of three cages, and sprayed two lots. One lot received nicotine sulphate (1-500) with soap added; the other lot received pyrethrum extract prepared after Van Leeuwen's formula* which gives oleoresin of pyrethrum at a concentration of about 1-800. The third lot or check was sprayed with water. After three days, four were dead in the check lot and 16 alive; all were dead in both the other cages. There is some evidence to show that trees sprayed with

Bordeaux mixture, lime-sulphur, or whitewash are injured considerably less than untreated trees, and therefore such materials may be considered as partial repellents.

LITERATURE

Britton, W. E., Report Conn. Agr. Expt. Station, 1911, page 296. Marlatt, C. L., Bulletin No. 71, Bureau of Entomology, U. S. Dept. of Agr., 1907.

NOTES ON THE NEST BUILDING HABITS OF THE PIPE ORGAN WASP*

By THOMAS B. OSBORNE

The nest consisting of three tubes cemented together is a part of one of originally five tubes, two of which were broken when removed from a partition in a stable at Washington, Conn., about August 22, 1916. This was fastened to a smooth board in a nearly vertical position with the opening downwards, as indicated in the drawing (Fig. 64, B). About three feet away another nest was being built. When first noticed, this was about one inch long, at 11 a. m. Two wasps were engaged in constructing this nest. One, smaller than the other, and apparently browner in color was inside; the other, black with a blue lustre, worked on the outside, collecting clay and putting each portion in place. The clay was brought moulded into a strip about three-fourths inch long and one-sixteenth inch in diameter. This strip, as near as I could see, was carried on the front leg and held by one end with the jaws. This end was applied to the crotch at the median line of the nest and then rapidly attached to the edge of the piece which had previously been put in place. Apparently it was moulded by the jaws and pressed into position until the end of the strip reached the end of the preceding portion and there came into contact with the board to which the nest was attached. The end was then flattened out against the board, the jaws and fore feet being used to make it adhere firmly. During this process, the wasp inside made a buzzing sound and seemed to be engaged in maintaining a

^{*}Jour. Econ. Ent., Vol. 19, pp. 786-790.

^{*}During the summer of 1916, Dr. Osborne, head of the Department of Biochemistry of this Station, spent his vacation in Washington, Conn., and became interested in watching some mud wasps construct their nest on a board of the barn. On returning to New Haven he brought me one of the wasps, the nests, and the notes and said that I might use them in any way I saw fit. The wasp was identified by Dr. H. T. Pernald, Amherst, Mass., as Trypoxylon albitarse Fabr. (male). The nests were provisioned with spiders which were sent to Mr. J. H. Emerton, Boston, Mass., who reported as follows: "The spiders from wasps nest are all Epeira trivitiata Keyserling, all females, and half of them adults. They make round webs and live in the tall grass and bushes all over the country". The illustrations on Plate XXVIII are from photographs by B. H. Walden; those shown in Fig. 64 were traced by Dr. Philip Garman from pencil sketches made by Dr. Osborne Dr. Osborne died suddenly, January 29, 1929, and as these notes had not been published, it was thought best to include them here. [W. E. Britton.]

¹This looked like Fig. 5, Plate II, Pelopaeus cementarius, 9, Bull. 2, Wis. Geol. and Nat.

²Like Fig. 3, Plate II, Chlorion coeruleum 9, Ibid.

proper sized bore for the tube under construction. When the clay was attached the larger wasp went inside the tube and the two set up a loud buzzing for a few seconds. It then came out and flew away to return after two or three minutes with another strip of clay which was put in place on the opposite edge of the opening of the nest. This process was continued. Each time the outside wasp returned it struck the wall about three or four feet from the nest, but located the nest after a few seconds by flying about on one side or the other, coming gradually nearer each time as

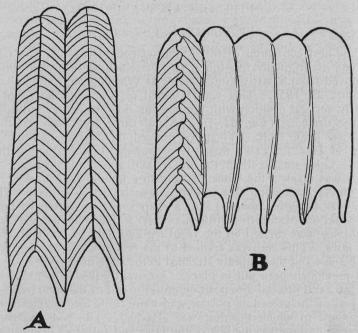


Fig. 64. Nests of the pipe organ wasp. Natural size.

though attracted to it by some invisible force. After every four or five trips by the outside wasp the inside wasp would come out and fly away. When it returned it struck the wall much further away than did the outside wasp and had more difficulty in finding the nest. Whether or not it brought anything with it I could not see. At any rate, whatever it carried was very small. On returning, this wasp went directly into the nest and stayed there until the outside wasp had put three or four more strips of clay in place. I did not see the first tube finished or the second tube begun for I had to go away when the former was about two inches long. About 9 a. m. the next morning the first tube was approxi-

mately three inches long and a second tube had been made which was about one and a half inches long when I first saw it. I watched the construction of the second tube until 11 a. m. when it was as long as the first. When it reached this length the inside wasp set up a very loud buzzing when the outside wasp came back with more clay and apparently made such a fuss that it did not dare attempt to put the clay in place. After attempting several times to do so the outside wasp flew off with the clay and came back again, after a few minutes, apparently without any clay and went inside the nest. It then made regular trips coming back with such small quantities of clay that I was unable to see that it carried anything. When it entered the nest, clay must have been brought because after several trips a partition had been built across the lower end of the tube. I did not see any spiders put into the tube before the partition was completed, but I did not watch them continuously and this may have been done while I was away or it may have been done during the trips of the inside wasp, but I think I would have seen the spiders when it came back to the nest if it brought any. A heavy thunder shower put an end to the work for the day. The next day, no more work seemed to be done and the outside wasp was not seen. One, or both, were in the nest in the afternoon as evidenced by the buzzing which followed on putting a straw into the tube. The tube first made had a partition about one-half inch from its mouth. It probably had two others lower down. Both tubes were attached to the wall in a vertical position with the mouth opening downwards. (Fig. 64, A, and Plate XXVIII):

MOSQUITO CONTROL WORK IN CONNECTICUT IN 1928

R. C. Botsford

Mosquito control work during the season of 1928 consisted largely of supervising the treatment of mosquito breeding areas, and was concerned especially with the ditching of salt marshes. Inasmuch as this season was the greatest for the treatment of new areas since 1916, it seems best to describe in some detail the method of procedure and the part this Station plays in the average mosquito control program undertaken by a community or individual.

PROCEDURE OF MOSQUITO CONTROL WORK

Chapter 68 of the Public Acts of 1923 authorizes the Director of the Connecticut Agricultural Experiment Station to investigate the places where mosquitoes breed and to order these areas treated as required to eliminate mosquito breeding therein. Investigation, or a brief survey, to determine the extent of the area to be treated

and the cost of treatment may be made upon request and for this work there is no charge by this Station. But sufficient funds must be provided to complete the treatment according to the survey before the legal order and notice is issued. This order and notice contains a brief description of the plan to be followed and is delivered to record land owners affected to notify them of the proposed work and a copy placed on file with the local town clerk, and also published in a newspaper of local circulation.

CONNECTICUT EXPERIMENT STATION

Funds for treating the area in question are usually provided from town funds or are contributed by local residents, associations or corporations. The project of mosquito elimination in any community is, as a rule initiated by one or more influential and publicspirited individuals who can give some of their time to a rather educational campaign concerning the absence of mosquito nuisance in relation to real estate values, the improvement or reclamation of swampy land, the raising of sanitary standards, the reduction of malaria cases, and the most effective reason of all-personal comfort out-of-doors and in.

The individual interested usually introduces a motion before the local town meeting requesting town funds for the work, or a house-to-house canvass can be made. Usually a combination of town appropriation and personal subscriptions is very satisfactory. State funds are not available at this time to aid in the labor cost of this work, but a limited amount of time may be given by this Station to aid in making a preliminary survey in supervising the field work and inspecting the work as it progresses.

When sufficient funds are available and it is desirable that this Station supervise the work, it is customary to send the funds to the Station for deposit with the State Treasurer. As the work proceeds, these funds are drawn as required by certified vouchers, and the contractor is paid only for work which merits our approval. Men experienced in mosquito control work and reliable contractors capable of treating large areas effectively are not easily obtained, and unless the work is properly supervised, large sums of money may be expended without obtaining the desired results and when this occurs future mosquito control projects in other communities may become more difficult to develop.

Wherever any land has been drained to the approval of the Director of the Connecticut Agricultural Experiment Station, the drainage works shall be kept in repair at State expense. To carry on this maintenance work, this Station is dependent upon what the General Assembly sees fit to appropriate for that purpose. For the past six years, funds have been so insufficient that some of the work has deteriorated and returned to a mosquito breeding condition and large areas recently ditched and approved could not be accepted for maintenance due to lack of funds. The inadequate funds available for maintenance cannot be prorated effectively over these large added areas of newly ditched salt marsh be-

cause a larger proportion of money would be expended for transportation and much less would be left per acre of salt marsh. Funds which would be sufficient to keep certain contiguous areas in non-breeding condition would be split up if expended over widely separated areas, thus increasing the transportation cost and cutting down the labor per acre. This would necessarily result in allowing small breeding places to exist on all areas, thus leaving all the work incomplete and consequently ineffective. Proper maintenance of ditched or otherwise treated areas is one of the most important phases of mosquito control. Trained men are necessary to keep the work in proper condition. This is especially true in regard to crew foremen who must be intimately acquainted with all the characteristics of the areas under their supervision and know the shortest routes to and from the areas. Several seasons of experience are necessary training for this work and men of this type should be available each season, which makes it necessary in some cases to pay these men through the winter months when no work can be done, in order to have them on hand for the spring work. The table below shows the area in acres of salt marsh under State maintenance in 1928-1929 and all ditched areas which could come under State maintenance in 1929-30 if funds were provided. It also shows the plan necessary for proper patrol and maintenance.

755

	NEW PLAN	FOR MA	AINTENANCE
Town	No. Acres 1927-1928	No. Acr 1929-19	
	WEST	ERN DIS	TRICT
Stamford	200 1,200	$ \begin{array}{c} 300 \\ 600 \\ 400 \\ 1,200 \end{array} $	$2,\!500~\textrm{acres} \left\{ \begin{array}{l} 1~\textrm{foreman}\$1,\!330 \\ 2~\textrm{laborers} \end{array} \right. 1,\!440$
	NEW F	HAVEN DI	ISTRICT
West Haven New Haven Hamden East Haven Branford Guilford	222 675 50 578 1,085	$\begin{array}{c} 222 \\ 750 \\ 520 \\ 482 \\ 900 \\ 1,085 \end{array}$	$3,959~\texttt{acres} \left\{ \begin{array}{l} 1~\texttt{foreman}\$1,330 \\ 4~\texttt{laborers} \end{array} \right. 2,880$
	EAST	ERN DIS	TRICT
Madison. Clinton. Westbrook. Old Saybrook. Old Lyme. East Lyme. Groton.	1,005	$ \begin{array}{c} 1,005 \\ 800 \\ 500 \\ 300 \\ 450 \\ 300 \\ 50 \end{array} $	$3,405 \text{ acres } \left\{ \begin{array}{l} 1 \text{ foreman \$1,330} \\ 3 \text{ laborers 2,160} \end{array} \right.$
Total	5,065	9,864	Total cost—Labor only \$10,470 for 1 year.

NEW WORK

A ₁	pprox. N	o. Linear feet of		Day	7 1	m . 1
Town	ditched	ditches	Cost	Labor	Legal Expense	Total Expenditure
Norwalk	500	14,164	\$354.10	\$2,860.60		\$3,214.70
New Haven.					\$18.40	18.40
North Haven			and the		20.26	20.26
Hamden	250	98,332	2,461.31	121.35	18.58	2,601.24
East Haven.	300	100,322	2,509.20	1,215.96	22.36	3,747.52
Branford	317	113,192	2,837.79	352.02	21.98	3,211.79
Madison	100	31,273	781.83	940.80		1,622.63
Westbrook	80	34,088	852.21			852.21
Saybrook	86	39,943	998.59			998.59
Old Lyme	300	128,330	3,228.25	103.04	11.48	3,342.77
East Lyme	130	58,423	1,461.48	1,201.89*	19.12	2,682.49
	2,063	618,067	\$15,484.76	\$6,795.66	\$132.18	\$22,312.60

WORK OF THE SEASON

The summer of 1928 was a mosquito year, as was also the two preceding seasons. Mosquitoes were very abundant in some localities, in fact, so aggravating that in some of the most conservative townships the electors in open town meetings made generous appropriations for ditching their salt marshes. In 1928, nine towns made appropriations totaling over \$25,000 and individuals contributed \$7,000 more, making a total of \$32,000. (Total of ditches installed 618,067 feet.) The majority of towns turned their funds over to this Station, but some preferred to pay the contractor direct. All details of the work were managed by this Station. The ditching was done in a lump contract and was awarded to John F. Ross, 1660 Putnam Avenue, Ridgewood, N. Y., at two and a half cents per linear foot. Mr. Ross spent practically all of his time on the salt marshes and no important details were overlooked to make the work as perfect as possible. The Deputy in charge inspected the work as it progressed and a high quality of work was maintained. In reviewing the work separately by towns, it is necessary to be as brief as possible and to refer the reader to the tabulation of statistics for details as to acreage, cost, future expenditure and so forth.

WORK DONE UNDER NEW HAVEN CHAMBER OF COMMERCE PLAN

Source of Funds	Resident Contri- butions	Town Contri- butions	New Have Quota	n	Total	Expended	Balance
Hamden North Have Branford	15.00	\$2,500.00	676.01	32% 17%	\$5,287.48 691.01	\$2,601.24 20.26	\$2,686.24 670.75
East Haven. New Haven	35.50	2,500.00	717.77 1,113.42 198.83	18% 28% 5%	3,538.77 3,648.92 948.83	3,211.79 3,747.52	326.98 -98.60
C. of C				370	300.00	18.40	930.43

*Fresh water swamp.

THE WORK BY TOWNS

NEW HAVEN

As a result of its recent campaign, the New Haven Chamber of Commerce collected \$21,232.00 to be used for relieving the City of New Haven from mosquitoes migrating from unditched salt marsh areas in Hamden, North Haven, East Haven and Branford, and for ditching a small area near Morris Cove.

Of this amount \$6,000.00 was appropriated by the City of New Haven for straightening and dredging Morris Creek, and in addition the Public Works Department from its own funds built a tide-

gate in Little River at Middletown Avenue.

The total publicity expenses, consisting chiefly of printing and distributing printed matter, was deducted from the contribution of New Haven residents, leaving a balance of \$3,976.51 to be donated to Hamden, North Haven, East Haven, Branford, and New Haven on an acreage pro rata basis as shown in column four in table. Hamden receiving 32 per cent, North Haven 17 per cent, East Haven 28 per cent, Branford 18 per cent, and New Haven 5 per cent. All funds originating within each of the four surrounding towns were to be expended within their own borders, plus the quotas mentioned above. This Station cooperated with the New Haven Chamber of Commerce throughout its campaign and supervised the ditching work. No new ditching was done in New Haven as it was necessary that the dredging of Morris Creek be completed first.

WEST HAVEN

The town of West Haven aided in maintaining the ditched areas. These areas were reported free from mosquito breeding the entire season. The work was under the supervision of Dr. Charles D. Phelps.

NORTH HAVEN

The town of North Haven failed to furnish funds and the New Haven quota was insufficient to start the work. (See table.)

The City of New Haven constructed a tide-gate on Little River which will protect the North Haven area from flooding by high tides and will facilitate ditching when the time comes.

HAMDEN

The town of Hamden contains 571 acres of salt marsh and is one of the new towns in mosquito control work. The work started near the New Haven town line and continued northward until funds were exhausted. About one-half the area was completed.

[†]This amount, \$3,976.51, including \$300.00 contributed by the New Haven Chamber of Commerce, was prorated to all towns according to acreage of area to be treated.

The town appropriation of \$2,500 will become available for work in 1929. (See table.)

EAST HAVEN

The town of East Haven contains about 545 acres of salt marsh, of which but 50 acres are maintained by State funds. Under the New Haven Chamber of Commerce plan, about 300 acres were ditched this season at the cost of \$3,747.52. (See table.) The areas yet to be ditched include the northwest corner of the marsh lying east of Hemingway Avenue, the long narrow marsh from Morris Creek to Hemingway Avenue, and areas near Morris Creek. All shore areas from the East Haven River to Morris Creek are completed. Funds are exhausted and about \$1,300 will be required to complete the ditching in East Haven.

The town of East Haven dredged the upper part of Morris Creek, known as Tuttle Brook from the New Haven line north to Main Street. The town also installed a permanent beach outlet at Silver Sands to take the place of a pipe line 1,200 feet long which failed to drain a low area each side of Cosey Beach Avenue. These two improvements are of great importance not only from a mosquito control standpoint but as a sanitary measure as well.

BRANFORD

All salt marshes in the town have now been ditched. The cost of completing this work was \$3,211.79 and covered the unditched area west of the Branford River to the East Haven town line. Final inspection only is necessary for State approval. (See table.)

The area east of the Branford River ditched in 1916 was patrolled and the ditches kept open with the exception of the diked Stony Creek marsh which requires reditching. The tide-gate at this location requires extensive repairs.

The construction of the tide-gates on the Branford River at Hubbard's Bridge should be completed. A new permanent concrete sill was installed at the 28 foot opening at considerable expense in 1927 and now new wing walls and new gates are required to make the unit complete.

GUILFORD

All ditches recently recut were patrolled and cleaned and the work of recutting continued. It is estimated that by the fall of 1929 all recutting should be completed and salt marshes in non-breeding condition. The broken dike at Great Harbor was repaired by the property owners and is now in good condition, although the beach is cutting back in another location dangerously close to the dike.

MADISON

Reditching of the salt marsh areas in Hammonasset Park was completed this season at a total cost of \$5,554.64. These funds were contributed by the State Park and Forest Commission and eliminated some of the worst breeding places in the town. The large area at Hogshead Point near East River should be reditched as soon as possible.

Corrugated iron pipes installed as beach outlets were somewhat damaged by storms but continue to function.

WESTBROOK

Ditching in the town of Westbrook was completed and sufficient funds remain to overhaul and clean the ditches in the spring of 1929.

OLD SAYBROOK

The town of Old Saybrook at its 1927 town meeting appropriated \$1,000 which was expended ditching about 86 acres to the rear of Plum Bank. Another \$1,000 was appropriated in 1928 to extend the ditching in 1929. The salt marsh areas recently ditched near Knollwood Beach by Simpson and Cosulich should be patrolled and ditches cleaned where necessary. The area at Fenwick ditched in 1916 should be entirely reditched.

OLD LYME

The town of Old Lyme at its fall town meeting appropriated \$5,000 to start ditching its salt marshes. Some funds were made available immediately and ditching was started in the Black Hall section as this was considered the source of the greatest number of mosquitoes.

The marshes on the Black Hall River and at Smith's Neck were ditched and the work well started on Great Island when cold weather put a stop to the work. Total footage of ditches installed to January 16 is 128, 330 feet.

EAST LYME

The summer residents of Black Point in the town of East Lyme raised \$3,000 for mosquito elimination in that vicinity. This amount was estimated sufficient in a recent survey by this Station to drain two fresh water swamps and a nearby salt marsh.

In the large brushy swamp on the top of the ridge, a ditch was dug extending from the roadway at the south end of the point northward to a small pond. It may be necessary to dig some spur ditches to distant depressions to make the drainage of the entire

area complete. A narrow fresh water swamp on the west side was ditched and drained by installing a corrugated iron pipe through the beach. The salt marsh west of the Point was ditched to a point a short distance above the wood road bridge (see table).

GROTON

Ditches were cleaned and graded where required and some new spur ditches installed. It is difficult to arrange more than one or two visits to this area a season, due to the distance from the nearest ditched area.

FAIRFIELD

The town of Fairfield cooperated as usual with the State and has aided this Station by supplying men and funds to keep the salt marshes in non-breeding condition. The draining of fresh water swamps continues to expand and has resulted in increased valuation of much property in addition to removing the source of disease-bearing mosquitoes.

WESTPORT

Ditching in the town was inspected and approved by this Station in 1927 but we could not maintain the work due to lack of State funds. The town of Westport however appropriated sufficient funds and employed Nicholas Matiuck to furnish labor and supervise the work. The ditches were patrolled and kept clean and areas requiring oil were sprayed with old crankcase oil as required.

NORWALK

For several seasons past the City of Norwalk has been infested with mosquitoes. At the request of Dr. Purdue, Health Officer, a preliminary inspection was made of the salt marshes and fresh water places. Prolific mosquito breeding was occurring in stagnant pools near the center of the city and immediate oiling was recommended to be followed later by filling or draining. The salt marshes were ditched in 1912 and were in fair condition. This Station recommended thorough reditching to put the work into condition which would pass State inspection. The City of Norwalk appropriated \$4,000 for this purpose, of which \$3,214.70 was expended this season. The ditching was approved on October 18, 1928.

STAMFORD

The city of Stamford for several years past has appropriated funds for mosquito control work. Some of these funds have been

added to State funds and expended under State supervision in maintaining the salt marsh ditches, and the balance for oiling fresh water swamps.

MOSQUITO CONTROL WORK IN 1928

STATUS OF CONNECTICUT SALT MARSH AREAS, 1928

	Town	Salt Marsh Areas	Salt Marsh Ditched	Main- tained by State	Total Cost of Ditching	Labor, Cost Maintenance, 1928	
	Greenwich	200	200	none	\$22,000.00		
	Stamford	300	300	200	3,245.80	\$107.92	
	Darien	300	300	none	3,800.00		
	Norwalk	600	600	none	7,500.00		
	Westport	400	400	none	5,913.82		
	Fairfield	1,200	1,200	1,200	8,400.00	509.83	
	Bridgeport	173					\$3,000.00
	Stratford	1,315					20,000.00
	Milford	630	A				9,500.00
	West Haven	463	222	222	*	83.55	3,500.00
	New Haven	750	750	675	12,000.00	310.50	750.00
	Hamden	571	250	none	2,601.24		2,500.00
	North Haven.	310					3,100.00
	East Haven	545	300	50	3,747.52		1,300.00
	Branford	895	895	578)		417.12	
	Guilford	1,085	1,085	1,085	20,000.00	789.57	
	Madison	1,005	1,005	1,005		1,777.03†	
	Clinton	785	677	none	10,000.00		2,000.00
	Westbrook	500	500	none	7,428.14		
	Old Saybrook.	1.373	186	none	2,000.00		15,000.00
	Lyme	493	ATT THE A				7,500.00
	Old Lyme	1,393	300	none	3,342.77		15,000.00
#	East Lyme	424	130	none	1,480.60		4,000.00
	Waterford	204					3,500.00
	New London.	34		Li ma			500.00
	Groton	304	50	50	1,000.00	15.00	4,000.00
	Stonington	555					8,500.00
	Totals	16,807	9,350	5,065	\$114,459.89	\$4,010.52	\$103,650.00

^{*}Ditched with New Haven. †State Park and Forest Commission \$1,622.63.

MISCELLANEOUS INSECT NOTES

Larch Sawfly: On July 30, Dr. R. B. Friend visited the Whittemore estate in Middlebury where many European larch trees had been stripped by the larch sawfly, *Nematus erichsoni* Hartig. The larvae had left the foliage and made their cocoons. An outbreak of this insect occurred in 1915, and a full illustrated account may be found in the Station Report for 1915, page 125. Spraying with lead arsenate will prevent defoliation. [W. E. Britton]

Spruce Epizeuxis Injures Blue Spruce: On July 2, 1928, several larvae and pupae of *Epizeuxis aemula* Hubner were collected on some blue spruce trees (Picea pungens) at Woodmont. Several adult moths were reared in the insectary from this material, emerging July 6 and 7. The larvae live mainly on the older needles back from the tips, and their webs and excrement, together with the dead needles, form a dense mat, as shown on Plate XXIX, a and b. A spray of lead arsenate would doubtless prove effective. [R. B. Friend]

The Horse Radish Flea Beetle on Cabbage: Adults of the horse radish flea beetle, *Phyllotreta armoraciae* Koch, were found attacking the leaves of young cabbage plants early in May, on the farm of F. E. Peckham at Norwich. When the plants were examined, most of the insects were on the under side of the leaves lying on or close to the surface of the ground, or in the axils of the leaves. The owner dusted the entire plot with lead arsenate and lime, one part of the former to four parts of the latter by weight, and the number of insects was materially reduced, although no exact experimental data were available. Prior to the planting of cabbage in the spring of 1928, horse radish had been growing on the land for several years. [R. B. Friend]

Say's Blister Beetle Injuring Peach Trees: On June 19, specimens of Say's blister beetle, *Pomphopaea sayi* Fabr., were received from Canaan, together with peach leaves which had been partially eaten by them. The correspondent reported that three young peach trees were covered with the beetles which were rapidly devouring the foliage. Three adult beetles were received. They were nearly three-fourths of an inch long, with head, thorax, and wing-covers dull green, legs honey-yellow, tarsi, knees and antennae, black. This beetle is rather rare in Connecticut and this is the first record of injury caused by it. Of course spraying with lead arsenate is the remedy. The beetle and injured peach foliage is shown on Plate XXIX, c and d. [W. E. Britton]

Weevil on Red Pine: The last of November, 1928, Mr. W. O. Filley, Station Forester, brought in some dead young red pines each of which contained several larvae of *Pissodes approximatus*

Hopkins, in the base of the trunk. The larvae were fully grown and in cells in the wood close to the bark. Adults were reared, emerging in the laboratory insectary January 18, 1929. The trees were about six years old and were part of a plantation in Goshen belonging to the American Brass Company. The infestation was confined to a small group of trees in a swale, and no signs of weevil injury were observed in the neighboring parts of the plantation. Several apparently healthy trees growing among those infested were examined and no indications of the presence of larvae could be seen. All infested trees were dead. This weevil very closely resembles the white pine weevil (*Pissodes strobi* Peck) in appearance. [R. B. Friend]

Abundance of Whiteflies: The mulberry whitefly, Tetraleurodes mori Quaintance, or probably its variety maculata Morrill, was extremely abundant on native and introduced trees and shrubs in 1928. This insect was observed in many nurseries and the flowering dogwood trees on the writer's premises were quite heavily infested. The air was literally full of flying adults the first half of September. Linden is a preferred host and a thoroughly infested leaf is shown on Plate XXX. On September 9 the writer observed thousands of pupa shells on the leaves of mountain laurel growing in woodland in Bethany. Most of them were clustered along the mid-vein on the under side of the leaves. As the adults had emerged, none could be obtained for identification, but the empty shells bore the characteristics of mori: past observations indicate that the variety maculata is the more common form in Connecticut. [W. E. Britton]

Carrion Flies Killed by Fungus: During the summer of 1928 the writer was impressed by the great number of metallic green or blue flies found dead and adhering to the leaves and stems of garden plants. Every gladiolus leaf had one or more and other plants bore them also. These flies were killed by a fungus, and were common not only in New Haven, but also in surrounding towns. Mr. E. M. Stoddard, of the Botany Department reported them as being abundant in his own garden in Whitneyville. On July 25, the writer visited a garden at 228 Sherman Avenue, New Haven, where in the rear yard a medium sized magnolia tree had dead flies attached to the outer margins of all the lower leaves, as shown on Plate XXXI. Dr. Friend examined the flies and found that most of them were Lucilia sericata Meigen, with an occasional specimen of L. sylvarum Linn., and L. caesar Linn. These flies breed in waste and decaying animal matter and it is difficult to explain why they were so much more abundant in 1928 than in other seasons. The fungus was identified by Dr. A. A. Dunlap of the Botany Department of Yale University, as Empusa muscae Cohn. [W. E. Britton]

Canker Worms in 1928: The fall canker worm, Alsophila pometaria Harr., usually causes more or less local damage in certain sections of the State each year. The defoliation of a large area in East Lyme in 1927 was recorded in the Report of this Station for 1927, page 261. During 1928, the damage in this section was less severe, but the infestation extended over a much larger area. In Hamden where canker worms have been abundant for at least two years, there was much less injury during the past season. The largest infestation observed in 1928 occurred from Madison through Clinton, Westbrook and Essex to the Connecticut River and covered several hundred acres. About fifty acres of woodland between Clinton and Westbrook were examined on June 22. The trees were largely oak, maple and birch and were nearly stripped. Practically the only foliage that was left were the mid ribs and larger veins of the leaves. The larvae were about full grown and were spinning down from the trees and attacking the undergrowth. The photograph on Plate XXVII, b, shows the appearance of the trees on June 22. From the highway a wooded side hill to the east for a distance of a mile or more appeared to be in a similar condition. Unsprayed fruit trees throughout the section appeared as though they had been scorched by fire. [B. H.-Walden]

Thrips Attacking Cauliflower: On September 14, a report was received that a large field of cauliflower, belonging to a market gardener in Southington, was badly infested with thrips and a visit was made to the place the same day. In one field of about thirty acres, the plants, instead of forming heads were turning yellow and appeared to be dying. There were many thrips on the leaves, which showed the characteristic work of this insect. Most of the individuals were wingless. The plants were also badly infested with stem rot. Owing to these two troubles it was evident that the plants had been checked to such an extent that they could not be saved by any treatment. The owner had another field of about twenty-five acres of younger plants which appeared to be in a thrifty condition. Though the leaves did not as yet show any serious injury, there appeared to be enough young thrips present to eventually stunt the plants. As the owner had a power duster for dusting field crops, it was recommended that he give these young plants an application of nicotine dust. The thrips, upon examination, proved to be the onion thrips, Thrips tabaci Linde. Although this species has been known to attack a number of different kinds of plants besides onions, this is the first record of its attacking and injuring cauliflower in Connecticut. It has, however, been reported as infesting cauliflower seed beds in New York. [B. H. Walden]

The Common Red Spider: The common red spider, Tetranychus bimaculatus Harvey (T. telarius of many authors), is one of the

most serious pests of plants in greenhouses, and sometimes of garden plants. It frequently develops on plants forced inside and continues to breed after removal to the flower beds outside. Phlox is frequently attacked, damage being most severe in outside plantings in August or September, usually in dry weather. The complete life history has been studied under greenhouse conditions, and it seems probable that life history in mid summer is approximately the same. It is stated frequently in literature, and it is known to occur under some conditions, that the adult mite winters over, not the egg as with other species. The life periods are very short, and development rapid. Vinal states that the total cycle is seven to eight days while the adults live about two weeks, the females depositing 50-60 eggs. This mite and phlox leaves injured

by it are shown on Plate XXXVI.

Various means of control may be employed. If the plants are conveniently located, frequent syringing with a fine spray from the garden hose is effective. In other situations, the plants may be sprayed with linseed oil emulsion, white oil emulsion, such as Volck, or dusted with very fine sulphur dust. Liver of sulphur (Potassium sulphide) is sometimes recommended for control of leaf spots, and should no doubt prove of some benefit in controlling the red spider since it deposits, on drying, a very fine sulphur dust on the surface of the leaves. Frequent applications of pyrethrum soaps such as Red Arrow1 also appear to be effective and noninjurious. The latter treatment is probably safest provided a neutral soap is used but is also the most expensive of the sprays. Syringing with clear water is of course cheapest, but requires frequent repetition to be most effective. White oil emulsions are probably most effective, but are not as safe and recommendation of the manufacturers should therefore be followed closely. [Philip Garmanl

A New Greenhouse Pest: During October, 1928 our attention was called to injury to greenhouse plants from a species of Tarsonemus apparently new to this district. This species, determined by Dr. Ewing of the U.S. National Museum by comparison with types, is identical with Tarsonemus latus Banks, although differing somewhat from his description. As observed, the species seems to be more active than pallidus which it resembles in general form, though being more robust. The fourth pair of legs of the male (Fig. 65) are entirely different from those of pallidus, as well as the first pair of legs of the female and the pseudostigmatic organs which are comparatively short and inconspicuouus.

The type of injury is the same as that caused by pallidus and consists of a scorched epidermis, sometimes shiny in appearance if compared with the dull surface of unaffected plants. The leaves later begin to curl and young plants may be stunted. The principal

¹Should be used stronger than the manufacturers recommend, for satisfactory results.

The possibility of damage to greenhouse plants from this pest is probably as great as that caused by the cyclamen mite, but the host plants will, of course, be different. Because of its similarity of habits and form it should be controlled by the same measures that control pallidus: namely, frequent applications of nicotine

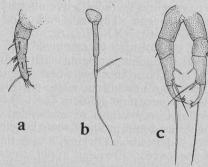


Fig. 65. Structure of *Tarsonemus latus* Banks. a, leg I of female; b, leg IV of female; c, hind legs of male.

sulphate, or naphthalene fumigation as described by Whitcomb and Hartzell. Moznette controlled it in Florida with sulphur dusts.

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[PHILIP GARMAN.]

INDEX

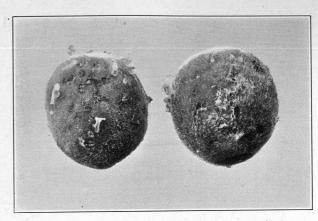
Acronycta auricoma, 703 Adelges abietis, 681, 689, 690, 692 pinicorticis, 682 Agriolimax agrestis, 678 Agrotis vosilon, 686 Alsophila pometaria, 675, 679, 728, 764 Alvoia octomaculata, 683 Anastatus bifasciatus, 725 Andricus cornigerus, 681 Anomala orientalis, 672, 686 Anthrenus verbasci, 685 Aphrophora parallela, 682 Apiary inspection, 703-712 Aporia crataegi, 703 Apple aphid, 676 green, 676 rosy, 676 wooly, 676 Archips rosana, 683 rosaceana, 683 Argyresthia thuiella, 680 Asiatic beetle, 743 Control work, 743-744 Aspidiotus pernicosus, 677 Attagenus piceus, 685 Autographa brassicae, 678 Bacillus pluton, 704 Biorhiza forticornis, 681 Blaps mucronata, 703 Botrytis, 691 Brevicoryne brassicae, 678 Calendra oryzae, 685 Carpocapsa pomonella, 675 Caragana, 681 Catalpa bungei, 690 Ceutorhynchus rapae, 678 Chionaspis americana, 682 pinifoliae, 682 Chlorion coeruleum, 751 Cimbex americana, 679 Coleophora laricella, 680 Conotrachelus crataegi, 676 nenuphar, 672, 675, 728 Contarinia pyrivora, 676 Convention of Entomological Workers. 686 Corcyra cephalonica, 686 Crataegus, 690 Crioceris asparagi, 677 Cryptorhynchus lapathi, 683 Cyllene carvae, 682 Cytisus, 690 Diabrotica vittata, 677 Dianthus, 685 Dichelonyx elongata, 680 Dichomeris marginellus, 683 Diprion simile, 679, 691

Emphytus cinctus, 703 Empoa rosae, 676 Empusa muscae, 763 Epeira trivittata, 751 Epitrix cucumeris, 677, 690 Epizeuxis aemula, 683, 762 Eriococcus azalae, 684 Eriosoma lanigerum, 676 Eulia pinatubana, 679 European corn borer, 679, 734-737 Evetria comstockiana, 683 Exoascus, 691 Exobasidium, 691 Fenusa pumila, 673, 680, 690, 692 Financial statement. Insect Pest, 671 Gipsy Moth, 712, 713 Foul brood, American, 705, 706 European, 704, 705 Fruit Insects, 674 Gillettea cooleyi, 681, 689, 690 Gipsy Moth, 712 Parasites, 725 Quarantine, 726, 727 Work, 712-727 Glypta rufiscutellaris, 733, 734 Gnomonia ulmi, 691, 692 Grapholitha (Laspeyresia) molesta. 675, 731 Halisidota tessellaris, 679 Haltica chalybea, 675, 729 ulmi, 679 Helenium, 690 Heliobsis, 690 Heliothis obsoleta, 677 Hemerocampa leucostigma, 679 Hemerophila pariana, 674 Hormaphis hamamelidis, 684 Hylemyia brassicae, 678 Hypermallus villosum, 682 Hyphantria cunea, 679 Idiocerus scurra, 682 Illinoia pisi, 687
Insects of Flowers and Greenhouse Plants, 684 Fruits, 674 Ornamental Shrubs and Vines, 683 Shade Trees, 679 Stored Vegetable Products, 685 Vegetables, 677 Inspection of Apiaries, 703-712 Nurseries, 689 Raspberry plantations, 699 Janus abbreviatus, 690 Japanese beetle Control work, 737-739 Quarantine, 739, 740

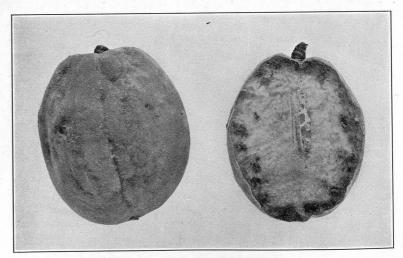
Juniperus communis, 683 virginiana, 683 Kalmia latifolia, 700 Kermes, 682 Lagoa crispata, 676 Lasioderma testaceum, 686 Laspeyresia molesta, 675, 731 prunivora, 675 Lecanium corni, 677 Lepidosaphes ulmi, 684 Lina scripta, 690 Lithocolletis hamadryadella, 680 Longistigma caryae, 682 Lucilia caesar, 763 sericata, 763 sylvarum, 763 Lygidea mendax, 676 Lygus carvae, 731 omnivagus, 730 pratensis, 685, 731 quercalbae, 676, 730 Macrodactylus subspinosus, 684 Macronoctua onusta, 685 Macrosiphum solanifolii, 678 Malacosoma americana, 674 Mamestra dissimilis, 703 picta, 685 Miscellaneous Insects, 686 Mosquito control work, 753-761 Myzus ribis, 677 Nematus erichsoni, 762 Neodiprion lecontei, 679 pinetum, 679 Notolophus antiqua, 703 Nursery Dealers, 699 Firms in Connecticut, 694-698 inspection, 689-698 pests, 690-692 stock, imported, inspection, 701-Oriental Peach Moth, 731-734 Ormenis pruinosa, 684, 690 Oryzaephilus surinamensiss, 686 Otiorhynchus ovatus, 690 sulcatus, 690 Pachypsylla celtidis, 681 Papaipema nitela, 677 Papilio podalirius, 703 Paratetranychus pilosus, 676, 703, 728 ununguis, 681 Pegomyia hyoscyami, 678 Pelopaeus cementarius, 751 Pemphigus ulmifusus, 681 vagabundus, 681 Peridroma margaritosa var. saucia, Periodical cicada, 744 Distribution, 745 Habits and Life History, 747 Injury, 749 Natural ememies, 749, 750

Control measures, 750

Periplaneta americana, 686 Philonix pezomachoides, 681 Phloeosinus dentatus, 682 Phobetron pithecium, 675 Phomopsis juniperi, 691 Photinia villosa, 691 Phlyctaenia ferrugalis, 685 Phyllocoptes quadripes, 681 Phyllotreta armoraciae 678, 762 Phylloxera caryaecaulis, 682 rimosalis, 682 Phymatodes variabilis, 682 Pipe Organ wasp, 751-753 Pissodes approximatus, 682, 762 strobi, 682, 763 Plagiodera versicolora, 680, 691 Plutella maculipennis, 678 Poecilocapsus lineatus, 684 Pomphopaea sayi, 675, 762 Pontia rapae, 677 Popillia japonica, 686 Prunus pissardi, 691 Psila rosae, 678 Psylla pyricola, 676 Pteronidea ribesi, 672, 676, 734 Publications of the Department, 670 Pulvinaria vitis, 682 Pyrausta nubilalis, 679 Recurvaria, 680 Reticulitermes flavipes, 686 Rhagoletis pomonella, 675 Rhizoglyphus hyacinthi, 684 Rhyacionia buoliana, 683 Rhynchites bicolor, 684 Sacbrood, 706-707 Sesia rhododendri, 684 Shade and Forest Tree Insects, 679 Schizura concinna, 675 Scolytus quadrispinosus, 682 Sphinx drupiferarum, 676 Tarsonemus latus, 765, 766 pallidus, 684, 765, 766 Tenebroides mauritanica, 686 Tetraleurodes mori, 763 maculata, 763 Tetralopha robustella, 680 Tetranychus bimaculatus, 764 telarius, 764 Thrips tabaci, 678, 764 Tibicina septemdecim, 683, 744 Tmetocera ocellana, 675 Toumeyella liriodendri, 682 Tremex columba, 683 Trialeurodes vaporarioum, 684 Triaspis curculionis, 675 Tribolium confusum, 686 Trichogramma minutum, 734 Trypoxylon albitarse, 751 Vegetable Insects, 677 Zeuzera pyrina, 683 Xylina, 676, 684



a. Peaches injured by oak plant bugs, natural size.



b. Section of peach showing injury by oak plant bugs, natural size.

WORK OF OAK PLANT BUGS.



a. View of burning apparatus.

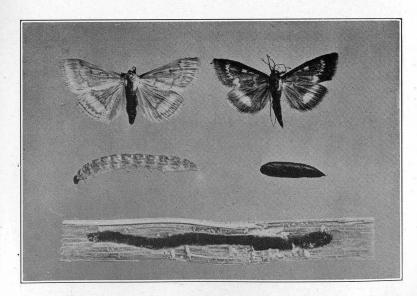


b. Another view of same apparatus.

CORN BORER WORK.

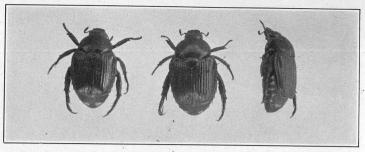


a. View showing corn field with burner in operation.

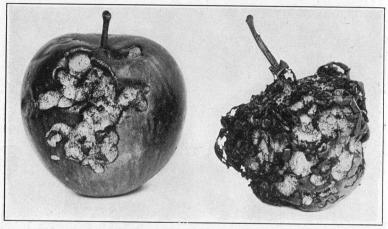


b. Female, male, larva, pupa and burrow in cornstalk. Slightly enlarged.

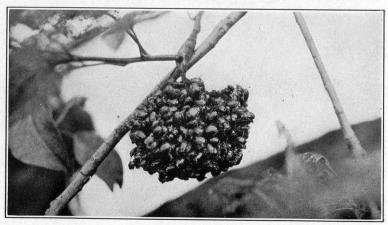
EUROPEAN CORN BORER.



a. Japanese beetle, Popillia japonica Newm.; adults twice enlarged.

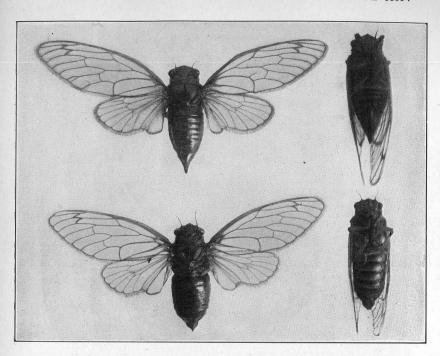


b. Apples injured by Japanese beetles (After Jap. Beetle Lab. U. S. Dept. of Agriculture).

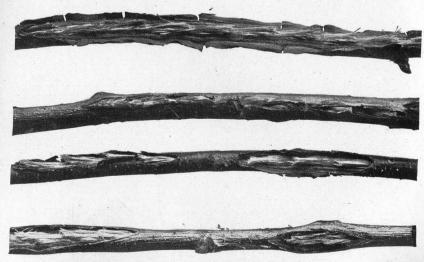


c. Japanese beetles clustered on fruit (After Jap. Beetle Lab., U. S. Dept. of Agriculture).

JAPANESE BEETLE.

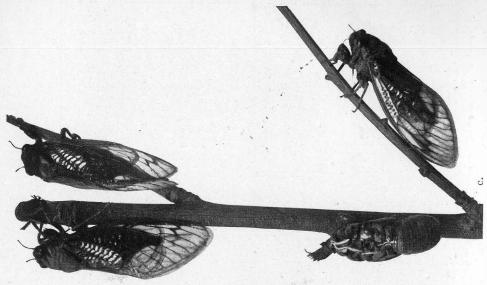


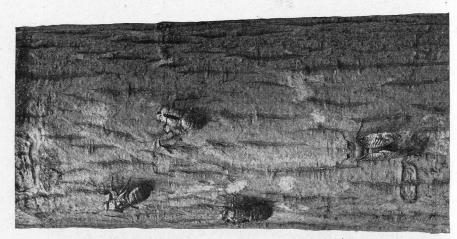
a. Males (below) and females (above). Natural size.

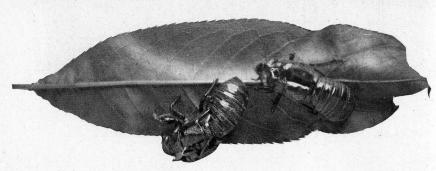


b. Twigs mutilated by the females in laying eggs.

THE PERIODICAL CICADA.

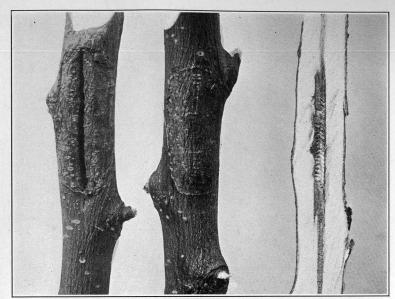






a, pupal shells on leaf; b, adult and pupal shells on tree trunk; c, adults and pupal shell on twigs; a and c natural size, b much reduced.

THE PERIODICAL CICADA.

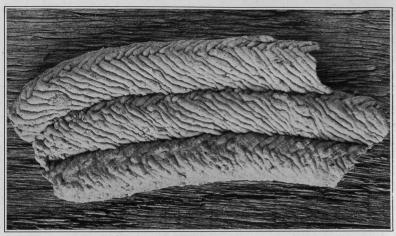


a. Apple twigs, splintered by periodical cicada; six years after injury, natural size.



b. Woodland in Westbrook stripped by cankerworms. Photo, June 22, 1928.

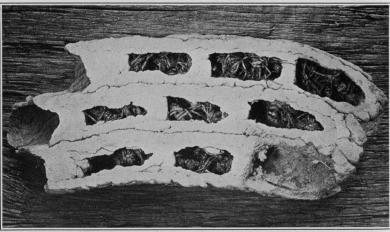
WORK OF PERIODICAL CICADA AND CANKERWORMS.



a. Nests of pipe organ wasp, natural size.

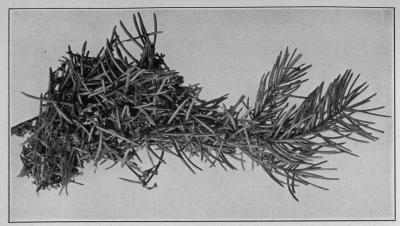


b. Male of pipe organ wasp, natural size.



c. Nests of pipe organ wasp, under side showing spiders in cells, natural size.

PIPE ORGAN WASP.



a. Spruce twig with leaves webbed together by spruce Epizeuxis, somewhat reduced.



b. Spruce Epizeuxis, adult moth twice natural size.

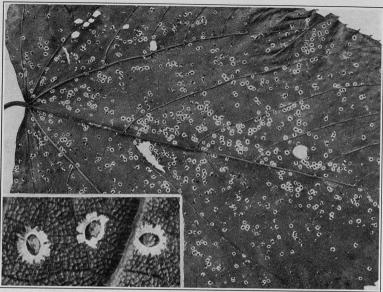


c. Say's blister beetle, natural size.

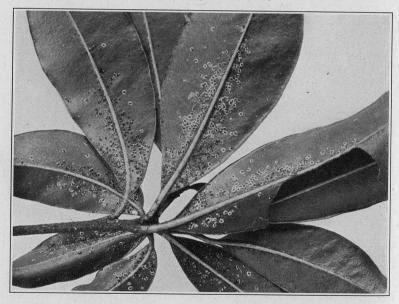


d. Peach foliage injured by Say's blister beetle, natural size.

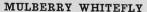
SPRUCE EPIZEUXIS AND SAY'S BLISTER BEETLE



a. Mulberry whitefly on linden leaf, natural size. (insert enlarged ten times)

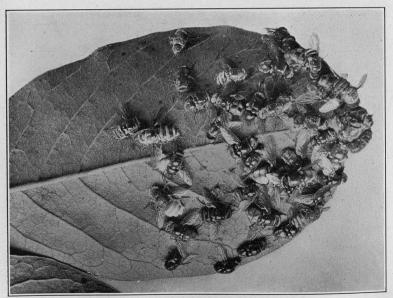


b. The same on leaves of mountain laurel, natural size.





a. Magnolia branch showing flies killed by fungus, reduced.



b. Magnolia leaf showing dead flies, natural size.

CARRION FLIES KILLED BY FUNGUS.



a. Ditching through cat-tails. Quinnipiac marsh, Hamden. Spade raised to cut sod.



b. Removing the sod.

MOSQUITO CONTROL WORK

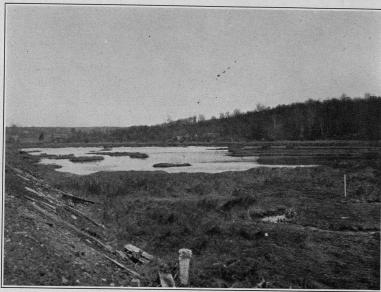


a. Breeding pools at South End marsh, East Haven, before ditching.

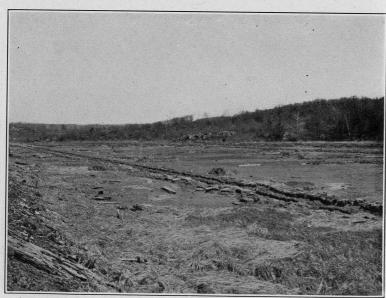


b. Same view; pools eliminated by ditching.

MOSQUITO CONTROL WORK



a. Marsh at Short Beach, Branford, where drainage has been restricted for years by trolley embankment.



b. Same marsh after ditching and enlarging outlet.

MOSQUITO CONTROL WORK.

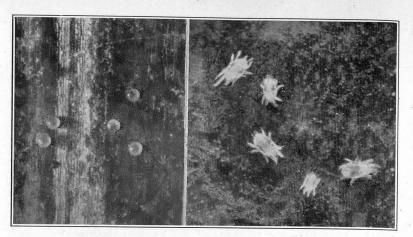


a. A small section of an extensive breeding area, Great Island, Old Lyme.

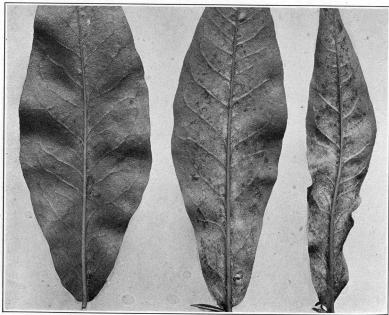


b. The same area about one week after ditching.

MOSQUITO CONTROL WORK.



a. Eggs at left, mites at right, all greatly enlarged.



b. Phlox leaves injured by red spider, natural size.

GARDEN RED SPIDER

Connecticut Agricultural Experiment Station New Haven, Connecticut

SOIL REACTION AND LIMING AS FACTORS IN TOBACCO PRODUCTION IN CONNECTICUT

By

M. F. MORGAN, P. J. ANDERSON AND HENRY DORSEY

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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L IMING experiments in many tobacco sections have shown that lime may be injurious, beneficial or of no effect, depending upon local conditions with respect to soil acidity.

The determination of soil reaction as measured in pH values, where 7 pH is neutral, with units below 7 increasingly acid and above 7 increasingly alkaline, affords a reliable method for indicating the effects which soil acidity may produce upon the tobacco crop.

The amount of lime required to produce a desired decrease in soil acidity can be predicted from pH tests with a fair degree of accuracy, provided the factors indicated in this bulletin are used for calculating the effect of soil texture and organic content.

A survey of the conditions of Connecticut tobacco fields with respect to soil acidity have shown that while a majority of the fields range between 5.0 and 5.6 pH, many are more acid or less acid than these limits.

Crop conditions on these fields indicate that tobacco on fields more acid than 4.8 pH are likely to be adversely affected, both in yield and quality, by such degree of acidity. On fields less acid than 5.6 pH, injury due to black root-rot is prevalent.

These observations are confirmed by field and green-house experiments.

Liming soils which are strongly acid improves the character of the burn and the whiteness of the ash of tobacco grown on such fields.

Tobacco grown on strongly acid soils is abnormally high in content of manganese. There are indications that poor tobacco on these soils may be due to an abnormal

concentration of soluble manganese in the soil and a consequent toxic effect upon the crop.

Liming the soil has reduced the absorption of potash by the tobacco plant, and has increased the necessity for liberal potash fertilization.

Some fertilizers, particularly sulfate of ammonia, increase soil acidity, while others, such as nitrate of soda, have the opposite effect.

Fields testing between 5.0 and 5.6 pH are in a satisfactory condition with respect to soil acidity. No lime should be used on such fields, and fertilizers which decrease soil acidity should be used with caution.

Fields more acid than 5.0 pH should not receive fertilizers with an acid tendency. At reactions between 4.6 and 5.0 pH, the equivalent of 1,000 lbs. of agricultural limestone per acre should correct the injurious degree of acidity on soils of average type for this section, while soils more acid than 4.6 pH may require as much as 2,000 lbs. per acre. Excessively sandy soils should be limed at somewhat smaller rates.

Fields between 5.6 and 6.0 pH may be made sufficiently more acid for protection against black root-rot by the selection of fertilizers with an acid tendency.

When the soil reaction is less acid than 6.0 pH, tobacco should not be grown. Other crops for a period of years, fertilized with acid-tending fertilizers may gradually restore a desirable degree of acidity.

Soil Reaction and Liming as Factors in **Tobacco Production in Connecticut**

M. F. Morgan, P. J. Anderson and Henry Dorsey*

Neutralization of the natural acidity of the soil by application of lime has a demonstrated value in the growing of many crops. The benefits thus derived have led to the inauguration of state wide liming campaigns in some sections. The publicity given to such propaganda involves the danger of creating the impression that liming is beneficial to all crops. However, it has been thoroughly demonstrated in the case of tobacco and potato crops that indiscriminate liming may be not only without benefit, but under certain conditions, positively harmful. On the other hand, it is a well-known fact that on some fields the application of lime has improved both the yield and the quality of tobacco. Such apparently contradictory evidence has not only confused the farmer, but also has confronted the agricultural scientist with the necessity of explaining such cases and of finding a method of indicating to the grower under what conditions he may expect beneficial results and why injury results at other times.

The principle effect of lime on soil is to change its reaction (degree of acidity). Since other substances which change soil reaction in the same direction have the same effect as lime upon the tobacco crop, it seems most likely that the reaction change produced by lime is primarily responsible for the effects observed on the crop. If this is a correct deduction, then the first and fundamental step in explaining these conditions and solving the

difficulty is to answer the question:

1. What is the optimum soil reaction for tobacco production? Corollary to this are the two questions:

2. What is the effect of too much acidity?

3. What is the effect of too little acidity?

The object of the present bulletin is to bring together the results of all the experimental work which has been done in the Connecticut Valley in trying to answer these questions, to summarize our present knowledge of the problem and to make it accessible to the growers and to other agricultural workers. Considerable data accumulated during recent years at Windsor, New

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Haven, and Storrs have not been published previously or only briefly presented in annual reports.

The steps followed in conducting the investigation were:

- 1. An extensive field survey in which the reaction of soil from over 2,000 tobacco fields has been tested.
- 2. Correlation of the reactions found with the condition of the tobacco grown on the fields.
- 3. Experimental plot tests with applications of lime and other soil amendments.
- 4. Greenhouse tests in pots.
- 5. Chemical analyses in the laboratory.

Previous Investigations

Until recent years no attempts have been made to determine the optimum degree of acidity of soil for tobacco production. Investigators in a number of states, however, have tried to measure the effects on the crop when soil acidity was partially or completely neutralized by application of lime. Without going into exhaustive detail, we present here the conclusions drawn from these liming experiments.

FIELD TESTS ON LIMING

Kentucky. On experimental fields in three different sections of the state two tons of limestone per acre were used where tobacco was grown in rotation with other crops. On the Lexington field there was no significant change in yield, on the Greenville field there was a decrease in yield while on the Mayfield soil there was an increase in one set and a decrease in the other. As a result of these tests Roberts, Kinney and Freeman (29) state that "Lime does not often benefit tobacco." The reaction of these soils before or after liming is not stated.

Tennessee. Mooers (20), in reviewing the results of six years of fertilizer tests on tobacco, states: "Liming was tested on several farms and at each place under a variety of fertilizer conditions, but no general conclusions can be drawn from the results except that tobacco does not appear to be very responsive to liming." During the next ten years, rotation experiments with tobacco, soy beans, wheat, grass and clover were tried at the Clarksville station on dark tobacco. In this rotation, two tons of ground limestone were applied to the wheat. At the end of the ten years (21) there was a difference in yield of only one per cent between the limed and unlimed tobacco. No records of the reaction of the soil are presented.

Ohio. Liming experiments on tobacco grown in a three-year rotation with wheat and clover were conducted at Germantown

(26) for 21 years. Lime was applied at the rate of 1,000 lbs. per acre (hydrated at first but limestone later) when fitting the land for tobacco. There were five pairs of plots in which lime was contrasted with no lime. When the yields were averaged at the end of 21 years it was found that in each of the five replications the yield of tobacco had been reduced. The reaction of this soil is not stated but since it "has been derived from glacial drift largely made up of limestone detritus" it may be inferred that it was not very acid at first. The fact that the depressing effect of lime was more noticeable during the latter part of the experiment indicates that root-rot may have played an important role here.

Maryland. Concerning an early experiment on liming in 1891 Patterson (27) states: "Lime injures the burning quality of tobacco and prevents its curing nicely." He finds the same effect also from magnesium salts.

In a later bulletin (28) Patterson also says: "Lime and magnesia compounds in small quantities seemed to produce but little effect, but in large quantities caused a growth that ripened unevenly and was hard to cure, yet with slightly improved combustibility, but on the whole, the application of lime immediately before planting of tobacco cannot be recommended."

In speaking of a later five-year series of experiments, Garner and Brown (16) state: "Where no nitrogen is supplied in the fertilizer, lime usually gives a considerable increase in yield, but where a nitrogenous fertilizer has been applied, no substantial benefit from liming is apparent. . . . The effect of the lime in increasing the availability of the soils supply of nitrogen, however, is very marked and in fact, for this reason liming may produce a decidedly unfavorable effect on the quality of the tobacco crop under certain conditions. Farmers have frequently observed that liming a soil which is well provided with organic matter produces a dark colored and coarse textured leaf and the reason for this is that the lime makes available for the tobacco plant an excess of nitrogen. . . . While lime is not of great importance for the tobacco crop when supplied direct and even may be highly injurious, its direct action when applied to other crops may be highly beneficial."

New York. In experiments at Baldwinsville where 2,000 lbs. of burnt lime were applied once in four years there was an increase of 106 lbs. per acre in the cured tobacco. Collison and Harlan (10) state that the soils in this section are not abundantly supplied with calcium while a large part of what is present is not in carbonate form. The reaction of the soil is not stated.

Virginia. Green (17) speaking of results with suncured tobacco in rotation at Bowling Green says: "One half of each fertilizer plot is limed at the rate of 2,000 lbs. of burnt lime per acre once in the rotation. In none of our experiments at Bowling Green has lime given marked beneficial results. Where lime was used on the ten plots the average gross value of the tobacco was 24 cents per acre less than where lime was not used. Our experiments covering four years and involving about 190 individual fertilizer plots have not shown sufficient results to warrant the use of lime." Chemical tests showed that this land had little need of lime, yet he continued: "Some farmers a few miles distant from the experiment field report beneficial results from lime. Perhaps this condition is only local." On another field he obtained a slight benefit from liming. Further Virginia tests are reported in the next section.

North Carolina, Georgia and Virginia Flue-cured tobacco. Rather extensive experiments conducted at various places in. these three states have been described by Moss et al (25). It will be sufficient to quote from their summary: "It would seem from the foregoing results that the use of ground limestone on the soils represented is not likely to give increases in the yield of tobacco unless the limestone carries a considerable quantity of magnesia If potash salts carrying magnesia are used in quantities supplying 10-20 lbs. of magnesia per acre, under average conditions, little or no increase can be expected from the use of lime on tobacco. This is largely true at least with the fertilizer mixtures used in these tests, for in such mixtures, the phosphates used supply sufficient calcium for the plant food requirements of the tobacco crop. It is possible, however, that some tobacco soils are so acid as to require liming for best results independently of the plant nutrients in the soil." They warn against the excessive use of limestone on account of danger of root-rot and of liberation of ammonia. The actual degree of acidity on the plots is not stated except at Oxford, N. C., where it ranged from 5.66 to 5.98 pH before application of lime.

Canada. At the Ontario station when ground limestone was applied at the rate of 2,000 lbs. per acre for Burley tobacco, there was an average reduction of 158 lbs. per acre. Digges (12) states: "While the experiment has been conducted only one year and the results cannot be taken too conclusively, they very strongly indicate that liming . . . is undesirable from both the standpoint of yield and quality." At Farnham, Quebec, a liming experiment was conducted on tobacco in rotation with oats and clover at rate of 2,000 lbs. of air slaked lime per acre applied early in the spring before fitting for tobacco. Summing up this experiment Montreuil (22) says: "In every case lime has had the effect of cutting down the yield and did not improve the quality of the leaf." In a later experiment on this same field tobacco was grown continuously for three years (1925-27) with the same lime

application as above. Slagg, Montreuil and Major (30) state concerning this experiment: "Significant decreases in yield and quality were secured wherever lime was applied during each of the three years of the experiment."

Connecticut. In the Poquonock experiments of 1892-96 where tobacco was grown continuously there were two pairs of plots contrasting lime at an annual rate of 300 lbs. per acre with no lime. Differences in yield, rank and fire-holding capacity of the tobacco were insignificant. No records of the soil reaction before or after liming were presented. Jenkins (18) drew no conclusion from this experiment but the data presented show that lime applied at this rate had no appreciable effect on the crop.

Massachusetts. Where tobacco was grown continuously and heavily limed (1 to 2 tons) each year, Anderson, Osmun and Doran (3) found the yield increased at first but later it was very much reduced and the roots were badly infested with the black root-rot organism.

Conclusions to be drawn from field liming tests in the principal tobacco growing sections of America. It is apparent from these published accounts that liming has been widely tested and that all the information which may be gained from routine lime plots is at hand. Briefly it is:

- Lime may be injurious, beneficial, or neutral in its effect on tobacco.
- 2. Not only are the yield results different for the various sections but even in the same state the effect may be different, for example, Virginia.
- 3. On the same field liming may be beneficial at first but injurious later; for example, Ohio and Massachusetts.
- Although results in most cases have been measured solely or mainly in yield, impairment of quality has also been mentioned in Maryland and in Canada.
- 5. None of the investigators mentions an improvement in quality.
- No attempts have been made to correlate the effects observed with the changes produced in reaction of the soil, except for the Massachusetts experiments.
- 7. The injurious effects in a few of the more recent tests have been ascribed to promotion of black root-rot. In the most recent Canadian experiment it was suggested that the decrease in yield was due to lime without respect to root-rot. In Maryland it was thought that impairment of quality was due to too rapid liberation of nitrogen.
- 8. No explanation of beneficial effects is attempted but it is not believed that there was an actual shortage of nutrient calcium in any case, with the possible exception of the New York experiment.

779

Working in the Connecticut Valley in 1907 Briggs (7) was the first investigator to call attention to the fact that black root-rot was most severe where the land was made more alkaline by the use of such materials as lime, wood ashes, and carbonate of potash. He made no attempt, however, to measure the degree of acidity in question.

The same conclusion was reached by Beals (6) in Massachusetts from his field survey in 1915. This work was continued by

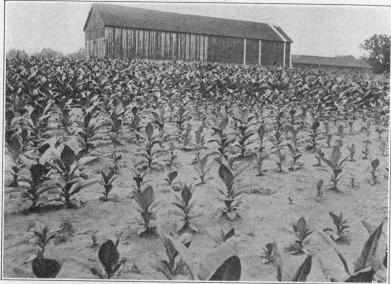


Fig. 66—Field of tobacco, showing black root rot on soil which is not sufficiently acid to prevent injury from this disease.

Chapman (9) who was the first to attempt to measure and correlate the soil reaction with root-rot. He determined the reaction of soils from a large number of tobacco fields by the Jones lime requirement method and by comparing the reaction with the condition of the tobacco on each field he came to the following conclusion:

"The tobacco soils of Massachusetts fall into three groups, as regards acidity. Soils with a lime requirement up to 3,000 lbs. per acre are not producing good crops, as a rule and are comparatively free from root-rot. Those with a lime requirement of from 3,000 to 8,000 lbs. CaO per acre are in good tobacco condition; but in this group pathogenic fungi are abundant in the soil, and

the plants during certain seasons are very liable to suffer from root-rots, caused by some of these fungi. Soils with a lime requirement of 8,000 pounds CaO up are usually comparatively free from such fungi, and even in unfavorable seasons little disease is found, but the tobacco is perhaps of slightly inferior quality."

In pot experiments Johnson and Hartman (19) confirmed in general the conclusion of Briggs, Beals and Chapman that an acid soil checks the severity of the disease. Using the Truog method of determining lime requirement they found the disease much reduced in soils more acid than a lime requirement of 4.6 tons. They also showed, however, that the critical reaction shifted with the susceptibility of the variety, Burley being badly diseased at a reaction which inhibited disease on Connecticut Havana.

Anderson, Osmun and Doran (3) were the first to correlate severity of infection with soil acidity as measured by the hydrogen-ion method. Working with field plots artificially inoculated and limed, they came to the following conclusions at the end of five years:

- 1. The immediate effect of liming an acid soil was to increase the yield of tobacco.
- 2. If sufficient lime is added, black root-rot is ultimately promoted and there is consequently a reduction in yield.
- 3. Black root-rot is present in most soils but is more injurious in nearly neutral soils because the causal fungus, *Thielavia basicola*, grows more rapidly and vigorously in a nearly neutral medium.
- 4. In the field under experimentation, black root-rot caused little or no loss in soils more acid than pH 5.6. It caused severe loss on all soils less acid than pH 5.9. It should be understood that this critical region between pH 5.6 and 5.9 is an intermediate zone which may be shifted to a somewhat higher or lower position by variations in temperature and compactness of soil and by differences in the degree of infestation of the fungus in the soil.
- 5. As the soil becomes less acid, above pH 5.9, the loss from black root-rot increases.
- 6. After repeated applications of lime brought the soil reaction to a point favorable to the fungus, the omission of lime for two years, with tobacco grown continuously meanwhile, did not result in any immediate reduction in the severity of black rootrot.

Soil Reaction, Soil Acidity and Lime Requirement—Some Brief Definitions:

In the sense considered in this bulletin, the term "soil reaction" is used to indicate the degree of intensity of acidity or alkalinity which exists in the soil. It is now quite generally expressed in

terms of "pH," on a scale where 7 pH (approximately) indicates the neutral point (neither acid nor alkaline) while lower units of pH, for example, 6 and 5 pH, indicate increasing degrees of acidity, while pH units above 7, such as 8 and 9, indicate alkalinity.

"Soil acidity" is a broader term, which includes not only the acid soil reaction, the intensity of which is measured in terms of pH, but the characteristic conditions of the soil which are related either directly or indirectly to such acid reaction.

Increasing degrees of soil acidity in a group of soils of varying reaction is usually evidenced by most, if not all the following conditions:

- 1. There is an increase in intensity of soil reaction, as indicated by pH values farther and farther below 7.
- 2. A decrease is to be found in the content of easily liberated (replaceable) lime and magnesia.
- 3. The more strongly acid soils may show a considerable concentration of soluble aluminum and maganese, with a consequent toxicity to the plant.
- 4. Carbonates of lime or magnesia when mixed with the moist soil are decomposed, with an absorption of the bases and an evolution of carbon-dioxide gas. The amount of lime which will be absorbed by the soil in this manner is greater on the more acid soils.
- 5. Nitrogen fixing bacteria which are free-living in well drained soils diminish or cease their activities and there is a decreasing effectiveness of legume bacteria and nitrifying organisms on the more acid soils.
- 6. In general, the rate of decomposition of soil organic matter is diminished at higher degrees of acidity.

It is not possible to say with assurance whether the other conditions are the cause or the result of the first one named, or that any or all of them are the result of some more remote soil processes which are evidenced only through these phenomena.

The "lime requirement" of a soil is commonly accepted as indicating the amount of lime, as burnt lime, hydrated lime, limestone or marl, which is required to bring the soil from its acid reaction to a condition of approximate neutrality, (7 pH.) It can be measured with a fair degree of accuracy by a number of chemical methods, and the results are expressed in terms of the number of pounds or tons of calcium oxide or calcium carbonate equivalent which the soil can absorb without becoming alkaline. The lime requirement of the soil is not the same as the lime requirement of the crop, since the crop may not require a neutral reaction and it may be desirable to maintain a certain degree of soil acidity.

A more complete statement in regard to the nature of soil acidity is given in Connecticut Agricultural College Extension Bulletin No. 101, while an exhaustive discussion of methods of measurement of soil acidity has been published by Conner, Morgan and Conrey (11).

A STUDY OF METHODS FOR MEASUREMENT OF SOIL ACIDITY

In the course of this survey four methods for the quantitative measurement of soil acidity were used. When the work was begun in 1925 the Stirlen double-wedge apparatus was the one immediately available for measuring pH values. This was used on two hundred soils. It was found that within the range of the bromthymolblue indicator (6.0-8. 6 pH) the data obtained were consistent with expected results. But soils of greater acidity, as measured by chlorphenol red, methyl red or bromcresol purple, tended to give results much nearer the same value—about 5.75 pH, than would be expected in a normal frequency distribution range. As soon as possible, a hydrogen-ion concentration apparatus for the electrometric determination of pH values, employing the gas chain hydrogen electrode, was set up and the "double-wedge" results were checked by this method. It was immediately apparent that the soils under investigation varied over a much wider range of pH values than had been found by the double-wedge method, and that soils below 5.75 pH were much lower in pH when measured by the hydrogen electrode. The following table shows a typical comparison of results by the two methods:

Table 1. Comparison of Double-Wedge and Hydrogen Electrode
Methods for Measurement of pH Values

Soil No.	Double-wedge	HElectrode
1	5.65	4.76
8	5.75	4.89
187	5.75	5.00
201	5.80	5.85
207	5.85	5.51
209	5.75	5.56
211	5.90	6.16
214	5.70	5.78
217	5.75	5.58
218	5.70	5.21
222	5.90	6.01
273	5.90	5.36
282	5.80	5.08
294	6.20	6.51
302	5.80	5.38

It was therefore decided to discard the double-wedge method.

At about this time the Morgan soil testing set (23) was developed by one of the authors and it was decided to make pH tests by both this and the electrometric apparatus, which was the procedure on about twelve hundred soils.

The gas chain hydrogen electrode was replaced by the more rapid and convenient quinhydrone electrode in the electrometric measurement, since the results of the two methods were found to be in close agreement.

The standard procedure finally adopted for determination of pH by the quinhydrone method is as follows:

10 gms. of freshly collected soil, 10cc of distilled water and approximately 10 mgs. of quinhydrone are stirred together for about one minute and the pH determined at once by means of a Leeds and Northrup Type K potentiometer, with the customary standard cell, storage battery and galvanometer. The half-cell used is the .01 N. HCl-.09 N. KCl quinhydrode half-cell described by Veibel (31). Connection with the half-cell was made by means of a saturated KCl agar bridge. Constant readings were obtained within a couple of minutes.

After several hundred soils had been tested independently by the Morgan soil testing set by the staff at the Tobacco Substation at Windsor and by the quinhydrone electrode at the Soils laboratory at the New Haven Station, a tabulation of 626 soils showed the following discrepancies between the results of the two methods:

As a result of these comparisons, it was decided that the Morgan soil testing set was of satisfactory accuracy for general field use, but that the special features of this investigation necessitated the use of a standard method which was independent of the personal factor involved in colorimetric measurement. Hence the quinhydrone-electrode results were the ones selected for final tabulation, and in subsequent measurements this was used exclusively for determining pH values.

Since the earlier investigations of Chapman (9) were conducted prior to the general adoption of pH measurements in soil studies, and his conclusions were based on the Jones lime requirement method, it was desirable to compare the pH values with the results of this method. 650 soils were sent to the Connecticut Agricultural College and the lime requirements in terms of lbs. of CaCO₃ per 2,000,000 lbs. of soil were determined by the modified Jones method used by Dorsey (14).

An inspection of the data obtained on these soils by the two methods showed that while there is a general relationship between the two sets of results, there were many wide discrepancies. This is shown in the following table, which includes 25 soils obtained at random by selecting every tenth soil in the series:

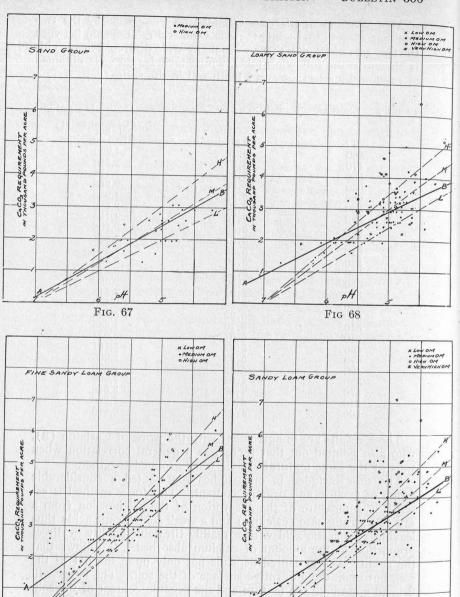
TABLE 2. COMPARISON OF JONES LIME REQUIREMENTS AND PH VALUES

OHN		CaCO ₃ Requiremen in lbs. per 2,000,000
Soil No.	pH	
660	6.16	1,290
470	6.07	2,258
530	5.93	1,774
650	5.86	2,258
600	5.85	1,935
560	5.83	2,580
520	5.70	4,193
370	5.59	3,708
590	5.57	2,903
620	5.55	2,903
540	5.50	3,386
630	5.48	3,870
550	5.39	2,580
390	5.38	4,515
430	5.28	2,580
670	5.22	5,483
510	5.10	1,935
440	5.04	4,031
480	5.03	3,581
490	5.03	2,903
420	4.95	3,870
380	4.92	7,095
570	4.89	3,548
540	4.86	5,966
500	4.52	3,870

These results are in agreement with the work of Carleton (8), who also pointed out that there was a general correlation when soils of the same textural classes were grouped together.

The soils included in our studies represented a considerable range of texture and organic content. The Jones method is essentially a measure of the absorption of the calcium-ion from a salt of a strong base (calcium) and a weak acid (acetic acid) thus leaving free acetic acid with a readily titratable acidity in direct proportion to the amount of calcium absorbed. It follows that the acidity thus measured depends not only upon the pH of the soil, but upon the absorptive surface of the soil. The latter will depend upon both the texture and the organic content of the soil.

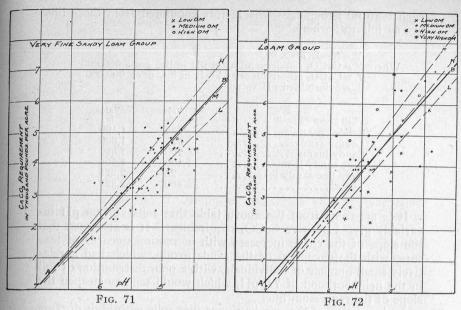
The soils which had been tested for pH and lime requirement were examined carefully by a trained soil survey worker, who estimated the texture and relative amount of organic matter of 551 of these soils which had been preserved for future study. The pH and Jones CaCO₃ requirement were then graphically plotted, with a separate graph for each textural group, variations in or-



The relationship between pH, lime requirement, soil texture and organic content.

Fig. 70

Fig. 69



The relationship between pH, lime requirement, soil texture and organic content.

ganic content being represented by symbols, for low, medium, high and very high amounts. It was immediately apparent that a definite correlation existed between pH and Jones lime requirement where soils of the same texture and organic content were compared. See figures 67 to 72.

Two groups of soil with more than a hundred individuals in each, the fine sandy loam and sandy loam groups, both with medium organic content, were selected for computation of correlation coefficient. The result are as follows:

Soil group	Correlation Coefficient
Fine sandy loam, medium organic content	$.757 \pm .015$
Sandy loam, medium organic content	856 ± 026

While a perfect correlation (1.000) is far from being attained, yet in consideration of the fact that the texture and organic content were estimated from observation rather than actually determined by mechanical analysis and laboratory method of organic matter determination, the results are in surprising agreement.

Figures 67 to 72 also show, as line AB, the mathematically determined regression lines for soils of average organic content in

each textural grouping. The factors computed from these lines are as follows: where

Y = A - B(7 - X)Where $Y = CaCO_3$ requirement at X pH in lbs. per 2,000,000 A = $CaCO_3$ requirement at 7 pH in lbs. per 2,000,000 X = determined pH value

Soil group	Value A	Value B
Sands	225	1,100
Loamy sands	925	1,000
Sandy loams	900	1,390
Fine sandy loams	1,100	1,500
Very fine sandy loams	25	2,225
Loams	400	2,325

It is apparent from the above table that soils at 7.00 pH invariably give a positive CaCO₃ requirement. It is also seen that the slope of the curve increases with increasing fineness of texture, with the exception of the sands group, which had a relatively small number of individuals, with a poor distribution of soil in the neighborhood of 7.0 pH, which would tend to steepen the slope of the regression line.

An inspection of the graphs shows that soils with high organic content give higher lime requirements at the same pH value than those of medium organic content, while the reverse is true of

soil low in organic matter.

For the purposes of simplification, it appeared desirable to assign arbitrary values in definite units to indicate a straight line correlation between pH and lime requirement, with a zero line requirement at 7.0 pH, which would fit the distribution of points on the graphs to the maximum degree. After considerable trial and error, the following factors were selected, to be substituted in the equation Y=1,000K(7-X):

Where $Y = CaCO_3$ requirement in 1bs. per 2,000,000 $X = determined\ pH\ value$

Texture	Organic Content	Value of K
Sands	low	1.00
"	medium	1.25
"	high	1.50
Loamy sands	low	1.25
" "	medium	1.50
" " " " " " " " " " " " " " " " " " " "	high	1.75
Sandy loams	low	1.50
" "	medium	1.75
" "	high	2.00

Text	ture			Organic Content	Value of K
Fine "	sandy "	y loan "	ıs	low medium high	1.75 2.00 2.25
Very "	fine s	sandy "	loams " " "	low medium high	2.00 2.25 2.50
Loan "				low medium high	2.25 2.50 2.75
**	" .			low medium high	2.50 2.75 3.00

Lines L, M and H, computed from these arbitrary values for low, medium and high organic contents, respectively, are shown on the graphs.

The degree of error in estimate of lime requirement from pH value by means of these lines as compared to the Jones lime requirements was computed for each soil studied. The results of these comparisons are as follows:

Error of estimate CaCO ₃ per 2,														Percent of Soils
300 or	1ess													37.56
500 "	"					3.00							1	68.96
1000 "	"							 						90.19
1500 "	"													96.91
2000 "	"						1							99.45
2300 "	"													100.00

Mean error of measurement: 509.2 lbs. Standard deviation: 600.9 ± 12.21 lbs.

A similar type of correlation between pH values and lime requirement was attempted by Arrhenius (5), who gives the following table as the amount of hydrated lime in Kg per hectare (approximately the same as lbs. per acre) to change the soil reaction 1 pH unit in the alkaline direction:

Soils	Poor in Humus	Average Humus	Rich in Humus
Sandy	500	1000	1500-3000
Fine sandy	500-1000	1000-1500	2000-3000
Light clay	1500	2500	3500
Average clay	$\frac{2500}{3000}$	3500	4000
Trouvy Clay	3000	4000	4500

Humus soils with 15 per cent organic matter-4000-8000

It is believed that with soils of the types represented in these studies, the lime requirement can be estimated with reasonable ac-

curacy for all practical purposes from determinations of pH values, using appropriate factors depending upon the texture and organic content of the soil. Accuracy within 1,000 lbs. CaCo per acre is sufficient, since rates of application of limestone are usually made to the nearest half ton quantity.

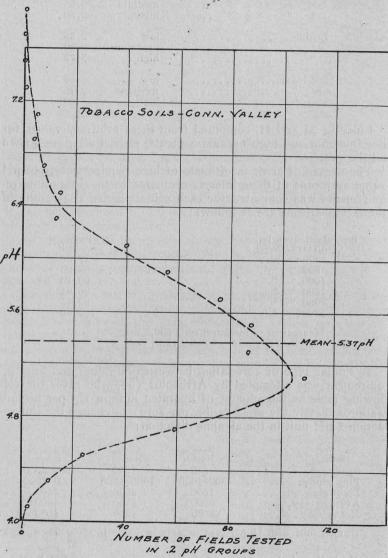


Fig. 73—Distribution curve, showing range of soil acidity on tobacco soils of the Connecticut Valley.

DISTRIBUTION OF SOIL ACIDITY IN THE CONNECTICUT VALLEY
TOBACCO DISTRICT

The results of electrometric pH tests of soil samples from seven hundred tobacco fields* have been brought together and graph-

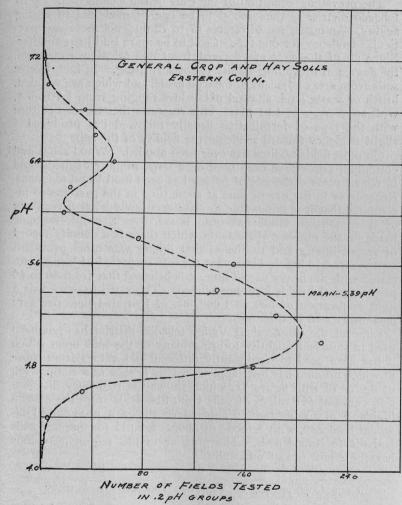


Fig. 74—Distribution curve, showing range of soil acidity on eastern Connecticut dairy farms.

^{*}We are indebted to J. S. Owens, Extension Agronomist, Conn., Agr. College, and B. G. Southwick, County Agent, Hartford County, Conn., for assistance in collecting these samples.

BULLETIN 306

ically plotted as a frequency distribution curve in figure 73. The soils ranged from 8.2 pH to 3.9 pH, with a pronounced modal point at 5.2 pH. The mean of all soils tested was 5.37 pH. Eighty-one per cent of the soils had pH values between 4.6 and 6.0 pH.

The prevailing condition of the soils of the Connecticut Valley tobacco district is thus found to be one of moderate to strong acidity. An inspection of figures 67 to 72 does not reveal any particular tendency for one type of soil to be more acid than another. Since all of the soils are derived from non-calcareous material, the degree of prevailing acidity is not surprising. In fact, twelve soils from areas adjacent to tobacco fields, and which are wooded, brush or waste land, showed pH values ranging from 4.7 to 5.4. with an average of 4.91 pH. This suggests that tobacco culture with the type of fertilization usually followed has produced a slight tendency toward reducing the acidity of the soil.

On most fields no lime has ever been applied. Wood ashes and cottonhull ashes have been used on a large number of fields, and in recent years carbonate of potash has been used to some extent. Records as to the use of lime at some time in the past are so incomplete that it is impossible to state accurately what percentage of these tobacco lands has been limed. As a rough estimate based on the number of fields on which there is a definite record of recent liming and the belief that liming was more prevalent some years ago before black root-rot was suspected of being associated with the heavy use of lime, it is believed that from 30 to 40 per cent of the fields have been limed. The usual practice was a light application of 500 to 1,000 lbs. of hydrated lime per acre once every two or three years.

Lime in the Connecticut Valley tobacco district has not been used in sufficient quantity to bring many of the soils upon which it has been used to significantly different pH values from those to which no lime has been applied. This is seen in a comparison of figure 73 with figure 74, which shows the frequency distribution curve of pH values of soils from 914 fields from the eastern highland of Connecticut. This curve shows a pronounced bimodal tendency, with a mode of about 5.1 pH for unlimed soils and 6.4 for limed soils. The practice in this region is to lime heavily if lime is applied at all.

CROP CONDITIONS AT VARYING DEGREES OF ACIDITY

When the soil samples were taken notes were also made as to the condition of the crop. However, since the samples were taken at a time of the year when the land was bare, it was necessary to rely on the memory and statement of the grower as to whether the crop was good, fair or poor. In most cases where black root-rot was suspected, careful examination of the roots were made by an experienced pathologist.

An attempt has been made to tabulate the records of all the fields upon which there was an estimate of crop conditions. This is shown in table 3.

TABLE 3. Crop Conditions as Related to Soil Acidity

				Percentag	e of Soils	in Group	
			No Black	Root-rot F	Record	Black Ro	oot-rot
No. of Soils in Group	React	ion Range	Very Good Crop	Fair Crop	Poor Crop	Moderate	Severe
54	6.4 pH	or above	19	2	54	7	18
119	5.8	6.4 pH	44	16	35	3	2
406	5.2	5.8 pH	61	25	13	1	0
193	4.6	5.2 pH	54	26	20	0	0
71	Belo	w 4.6 pH	36	24	40	0	0

Black root-rot infestation is particularly severe on soils above 6.4 pH. Entirely satisfactory crops are found on a decreasing percentage of the fields above 5.8 pH. and below 5.2 pH. However, the percentage of poor crops remained relatively low between 4.6 and 5.8 pH.

As indicated by these results, tobacco in the Connecticut Valley is practically safe from black root-rot troubles and produces best results under the moderately acid conditions ranging from 5.2 to 5.8 pH. Increasing acidity beyond 5.2 pH has adversely affected the crop, particularly below 4.6 pH.

FIELD EXPERIMENT WITH A VERY ACID SOIL

In the course of the soil reaction survey a field belonging to Mr. J. E. Phelps in Suffield was found to be unusually acid (3.9 pH). Although the soil was of a favorable type, was highly fertilized, and in earlier years had produced large yields of good tobacco, the crop in more recent years was very poor both in yield and quality. When first observed by the writers in 1925, there was only one spot in the field where growth appeared normal. On this spot the owner had burned stalks and the reaction was found to be 5.2 pH. Examination of the roots showed that no form of root-rot was responsible for the poor growth. The leaves of the plants showed the characteristic yellow spotting which we later associated with manganese toxicity. Since this combination of conditions led us to believe that the trouble was due to a too acid condition of the soil, a series of plots was laid out on this field in 1926 for the purpose of determining what benefit could be derived from applications of lime and also of superhosphate. Lime was applied at rates of 1,500, 3,000 and 5,000 lb. CaO per acre; superphosphate at rates of 1,000 and 2,000 lbs. per acre. The response to the higher applications of both lime

and phosphate was very definite and striking. The tobacco on these was quite normal in size and appearance while the untreated plots were again abnormally stunted and the leaves showed the same spotting as on previous crops. The lower applications were beneficial but to a less degree than the higher ones. The experiment was repeated the following year on different plots with much the same results. The best tobacco was produced on the 1927 plots which were treated with a combination of 2,000 lbs. lime and 1,500 lbs. superphosphate.

Pot experiments with soil from the above field, conducted at the New Haven Station showed marked improvement in growth of Turkish tobacco from applications of lime, although heavy applications of phosphorus in the form of orthophosphoric acid, equivalent to 3,000 lbs. of superphosphate per acre, failed to show any response. Similiar results were obtained from the growth of

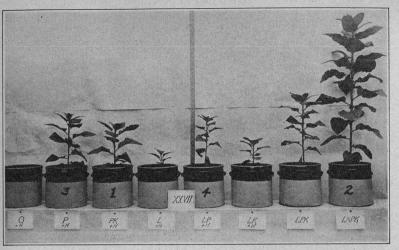
barley on this soil.

In experiments on the station farm it was learned that the to-bacco leaves take up considerably more manganese (see Tobacco Station reports for 1927 (2) and 1928 (4)) from an acid soil. Apparently in a *very* acid soil, the amount of manganese absorbed becomes toxic. When the manganese in the soil is thrown out of solution by application of lime or supherphosphate, it is not absorbed in sufficient amount to interfere with growth and the plant develops normally. All tobacco contains a small amount of manganese, but experiments have failed as yet to show that this is essential to the plant.

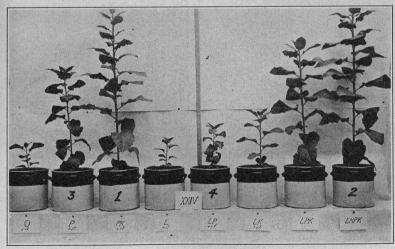
There is also the possibility that alumina in these very acid soils may become toxic to tobacco. This substance also would be rendered insoluble by lime or superphosphate. This is another possible explanation of the benefit derived from liming such soils.*

Pot Experiments With Tobacco Grown on Twenty-Four Connecticut Soil Types

Incidental to a study of the fertilizer and lime requirements of typical Connecticut Soils, Turkish tobacco, a strain of high uniformity and well suited in habits of growth to greenhouse conditions, was grown as a test crop to reveal soil differences. Certain phases of the results of these investigations, while summarized elsewhere (24), are of special interest in connection with the effect of soil reaction.



A



B

FIG. 75—Greenhouse pot experiments with tobacco, showing effect of lime on two different soils. No. XXVII shows marked response to lime, comparing (2), with lime, (1) without lime, both completely fertilized. No response to lime is observed on No. XXIV. Note also that lime without potash—(4) has reduced growth and produced potash starvation symptoms on both series as compared to unlimed without potash—(3).

^{*}During a recent visit to the tobacco sections of Cuba, one of the writers (Anderson) had occasion to test soils from many fields, which showed the same type of stunted growth and yellow mottled leaves which we have considered characteristic of manganese toxicity in the Connecticut Valley. All these soils uniformly tested below 4.6 pH, while adjacent soils where tobacco was normal tested above 4.6. Growers there have known for years that such a condition could be overcome by the application of lime.

Twenty-four soils were studied in greenhouse pots, with various combinations of nitrogen, phosphorus and potassium, with and without lime. These soils represented most of the important soil types of the entire state. Only two of them were from old tobacco fields, the others being chiefly from old hay fields. Two crops of tobacco were grown on these soils in 1928, and with one exception, to be noted later, the results were similar for both crops. The results of the second crop, showing a comparison between the complete fertilizer—NPK—and the complete fertilizer and lime—LNPK—yields, are summarized in table 4.

Table 4. Growth of Tobacco on Limed and Unlimed Soils in Greenhouse Pots.

Soil Reaction	0 11 7		
NPK	Soil Reaction LNPK	Yield NPK compared with LNPK	D-+ C :
(pH)	(pH)	%	Pot Series
4.01	6.8	17.61	XXVII
4.55	6.86	79.63	XXXIV
4.59	7.23	29.44	XXXVII
4.73	6.62	47.45	XIX
4.73	6.71	69.71	XVII
4.75	6.92	92.25	XXXI
4.75	6.77	102.70	XXVIII
4.80	6.98	92.39	XXV
4.81	6.83	$\frac{92.39}{74.14}$	XVIII
4.88	6.82	115.43	XXXV
4.90	6.98	111.14	XV
4.91	6.66	120.79	XXX
4.91	6.40	112.56	
4.97	7.03		XXXII
4.97	6.60	104.20	XXI
5.05	7.16	96.86	XX
5.06		125.86	XXIV
5.09	6.80	131.14	XXXIII
5.11	7.40	95.66	XIII
$5.11 \\ 5.12$	6.48	30.41	AVI
	6.29	128.30	XIV
5.16	6.87	87.97	XXIX
5.18	7.16	122.21	XXVI
5.52	6.38	111.28	XXXVI
7.48	7.55	120.90	XXII

From the above table it is apparent that no consistent benefit from the use of lime is obtained at reactions above 4.88 pH, and one soil at 4.75 pH yields better without lime than when limed to 6.77 pH. Above 4.88 pH eleven soils gave reduced yields when limed, while four soils were slightly improved.

Black root-rot was not found on any of the limed soil, since only two of the soils had previously been cropped to tobacco, and these had not been infested in the field.

A most striking result in these experiments was the reduction in yield on limed pots when potash was not applied. With the exception of two soils which failed to show any response to potash, the yield was reduced on the LNP pots as compared with the NP pots, and the symptoms of potash hunger were much more apparent on the lime pots. It appears that where potash is a limiting factor in the soil, the correction of acid condition by the application of lime reduces the availability of the soil potash to the plant.

Two soils in the above experiment, both very strongly acid, exhibited peculiar physiological conditions on one or both crops





A-Series XXV, first crop.

B-Series XXVII, second crop.

Fig. 76—Tobacco plants grown in complete fertilizer pots without lime on two very acid soils.

on the unlimed treatments. Series XXV, at a pH of 3.96 on the NPK pots during the growth of the first crop, produced plants having all their leaves very highly mottled over their entire surface. Certain patches on the leaves where the mottling was most pronounced were wrinkled and distorted and small spots of the tissue turned brown and fell out later. The plants were of fair size on the well fertilized plot in spite of the peculiar growth. This soil was examined for soluble aluminum and manganese during the growing period of the first crop, and the completely fer-

tilized pots without lime showed 322 lbs. of aluminum and 816 lbs. of manganese per acre soluble in .5 Normal acetic acid.

The second crop on this soil did not show these abnormal effects. The growth was normal in appearance on the unlimed pots, though it showed a somewhat increased growth with lime. The acidity had become reduced from some unknown cause to 4.80 pH on the same pots which had formerly tested nearly 1.0 pH more acid. The soil was again analyzed for soluble aluminum and manganese, and showed that the soluble aluminum content was practically unchanged, while the soluble manganese content was reduced to 32 lbs. per 2,000,000. The abnormal plant grown in the NPK pot from this soil is shown as "A" in figure 76.

The other abnormal soil produced plants somewhat like those described above, but much more stunted and with the mottled condition of the leaves localized in certain areas where the tissue was much wrinkled and distorted and brown spots of considerable size developed. The lower leaves especially showed a "marbled" appearance. During the first crop the soil on the PK treatment showed a reaction of 3.96 pH, and the aluminum and manganese soluble in .5 N. acetic acid was 666 and 68 lbs. per 2,000,000 respectively. The second crop showed similar results. The PK treatment soil then was practically unchanged—4.01 pH, and the soluble aluminum and manganese was practically unchanged. The abnormal plant grown on the NPK pot from this soil is shown as "B" in figure 76.

THE EFFECT OF FERTILIZERS ON SOIL REACTION

In view of the influence which soil reaction may thus have on the growth and quality of the crop it is well to inquire what effect the continuous application of the ordinary tobacco fertilizer materials has on the reaction of our soils. The fertilizer plots at the Windsor station have offered opportunities for answering this question for a number of the substances. Some results have been published in the reports for 1927 and 1928. It will be sufficient here to merely refer to these and to results at other stations where similar tests have been made.

Cottonseed meal, castor pomace, linseed meal, tankage, hoof meal, horn meal. These organic ammoniates have had a tendency to make the reaction very slightly more acid. The change, however, is not pronounced and from a practical standpoint may be disregarded.

Dry ground fish on the Windsor plots made the soil somewhat more acid than the preceding materials but even here the change was small.

Urea for the first few weeks causes the soil to become more alkaline but after this it drops down until it is slightly more acid.

Nitrate of soda has the strongest tendency toward alkalinity of any of the ordinary ingredients of the tobacco mixture. This may be seen from the comparative reaction of four plots on the station farm at the end of the three years during which each plot received its nitrogen supply in a different carrier:

	pl	I
Cottonseed meal plot	5.	08
Nitrate of soda plot	5.	50
Sulfate of ammonia plot		
Synthetic urea plot		

Nitrate of lime has the same tendency as nitrate of soda but, according to a two year test at the station, to a somewhat less degree.

Sulfate of ammonia has a pronounced tendency toward acidification as indicated in the table above and as discussed fully in the tobacco station reports for 1927 and 1928. This is also supported by investigations at many other stations too numerous to cite at this time.

Carbonate, sulfate and nitrate of potash. Of these three most common sources of potash in the tobacco mixture, sulfate is reputed to make the soil slightly more acid, while carbonate is said to reduce the acidity. In a four year experiment at the tobacco station farm where each of these carriers was used on separate adjacent plots it was found that none of them had a measurable effect in changing the soil reaction during that time. In a greenhouse experiment, however, where the important factor of leaching was eliminated, it was found that carbonate reduced acidity by .3 of a pH unit.

Superphosphate (acid phosphate) precipitated bone, bone meal

and steamed bone all make the soil slightly less acid.

Cottonhull ash theoretically should make the soil considerably less acid on account of the carbonates of calcium, magnesium and potassium contained. No tests covering a sufficiently long period, however, have been made.

Wood ashes has a strong alkaline tendency.

Manure. The effect of manure is to make the soil less acid. The degree of change on a coarse sandy loam may be judged by the reactions of the manure and adjacent plots at the tobacco station at end of third year of treatment.

Plot	Treatment	Reaction
M1	20 tons stable manure annually	5.85
C3	Adjacent no-manure plot	5.33
F6	" " "	5.33
M1-1	10 tons stable manure annually	5.60
C3-1	Adjacent no-manure plot	5.27
F5	" " " "	5.17 pH
M2	20 tons "Adco" manure annually	5.59
C14	Adjacent no-manure plot	5.25
M2-1	20 tons "Adco" manure annually	5.50
C14-1	Adjacent no-manure plot	5.30

EFFECT OF LIME ON COMBUSTION OF TOBACCO

On three fields at the Windsor station and at Poquonock, liming experiments have been conducted for several years. After fermenting the tobacco from the limed plots and adjacent unlimed plots, the combustion was compared on single leaves and on cigars made from tobacco from these plots. The tests were repeated for three years. (See the station reports for 1927 and 1928 for details.) Results in all cases have uniformly showed that heavy liming has:

1. Reduced the fire holding capacity of the leaves when tested singly (strip test), but

2. When on the cigar the fire holding capacity has been just as good or usually better than for unlimed tobacco.

3. In all cases lime makes the ash white.

4. The coal band is narrower, that is, the burn is closer and less irregular.

5. Too much lime causes the ash to flake.

6. The taste and aroma have been improved.

Altogether then, liming has been beneficial to the burn and the practice is to be recommended as long as the reaction of the soil is sufficiently acid that there is no danger of lime shifting it to a condition favoring root rot. If the soil tests 5.0 pH or below and combustion is not satisfactory, lime should be beneficial.

EFFECT OF LIMING THE SOIL ON COMPOSITION OF TOBACCO

Tobacco from limed soils thus exhibits characters of combustion which are different from those of tobacco grown on soils which have not been limed. Some of these characters, particularly the whiteness of ash and closeness of burn are desirable; other, such as the "flaking" of ash and reduction in fire holding capacity on the leaf are objectionable. These differences in burn are correlated with changes which liming produces in the chemical composition of the leaf. In order to see to what extent such changes are produced, tobacco (of the crop of 1926) from limed and adjacent unlimed plots—which otherwise were identical in character of soil and previous treatment—was analyzed with respect to those elements which it was belived might be affected by liming. Three different series of plots were used in these analyses as follows:

Limed plots on Field VIII. Beginning with 1922 these plots were limed heavily each year. With the last application in the spring of 1925 they had received during these four years five tons of hydrated lime per acre and the reaction of the soil was slightly above 7.0 pH.

Thielavia series. These consisted of three plots. One half of

each received an application of one ton of hydrated lime per acre each spring, beginning in 1924.

Poquonock field. Plots on this field were limed at the same rate as the Thielavia series, in the spring of 1925 and 1926.

Table 5. Analyses of Tobacco from Limed and Unlimed Plots. Crop of 1926. Water-free Basis.*

				FIELD	VIII				
					Perce	ntage of r	ninerals		
Plot No. L L1 L2 L3 L38 L39 C3-1 F6-1 N1-5 N1-6	Grade M M M M M M M M M	Lime Lime Lime Lime Lime Lime Lime No lime No lime No lime No lime	Total Ash 23.89 23.05 22.63 22.90 23.49 21.83 26.90 28.15 25.20 25.22	P ₂ O ₅ 0.78 0.73 0.73 0.74 0.75 1.05 0.85 0.87 0.88 0.93	$\begin{array}{c} \text{K}_{2}\text{O} \\ 6.52 \\ 6.38 \\ 5.92 \\ 6.06 \\ 6.87 \\ 6.37 \\ 8.90 \\ 8.36 \\ 7.51 \\ 7.62 \end{array}$	CaO 4.72 4.82 4.73 4.79 4.52 4.13 5.67 6.55 6.53 6.13	MgO 3.79 3.58 4.21 3.89 3.61 3.12 1.16 1.19 1.38 1.29	Mn ₃ O ₄ .01 .01 .01 .01 .01 .01 .01 .01 .00 .06 .06	Al ₂ O ₃ .09 .08 .06 .08 .11 .08 .09 .21 .07
			Po	QUONO	K FIEL	D			
4A 15A 6A	All All All	Lime No lime No lime	24.57 27.26 28.19	$0.77 \\ 0.77 \\ 0.85$	6.79 7.23 7.80	4.98 5.30 5.84	3.11 1.55 1.18	.03 .21 .12	.17 .23 .31
			Т	HIELAVI	A PLOTS	5			
T1A T1B T1A T1B T2A T2B T2A T2B T3A T3B T3B	M M S S M M S S M	Lime No lime No lime	22.83 24.78 25.33 27.43 23.86 24.63 25.70 26.82 23.83 25.43 27.49	0.72 0.84 0.62 0.76 0.82 0.84 0.60 0.75 0.69 0.85 0.68	5.12 6.67 4.18 6.62 6.10 7.37 5.52 7.10 5.73 6.81 7.17	5.53 6.11 6.38 7.04 5.37 5.62 6.00 6.42 5.15 6.19 6.89	3.49 1.56 4.54 1.57 3.13 1.18 3.15 1.18 3.58 1.62 1.59	.01 .29 .02 .28 .01 .04 .02 .04 .01 .06	.08 .14 .11 .31 .05 .11 .14 .13 .11

The lime was not analyzed each year but it was commercial lime from western Massachusetts and unquestionably all of it had some magnesia in it. Some samples from that section have as high as 30 per cent MgO.

Results of the analyses presented in table 5 show that:

- 1. In every comparison, liming reduced the percentage of total ash, of calcium, phosphorus, manganese and potash. Aluminum was reduced in some cases but not in all.
- 2. In every case, liming approximately doubled the percentage of magnesium.

^{*}Analyses by E. M. Bailey, Station Chemist.

In experiments with tobacco in Ohio, Ames and Boltz (1) also found that liming a soil reduced the percentage of calcium, potassium, manganese, phosphorus and sulfur but increased the magnesium.

CONNECTICUT EXPERIMENT STATION

Garner (15) found that magnesium salts are injurious to fire holding capacity of tobacco (more so than the calcium salts). He also found that all magnesium salts produce a white ash.

Apparently the white ash and reduced fire holding capacity which was found on our limed plots are due to magnesium rather than to calcium.

EFFECT OF LIME ON COMPOSITION OF TOBACCO FROM GREEN-HOUSE POTS AT NEW HAVEN

In connection with the greenhouse studies at New Haven which have been described previously, composite samples of both the leaves and stalks from the tobacco grown on various combinations of fertilizer and lime were analyzed by the station chemist for certain constituents. The results are shown in table 6.

TABLE 6. ANALYSES* OF TOBACCO FROM GREENHOUSE POTS. COMPOSITE OF 23 CONNECTICUT SOILS. SECOND CROP, 1928. WATER-FREE BASIS.

			,			
				eaves entage of		
Treatment	Ash	CaO	MgO	Mn ₃ O ₄	P ₂ O ₅	K ₂ O
N	27.85	8.13	1.82	.21	.71	2.67
NP	25.08	8.28	2.08	.42	.77	1.57
NPK	25.36	6.78	1.71	.44	. 57	4.98
LN	27.14	10.96	1.35	.07	. 56	.94
LNP	27.46	10.96	1.15	.01	. 85	.76
LNK	28.65	9.01	1.29	. 02	.60	3.34
LPK	27.12	10.35	. 96	.01	. 65	2.20
LNPK	26.11	10.58	. 94	.01	. 57	1.85
			St	talks		
			Perce	ntage of		
Treatment	Ash	CaO	MgO	Mn ₃ O ₄	P2O5	K_2O
N	15.42	2.85	. 67	.02	.88	5.08
NP	10.49	1.93	. 64	. 05	. 67	2.97
NPK	11.65	1.03	. 29	. 03	. 55	5.54
LN	12.82	3.97	. 65	tr.	. 64	2.83
LNP	13.13	4.78	. 60	.00	.72	1.56
LNK	13.71	2.16	.37	.00	. 58	5.18
LPK	8.98	1.81	. 22	.00	. 57	2.90
LNPK	7.61	1.83	. 21	.00	.44	2.33

An inspection of the data shows that the effect of lime, when applied to acid soils in the form of pure calcium carbonate (containing no magnesium) has been to very materially reduce the con-

tent of potash, to slightly decrease the content of magnesium and to materially increase the content of calcium in all the comparisons where other fertilization has been the same. The increased content of lime in the tobacco from the limed pots may appear to be contradictory to the results at Windsor, where lime did not produce an increase in the calcium content of the plant, but materially increased the magnesium content.

However, it must be recalled that a magnesian limestone was the source of lime in the Windsor experiment.

A striking difference between unlimed and limed tobacco, as shown by the analysis of the plant, has been the presence of considerable maganese in the unlimed tobacco, while liming has practically eliminated this element from the plant. This is in complete accord with the Windsor results and is evidence that the poor production of tobacco on highly acid soils is associated with both a high concentration of manganese in the soil and plant.

REGULATING THE SOIL REACTION FOR TOBACCO

From all the data which have been accumulated during this investigation it is apparent that for the majority of soils in this section the optimum reaction is between 5.00 and 5.6 pH. The fact that *some* fields with a reaction as high as 6.00 or as low as 4.6 are producing satisfactory crops is probably due to the modifying influence of other factors which are not discussed here. It is also true that some fields which have, the optimum soil reaction are not producing satisfactory crops—showing that soil reaction is by no means the only factor which determines the suitability of a field for tobacco.

The practical question to the grower then is: How can he keep his soil permanently within the optimum? If it is already optimum, how can he keep it from changing to an unfavorable higher or lower reaction? If it is too low (too acid) or too high (not acid enough) what measures can he adopt to correct it?

A certain amount of regulation can be accomplished by proper selection of the fertilizer materials. As indicated by the preceding statements, the effect of each of the ordinary tobacco fertilizer materials is fairly definitely established now. If the grower finds his soil to be near the upper limit of the optimum range, or above it, he should avoid the liberal use of any materials which tend to make it more alkaline and rather favor those with an acid tendency. In this connection, however, he should be cautious about the too liberal use of sulfate of ammonia, which of all the materials, has the most pronounced acidifying power, but which appears to have an adverse effect on combustion (see reports of the Tobacco Station for 1927 and 1928). If the soil tests near the

^{*}Analyses by E. M. Bailey, Station Chemist.

lower limit of the optimum range, or below it, he should favor the materials with an alkaline tendency.

CONNECTICUT EXPERIMENT STATION

It will be observed, however, that most of the materials produce only very slight changes in the soil. If the field is very much too acid or too alkaline the effects of fertilizers are too slight and too slow; other more effective methods must be used.

If the soil is too acid, the remedy is simple: It may be corrected by applications of lime materials (limestone, burnt lime or hydrated lime). It does not seem to make much difference which of these is used as long as the actual amount of oxides of calcium and magnesium is the same and when they are ground to the same degree of fineness. Unless the soil is very acid (4.5 or below) the equivalet of 1000 lbs. per acre of limestone should be a sufficient amount to apply at one time. Below 4.5, the application may be doubled. If later tests show that the soil is still too acid, the treatment may be repeated after a year or two. Wood ashes is also a good material to use on the more acid soils.

However, when a soil has become too alkaline—usually due to a too liberal application of lime or ashes—and black root-rot has become troublesome, it is not a simple or easy matter to reduce it to the proper degree of acidity. Frequently it will be more profitable for the farmer to use this field for other crops for several years before raising tobacco there again. Due to the leaching of the alkaline elements these soils naturally become gradually more acid. Also during this period the root-rot fungus becomes less prevalent in the soil and this disease will be less troublesome when tobacco is raised again there.

Finely ground sulfur, or "inoculated sulfur", has sometimes been used to make the soil more acid. Experiments with this material in comparison with sulfate of ammonia are now in progress on three tobacco farms and a preliminary report is given in the Tobacco Station report for 1928 (4). Although it has been much more effective than sulfate of ammonia on the soils tested. it is too early to recommend its use since no determination of its effect on the quality of the tobacco has been made yet.

Aluminum sulfate is also being tested and appears promising but the tests have not progressed to a point where recommendations can be made.

In acidification experiments at the Massachusetts Station, Doran (13) used a number of mineral and organic acids and was able to increase both the soil acidity and yield of tobacco with sulfuric. nitric and phosphoric acid. Sulfur had the same effect.

As yet, none of these rapid acidifying agents have been used on a large scale in a practical way.

SUMMARY

A review of investigations in most of the tobacco growing sections of the United States and Canada show that lime has rarely produced material increases in the tobacco crop in field experiments, and that in some cases there is an injury from the use of lime, which is ascribed to the greater prevalence of black root-rot on the limed soils. Most of these field experiments have not given careful consideration to the degree of acidity which exists on the unlimed soils.

A study of methods for the determination of soil acidity as a factor in tobacco production in the Connecticut Valley has shown that there is a close correlation between pH values as determined by both colorimetric and electrometric (quinhydrone electrode) methods and the Jones lime requirement results, when the modifying effect of texture and organic content of the soil are properly evaluated. Correlation factors for various textural classes of different organic contents have been computed.

Over two thousand tobacco fields have been surveyed for soil reaction and the results of several hundred representative cases have been tabulated to determine the frequency occurrence of different degrees of soil acidity (pH values), as well as the character of tobacco grown at these reactions. A soil reaction of between 5 and 5.4 pH is of most frequent occurrence. There is a range between 3.9 and 8.2 pH, with a mean value of about 5.4 pH.

Tobacco fields between reactions of 4.8 and 5.6 pH have been found to produce the highest percentage of satisfactory crops. Below 4.8 the degree of acidity becomes an adverse factor, while above 5.6 pH the injurious effects of black root-rot are in evidence and there is some indication that even in the absence of black rootrot tobacco may be somewhat affected in an adverse direction by conditions of very slight acidity, neutrality or alkalinity.

Very acid soils - below 4.8 pH - have shown increased growth of tobacco when lime is added to a complete fertilizer treatment, in greenhouse experiments. In the field, on a very acid soil, producing poor tobacco even when liberally fertilized, tobacco has been much improved by applications of lime and superphosphate. On extremely acid soils, the injurious effects may be due to toxic manganese, alumium, or both.

Various fertilizers produce different effects on the reaction of the soil. Ammonium sulfate is conspicuous in increasing acidity, while nitrate of soda is the most effective in producing higher pH values (decreased acidity). Urea has a slight acid tendency and the effects of the organic ammoniates are probably very slightly in the acid direction. Manure and all the common carriers of phosphorus tend to decrease the acidity. Carbonate, sulfate and nitrate of potash have produced little or no effect on soil reaction under field conditions.

Analyses of tobacco from unlimed and limed soils show that lime decreases the percentage of potash and manganese and that where magnesian limestone is used, there is an increase in the content of magnesium with a decrease in the calcium content. In pot experiments a pure calcium carbonate form of lime has increased the calcium content of the plant, with a slight reduction in the magnesium content.

Liming acid soils in experiments at Windsor has improved the character of the burn and the whiteness of the ash.

When soil conditions are too acid for satisfactory results, in case of tobacco at pH values below 4.8 pH, lime in some form is the cheapest and most effective means of reducing soil acidity.

Soils which are at an unsatisfactory reaction from the standpoint of black root-rot can be corrected to some extent by selecting acid-producing fertilizers, although reactions above 6.0 pH are difficult to change sufficiently in a short time, by any practical means now at hand. Further investigations concerning methods of making black root rot soils more acid are in progress.

RECOMMENDATIONS

Since the soil reaction is an important factor in the production of high grade cigar-leaf tobacco in Connecticut, it is desirable that the grower keep himself informed by means of soil tests as to the soil reaction conditions on his tobacco fields.

If the soil is at reactions between 5.0 and 5.6 pH, no lime should be used, and fertilizers tending to diminish the soil acidity should be used with caution. On soils testing below 5 pH the use of fertilizers tending to increase acidity should be avoided, while on many soils between 5.0 and 4.6 pH the occasional use of not more than 1000 lbs. per acre of agricultural limestone or its equivalent in other forms of lime should correct the too acid soil conditions which are present. Soils below 4.6 pH may be safely limed at the rate of 2,000 lbs. per acre, although on excessively sandy soils lighter applications should suffice. The soil should be tested the following year and if still too acid, more may be applied.

Fields with reactions above 6.0 pH are not safe for tobacco, and should be put in other crops until an acidity indicated by reactions of 5.8 or below can be developed through leaching and crop removal, with a consequent loss of lime and other basic materials from the soil.

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Connecticut Agricultural Experiment Station New Haven, Connecticut

The Thirty-Third Report on FOOD PRODUCTS

and the Twenty-First Report on DRUG PRODUCTS

1928

Food and Drug Inspection and Related Work

By

E. M. BAILEY

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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CONTENTS AND SUMMARY

Material	Page	The Station	The Dairy and pp pp Food Commissor of Sioner	Total	Adulterated, below standard, or otherwise illegal
FOODS Carbonated Beverages, etc	814 815	0	152	152	19 0
Cereal Products. Coffee, etc. "Diabetic", Special and Miscella-	815 815	1 1	0 6	1 7	$\begin{array}{c} 0 \\ 2 \end{array}$
neous foods	816 820	39 5	0 3	39 8	··i
Butter	821 821 822 823	0 0 4 0	66 1 16 27	$\begin{array}{c} 66 \\ 1 \\ 20 \\ 27 \end{array}$	$\begin{bmatrix} 1\\1\\0\\6 \end{bmatrix}$
Sweet cider Orange juice. Dried fruits. Preserves. Honey. Ice Cream, etc. Maple Products. Meat Products.	823 823 823 824 - 825 825 825 825	0 0 0 0 0 0 0 1 4	4 1 13 55 1 275 1 8	4 1 13 55 1 275 2 12	0 0 0 0 2 0 6
Milk and Milk Products: Market Milk. Chocolated Milk. Cream. Cream, canned. Milk, canned. Human milk. Paprika. Tea. Vinegar Miscellaneous.	827 827 827 827 827 827 829 829 831 831	17 0 6 0 0 2 2 14 14 25	277 2 0 1 1 1 0 9 0 10	294 2 6 1 1 2 11 14 24 25	35 0 0 0 0 0 0 0
Total for foods		136	929	1065	73

Tobacco Sub-station at Windsor

			pled by or itted to		elow other-
Material	Page	The Station	The Dairy and Food Commissioner	Total	Adulterated, b standard, or wise illegal
DRUGS					1
Aspirin tablets	832	0	12	12	1
Tablets. Tablets. Soluble barbital Phenobarbital tablets. Belladonna Cinchona. Colchicum. Ferric chloride. Hydrastis. Hydriodic Acid, diluted. Hydriodic Acid, Syrup of. Ipecac. Lead Subacetate. Magnesium Citrate. Mercurial Ointment. Nitrous Ether, Spirit of. Nux Vomica. Stramonium. Strontium Salicylate. Witch Hazel Water. Zinc Chloride. Zinc Oxide Ointment.	833 833 833 834 834 835 836 836 837 837 837 839 841 841 841 842 842	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	5 3 1 6 9 4 18 2 4 8 3 4 27 17 24 5 1 3 14 2 12 12 12 13 14 14 15 16 17 17 17 17 17 17 17 17 17 17 17 17 17	5 3 1 6 9 9 4 18 2 4 8 3 4 4 27 7 17 224 5 1 3 23 2 12 193	0 0 0 1 1 5 2 2 2 0 0 1 1 0 0 1 4 3 0 0 0 5 2 0 0 5 8
		9	104	190	90
MISCELLANEOUS Proprietaries, etc	843 844 847	$\begin{array}{c} 0 \\ 14 \\ 20 \\ \end{array}$	3 0 20	3 14 40 6	1
Total for miscellanecus		40	23	63	1
Total for all		184	1136	1320	133
Babcock Glassware and Thermometers	848	2746	0	2746	22

The Thirty-Third Report on Food Products and the Twenty-First Report on Drug Products

Food and Drug Inspection and Related Work

By E. M. BAILEY

The Station is charged with the administration and enforcement of the fertilizer law; with the administration, but not the enforcement, of the feeding stuffs law and the insecticide law; and, jointly with the Dairy and Food Commissioner, with the administration of the food and drugs act; but enforcement of the last named act rests with the Commissioner. The analytical work required by these statutes is done in the Department of Analytical Chemistry of the Station. In addition special statutes impose other obligations upon this department, notably the responsibility for certification of Babcock glassware and dairy thermometers and for cooperation with the State Water Commission in such analytical work as our facilities permit. Moreover, a considerable amount of work is done each year for the Storrs Experiment Station, and for the last few years the laboratory has collaborated rather extensively in the tobacco investigations being carried on by our own station at Windsor. The department is further required to prepare three annual reports covering the regular inspections of fertilizers, feeding stuffs, and foods and drugs as well as reports, not at fixed intervals, upon insecticides. During the past year a fairly comprehensive compilation of analyses of insecticides, fungicides, bactericides and weed killers has been issued, and other special bulletins are issued from time to time.

The work summarized in this report is that done for the year 1928 for purposes of food and drug control as required by the Dairy and Food Commissioner, and other work of a similar nature closely related thereto which is of public interest. The chemist in charge has continued to serve as a consultant to the Council on Pharmacy and Chemistry of the American Medical Association; as a member of the Executive Committee and of the Committee on Recommendations of Referees of the Association of Official Agricultural Chemists; and as a member of the (Federal) Joint Committee on Definitions and Standards for Foods.

The cooperation of the staff of this department in carrying on the work herein reported, as well as that reported elsewhere, is gratefully acknowledged.

FOODS.

CARBONATED BEVERAGES.

Of one hundred and fifty-two samples of carbonated beverages examined for the Dairy and Food Commissioner, sixteen samples contained artificial color, or flavor, or both, the presence of which was not declared upon the labels. One sample was found to contain saccharin; one contained visible dirt, and one bore misleading statements on the label. In no case was the minimum sugar content of 5 per cent not met.

TABLE I. MISBRANDED OR ADULTERATED BEVERAGES.

No.	Product	Dealer (Not necessarily the manufacture)	Remarks
38771 38770 38765 38763 38960 38699 38698 38046 38038 38042 38755 38658	0.0000000000000000000000000000000000000	Bridgeport: Berkshire Bottling Works Coco-Cola Bottling Co Hallett Mineral Water Co. Danbury: R.F. Baker Co., Inc. Hartford: Boston Branch Groc. Co. Pequot Spring Water Co. United Bottling Works. Middletown: Coco-Cola Bottling Works. New Britain: Spring Bottling Works. New Haven: Clancy Bottling Works. Elm City Bottling Works. New London: Nutmeg Club Beverage Co.	Undeclared artificial color. Undeclared artificial color. Undeclared artificial color. Undeclared artificial color. Undeclared artificial flavor and color. Undeclared artificial color. Undeclared artificial color. Undeclared artificial color. Undeclared artificial color. Saccharin present.
38681 38680 38775 38017 38018 38033	Birch beer soda Lemon and lime soda Lemon and lime soda Lemon and lime Strawberry soda Strawberry soda	Pawcatuck: Gordon's Market. Mfr. Turk's Head Beverage Co., Prov., R. I Corbo Spring Water Co National Spring Water Co. Thompsonville: Superior Mineral Water Co Waterbury: Diamond Bottling Corp Diamond Bottling Corp Willimantic: Hosmer Mt.Spring Bottling Works	Visible dirt. Undeclared artificial color. Undeclared artificial color. Misleading declaration on label. Undeclared artificial color. Undeclared artificial flavor and color. Undeclared artificial flavor and color.

In one instance a product was labelled "Imitation Orange Soda" but it contained artificial color with no label declaration to that effect. It is held that the ingredients which give to a product its artificial character should be stated and in this case therefore the declaration of artificial color should not be omitted.

A label on lemon and lime soda, No. 38775, bore a statement to the effect that the contents of the bottle (1 quart), was equal to 308 calories of solid food or seven pounds of oysters. This statement is substantially correct so far as calorie equivalents are concerned but it is misleading in that soda water, in which the solids are practically all sugar, cannot be reasonably compared with oysters, or any other food in which there are other nutrients such as protein, or fat, or both. Calories measure energy production which is only one type of food value.

CATSUP.

One sample of catsup, Elizabeth Park Brand made by S. Vogel Sons, Hartford, Conn., was analyzed as follows:

No.	9815
Total solids	35.99%
Water-sol. solids	34.70
Ash	4.00
Salt (NaCl)	2.92
Salt-free ash	1.08
Protein (Nx6.25)	1.88
Fiber	0.47

CEREAL PRODUCTS.

One sample was examined, No. 8346. This was Roman Meal manufactured by the Roman Meal Corporation of Buffalo, N. Y. and Tacoma, Wash.

The product is said to be a natural laxative because of the bran present and is claimed to contain wheat, rye, bran and deodorized and tasteless flaxseed.

The ingredients claimed were found to be present; but the odor and taste of flaxseed was still evident.

The analysis is as follows:

Moisture	6.30%
Ash	4 10
Protein (Nx6.25)	17.31
Fiber	
Carbohydrate (other than fiber)	
Fat	

COFFEE.

Seven samples of coffee or modified coffee were examined.

40732 and 40920. Roma Brand Perfect Blend Coffee, Roma Coffee Co., Hartford, Conn. Both of these samples were found to contain an admixture of chicory which was identified by microscopic examination. The samples contained 1.03 and 1.04 per cent of caffeine respectively which indicated that chicory did not exceed 10 per cent of the mixture.

¹ State Regulation 18, p. 21, 1927.

There is no objection to the sale of a mixture of this sort provided such is sold under a label which declares the true character of the product. Under the above label this product is adulterated and misbranded.

41266, Coffee, purchased at the Piggly Wiggly store in West Haven was not found to be adulterated.

9523, 39831 and 39834. Sanka Coffee, 97 per cent of caffeine

removed. Sanka Coffee Corporation, New York.

One of these samples, 9523, was purchased by the Station agent and the others by the Dairy and Food Commissioner. The caffeine content found was 0.05, 0.07 and 0.03 per cent respectively. Assuming 1.2 per cent as a fair average caffeine content for coffee the indicated caffeine removal varies from 94 to 97.5 per cent which fairly substantiates the manufacturer's claim.

Sample 9523 was examined in more detail as follows:

Ash	4.20%
Water-sol. ash	3.48
Water-insol. ash	0.72
Soluble solids	20.68
Petroleum ether extract	15.09
Caffeine	

39832. Kaffee Hag, Kaffee Hag Corp., owned and operated

by the Kellogg Co., Battle Creek, Mich.

This product is likewise claimed to have had 97 per cent of the caffeine removed. Our analysis showed 0.07 per cent present. This product examined in this laboratory on five occasions from 1915 to 1925 showed caffeine ranging in amounts from 0.03 to 0.10 and averaging 0.06. The per cent removed depends upon caffeine content of the original coffee, but on a basis of 1.2 per cent for ordinary coffee the manufacturer's claim is fairly substantiated.

SPECIAL AND MISCELLANEOUS FOODS.

Thirty-nine samples of this class of foods have been examined

and the analyses are given in Table II.

Of the Cellu products, 8334 and 8335, the composition of the Soy Bean flour indicates that about one-half of the oil of the original beans has been removed. Soy Bean Crisps have substantially the composition of the entire bean.

The Diet Rite Products Company have taken over the business formerly conducted by the Woman's Baking Company of Boston. The "fat" in these products is largely mineral oil as previous analyses have shown. Mineral matter (ash), is now considerably lower than formerly possibly due to a change in formulas.

The Energen products are labelled showing the amounts of protein, fat and carbohydrate per unit of food and these statements are substantially correct as shown by our analyses. The products

in general show large amounts of carbohydrate which must be classed as "available" (starch plus soluble carbohydrate). Agar-Bran Biscuits are relatively low in protein and the carbohydrate is probably very largely unassimilable. Energen Protein Food is low in carbohydrate but the high protein is a potential source of a considerable amount of glucose in digestion.

Loeb's Dietetic Bran Wafers and Starch-free Bran are both low in that part of the carbohydrate which may be regarded as available. Microscopic examination reveals only traces of starch present. A sample of Aerated Gluten Bread, submitted by a purchaser, shows about the same composition as other samples of

this product previously examined.

In a previous report¹ an analysis of Thomas Gluten Bread is given. This was the name under which the sample was submitted. but the manufacturer questioned the identity of the product and suggested that the sample was, no doubt, their Protein Bread and not their Gluten Bread. To verify this a sample of one of these products was secured in the market by our station agent and a sample of each of them was later submitted by the manufacturer. From the analyses of these samples it appears that the product which we examined a year ago was in fact the protein bread and not the gluten product as stated in our report.

Diaban Dietetic Flour varies somewhat from the composition shown by our previous analysis of this product,2 but the difference is not greater than would probably occur in manufacturing

practice over a period of time.

Jeru Artichoke Flakes are prepared from Jerusalem artichokes by slicing, and cooking in oil. The carbohydrate is chiefly inulin and the result reported as inulin in our analysis is based upon the reducing sugar obtained upon a 15 minute hydrolysis at which time, in our experience, the maximum reducing power is reached. On longer hydrolysis reducing sugars diminish, probably due to the destruction of levulose.

The advantage of inulin feeding in cases of diabetes has been the subject of extended inquiry on the part of students of this disease. A recent paper by Carpenter and Root³ describes some convincing experiments.

Diaetei Primar Mehl submitted by a physician is said to be a

German product used in diabetic dietaries.

A sample of canned fruit (in tins) was submitted by Dr. E. P. Joslin of Boston. The fruit is variously known as "Bakapple", "Bake-apple berry" or "Cloudberry". It resembles our raspberry and its botanical name is Rubus chamaemorus. The plant is found in the peat bogs of the far north even within the Arctic Circle. It is found in northern Europe, Asia and North America. In this country it occurs only as far south as Maine in the east and British Columbia in the west.

Conn. Exp. Sta. Bull. 295, p. 312, 1927.
 Conn. Exp. Station Bull. 276, p. 342, 1925.
 Archives of Internal Medicine, Vol. 42, p. 64, 1928.

Water

%

Ash

%

Protein

%

Fiber

%

Manufacturer and name of product

No.

Carbohydrate other than fiber

Un-

determined

%

Fat

%

Starch + soluble

%

	Chicago Dietetic Supply House, Chicago, Ill.	%	%	%	%	%	%	%	, G
8334 8335	Cellu Soy Bean Flour	$6.43 \\ 1.40$	6.20 6.85	45.00 46.06	4.05 5.38	11.19 7.00	17.42 13.38	9.71 19.93	NNEC
573 574 575 576 577 578 579 580 581	Diet Rite Products Co., 440 Huntington Ave., Boston, Mass. Lemon cookies Anise cookies Vanilla cookies Bran, washed Bran muffins Carraway cookies Cocoa cookies Spice cookies Soup wafers	3.80 5.20 4.60 4.53 7.05 5.33	1.48 3.11 1.80 1.17 3.42 2.76 2.84 2.84 6.69	4.38 8.69 4.63 13.63 10.50 9.75 9.13 7.50 4.25	20.70 9.25 19.65 17.20 13.78 9.53 7.80 10.03 15.85	2.50 61 48 44 51	5.67 3.03 7.73 1 55.50 1.74 3.89 3.55 7.71	23.97 25.72 21.59 5.47 3.51 23.74 30.90 22.14 24.52	TICUT EXPERIMENT STA
8220 8221 8222 8223 8224 8225 8226 8227 8228 8229 8230 8231 8232	Energen Foods Co., 261 Broadway, N. Y. Energen Biscuits, Endobran Energen Biscuits, Digestive Energen Starch-reduced Rolls Energen Wheat Meal Bread Energen Biscuits, Agar-Bran Energen Bread, Batons Energen Rusks Energen Bread with Casein Energen Gluten Semolina Energen Protein Food Energen Pastry Flour Energen Macaroni with Gluten Energen Bismeal Breakfast Food	3.18 3.80 4.13 4.39 4.64 4.28 4.70 4.77 5.85 6.75 7.03 6.23 5.18	3.00 1.47 0.89 0.95 5.03 0.64 0.67 0.91 0.65 4.46 0.58 0.96 1.33	16.13 22.75 37.94 41.44 15.13 39.63 39.38 45.75 21.75 73.25 23.88 30.50 31.56	6.35 0.45 0.65 1.00 10.18 0.35 0.35 0.35 0.45 0.43 0.48 1.18	20.63 38.25 44.69 41.00 8.00 47.44 46.44 37.44 68.38 1.19 54.38 58.01 52.88	24.64 4.96 3.05 3.14 52.84 1.24 2.24 4.28 0.42 7.50 11.06 none 3.27	26.07 28.32 8.65 8.08 4.18 6.42 5.99 6.50 2.60 6.40 2.64 3.82 4.60	ATION BULLETIN 307

TABLE II.	ANALYSES	OF SO-CALLED	DIABETIC.	SPECIAL AN	ND MISCELLANEOUS	Foods-Concluded.

						Carboh;	ydrate nan fiber	
No.	Manufacturer and name of product	Water	Ash	Protein	Fiber	Starch+ soluble	Un- determined	Fat
	Energen Foods Co., 261 Broadway, N.Y.—Con.	%	%	%	%	%	%	%
3233 3234	Energen Tapioca	$6.45 \\ 4.05$	0.24 4.86	8.50 38.94	0.35 3.85	83.48 11.33	none 18.38	$0.98 \\ 18.59$
9402 9403 9883	Loeb's Dietetic Food Bakery, 505 W. 171st St., New York City. Dietetic Bran Wafers Starch-free Bran Aerated Gluten Bread.	7.61 7.47 7.21	6.04 4.91 1.59	$\begin{array}{c} 22.69 \\ 18.75 \\ 42.86^{2} \end{array}$	12.04 16.75 0.75	$\begin{array}{c c} 4.88^{1} \\ 5.00^{1} \\ 34.25 \end{array}$	36.83 40.75 3.22	9.91 6.37 10.12
)399)400)401	The Pure Gluten Food Co., '90 West Broadway, New York City. Hoyt's Gluten Muffin Flour	9.32 9.64 10.13	6.00 6.07 6.78	$ \begin{array}{r} 36.71^{2} \\ 37.45^{2} \\ 14.42^{2} \end{array} $	0.27 0.28 1.71	40.81 40.31 55.94	5.75 5.35 9.17	1.14 0.90 1.85
599 978 979	S. B. Thomas, Inc., Long Island City, N. Y. Thomas' Protein Bread. Thomas' Protein Bread. Thomas' Gluten Bread.	39.89 37.53 35.49	2.33 2.00 1.81	11.28 10.42 30.68	0.58 0.37		$45.14^{3} 48.00^{4} 30.17^{4}$	1.36 1.47 1.48
464	MacDowell Bros., Ogdensburg, N. Y. Diaban Dietetic Flour	8.21	6.24	25.00	2.31	34.19	7.64	16.41
876	Jeru Artichoke Products Co., Denver, Col. Jeru Artichoke Flakes	6.91	3.30	3.79	2.01	35.865	5.29	42.84
9875 3730	Miscellaneous. Diaetei Primar Mehl	9.84 84.24	3.88 0.52	48.50 1.94	$0.75 \\ 3.33$	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1.70 4.99	1.20 0.28

Starch, trace only.
 Factor 5.7
 Includes starch and fiber.
 Includes starch and soluble carbohydrate.

<sup>Reducing sugar after 15 mt. hydrolysis, calc. as inulin.
Also called Bake-apple or Cloudberry.
Total sugar calc. as invert sugar.</sup>

821

EGGS AND EGG PRODUCTS.

CONNECTICUT EXPERIMENT STATION

Three samples of liquid eggs were submitted by the Dairy and Food Commissioner. Nos. 38616 and 38617 were commercial products and 38618 was freshly broken whole eggs. The question was to determine whether the commercial products were whole eggs or whether they contained excess of white.

The analyses were as follows:

	No. 38616	No. 38617	No. 38618
Ammoniacal nitrogen, mgms. per			
100 cc	3.1	5.5	2.1
Solids	27.96%	27.41%	28.04%
Ether extract	10.47	10.49	10.21
Lipoids	15.31	11.38	13.90
Lipoid P ₂ O ₅	0.40	0.30	0.37
Water-sol. protein nitrogen precipi-			
tated by 40% alcohol	0.76	0.77	0.73
Odor	none	offensive	none

Compared with the sample known to be freshly prepared whole eggs the other two samples appear to be whole egg products. The average ether extract in whole egg is about 10 per cent whereas it is over 25 per cent in egg yolk and less than 0.1 per cent in egg white. The average for lipoid P2O5 in whole eggs is about 0.36%, and for water-soluble protein nitrogen precipitable by 40 per cent alcohol about 1 per cent.1

The high content of ammoniacal nitrogen in sample 38617 indicated a state of decomposition as did also the noticeably offensive odor of the product. Assuming 2.62 as about the upper limit for ammoniacal nitrogen in edible eggs of 10 per cent ether extract, sample 38616 showed some evidence of deterioration

but no odor was perceptible.

Four samples of dried egg volk and milk powder mixtures were examined. These samples were submitted by the purchasers from stock bought in quantity for use in ice cream manufacture. While these mixtures were referred to by the purchasers as "egg yolk" or "egg yolk powder" there now appears to have been no misunderstanding on their part as to the character of the mixtures, and we were asked to determine the proportions of egg and milk product in them.

Samples 603 and 604 were submitted by R. F. Worden & Sons, Inc., Waterbury. The first sample represented goods bought from the John Lowe Co. of Brooklyn and the second

from the National Kreem Co. of New York City.

Samples 734 and 735 were submitted by the Rider Dairy Co. of Danbury, manufacturer not stated.

The analyses are as follows:

	603	604	734	735
	%	%	%	%
Moisture	4.37	4.22		
Ash	5.20	4.51	4.63	4.53
Total nitrogen	5.32	5.27	5.25	5.11
Ether extract	30.23	36.73		
Lipoids	39.73	46.88		
Lipoid-P2O5	1.00	1.23		
Sugar (as lactose)	18.60	13.46	16.93	14.52

The samples contain egg yolk in the approximate proportions of 65 to 75 per cent the remainder being skim milk powder or a similar product.

FATS AND OILS.

BUTTER.

Sixty-six samples of butter were examined for the Dairy and Food Commissioner and no serious deficiencies in fat or excesses of moisture were found except in one sample, 37888, which contained 18.3 per cent of water and 77.9 per cent of fat. Butter should contain not less than 80 per cent of fat and not over 16 per cent of water.

The deficient sample was purchased of Andrew Koleskenik,

Sevmour.

The results of the inspection are summarized as follows:

	Moisture	Fat
	%	%
Maximum	18.3	87.7
Minimum	10.1	77.9
Average	14.5	82.0

OLEOMARGARINE.

One sample of Verco Brand Margarin, 37127, made by the Mayfair Margarin Co., Providence, R. I. was examined for the Dairy and Food Commissioner.

The product was sensibly yellow but no artificial color was found to be present. It was properly labelled as oleomargarine, but the pictorial sign of a coconut tree and coconuts and the declaration that the product contains no lard, oleo oil or any animal oil, thus emphasizing its exclusively vegetable character, was objected to in view of the fact that admittedly a substantial part (10 per cent), of the fatty ingredients is butter fat.

The analysis was as follows:

Moisture	9.60%
Ash	2.65
Casein, Nx6.38	0 84
Fat	87.00

Jour. A. O. A. C., 8,614.
 U. S. Dept. Agr., Bull. 846, (1920).

LARD.

Sixteen samples bought for pure lard were examined for the Commissioner. No evidence of adulteration was found in any case. Four samples were collected by the Station for experimental purposes, and one was submitted by a purchaser.

The samples were examined as shown in Table III.

TABLE III. EXAMINATION OF LARD.

DAAMINATION OF LARD.							
No.	Dealer	Butyro- refrac- tometer reading @ 40° C.	M. P. of glycerides, degrees C.	M. P. of fatty acids from glycerides, degrees C.	Halphen tes		
	Hartford:						
40296	the died I dollie I'ca						
4000	Co., Main St	50.6	64.2		faint red		
40295							
40294	Co., Park St Atlantic and Pacific Tea	50.6	64.3	• • • •	faint red		
10101	Co., Washington St	50.7	64.3				
40745	Atlantic and Pacific Tea	50.1	04.5	••••	faint red		
	Co., Park St. 1	50.9	64.5		faint red		
40744	a resulting and racine real				ranno red		
39945	Co., Lawrence St. ²	50.4	64.2	57.5	negative		
00040	Atlantic and Pacific Tea Co., Albany Ave. and						
	Chestnut St	50.8					
		00.0			negative		
40505	New Haven:						
40737 40741	A. Cavellero, Oak St	50.3	63.2	57.0	faint color		
40141	Kolligian and Okooman, Orchard St	-0-	20 -				
40742	Kolligian and Okooman,	50.5	63.7	56.5	negative		
	Orchard St	50.5	63.8	57.2	fairt1		
40739	Lazar, Harry, Goffe St.	50.7	63.9	57.0	faint color negative		
10740	Nederman, A., Goffe St.	50.4	63.8	56.8	trace of		
10740				00.0	color		
10743	Terrece, O. S., Bassett St.	50.7	63.7	56.8	faint red		
	_ Stafford Springs:						
10747	Economy Grocery	50.6	64.3				
	=senomy Grocery	00.0	04.3		trace of		
10746	First National Stores, Inc.	50.6	64.0		color negative		
		3000			negative		
0748	Suffield:						
0140	Economy Grocery	50.7	64.0		trace of		
0749	Atlantic and Pacific Tea				color		
	Co	50.6	64.3		trace of		
Name of		30.0	04.5		color		

¹ Iodine No. 63.4. ² Iodine No. 61.8.

Examination of the crystals obtained by the Belfield test were in nearly all cases typical of lard and no evidence of beef stearine was found. In one sample typical lard crystals were formed and also some of a very different type. The two types were separated and their melting points determined. The figures for each were nearly identical and within the limits for pure lard as were the melting points of the fatty acids obtained from the glycerides.

In many cases the Halphen test gave faint reddish colors. In view of the fact that cottonseed products when fed to animals may impart characters to animal fats which result in a positive reaction by this test, these results are probably not significant as an index of adulteration.

OLIVE OIL.

Twenty-seven official samples of olive oil were examined. Six were adulterated. The adulterated samples are as follows:

No.	Brand, Manufacturer or Dealer	Retailer	Remarks
40709 39844	Titan	Ansonia; James Phillips	Contained cottonseed oil.
	Waterbury	Stephen Senecky New Haven; C. Cavellaro,	Contained cottonseed cil.
38975	Cream Olive Oil, Lucca.	Oak St	Contained cottonseed oil.
38664	Blue Star, H & W,Inc., New York	E. Rosner, Dixwell Ave.	Contained peanut oil.
40724	Marca Crestena	A. Cocco, Wash	Contained cottonseed oil.
39841	El Toro, Stack Bros.,	Seymour: Chas. Plink, New	Contained cottonseed oil.

FRUIT PRODUCTS.

SWEET CIDER, ETC.

Four samples of apple cider were submitted by the Commissioner. They contained from 10.7 to 15.7 per cent of solids. One was preserved with benzoate of soda but in the others no preservative was found. The preserved sample contained 11.12 per cent of solids, 0.57 per cent of ash and 0.59 per cent of acid expressed as malic acid.

A sample of Monquin Brand orange juice labelled as unheated natural juice with cane sugar, and 0.2 per cent benzoate of soda, but without artificial color or flavor, was found to be of the substance and quality stated so far as our examination could discover.

DRIED FRUITS.

In the process of preparing dried fruits the fumes of burning sulphur are employed in order to prevent or diminish discoloration due to oxidation which would impair the marketability of these products.

HONEY.

One sample of honey, 40903, was submitted by the Commissioner. It was within the limits of composition for pure honey and was passed.

ICE CREAM, ETC.

Two hundred and seventy samples of ice cream were examined. The distribution of samples with report to fat content is shown by the following summary.

Per cent of fat	No. of samples	Per cent of total
8.0 to 9.9	25	9.3
10.0 to 11.9	65	24.1
12.0 and above	178	65.9
7.9 and below	2	0.7

From this data it is seen that about two-thirds of the samples examined contained 50 per cent more milk fat than the minimum specified in our law, viz., 8 per cent. This does not mean however, that two-thirds of the production in the State is of that grade.

FROZEN PUDDING.

Five samples of this type of products were examined. They generally contain less than 8 per cent of fat but are sold under declarations which make them legal products. Regulations require these products to observe the same sanitary measures as are in force for ice cream.

MAPLE PRODUCTS.

One sample of maple sugar, 9092, submitted by Daigle Bros., Marion, was examined and not found adulterated.

Analysis:

Moisture 13.28 per cent; ash 0.97 per cent; insoluble ash 0.38 per cent; lead number (Winton), 2.38 per cent; malic acid value 0.58 per cent.

One sample of maple syrup, 37123, St. Johnsbury Pure Vermont Maple Sap Syrup was examined for the Dairy and Food Commissioner and was not found adulterated.

MEAT PRODUCTS.

Eight samples of frankfurt sausage were examined six of which contained starchy material, or color, or both for which proper declaration was not made. This should not be understood to mean that such a large proportion of frankfurts is illegally sold in this State. The explanation is that the inspector takes only those

The limit beyond which sulphur dioxide should not be allowed in food products is a debated question. The regulations in this State raise no objection to this substance in products which by long usage have been prepared with sulphur dioxide provided it is not used to conceal damage or inferiority, such as the marketing of excessive water; and provided the proper label declaration is made. What quantity may be regarded as a menace to health has not been determined and no official limit for sulphur dioxide in foods has been fixed. At one time a limit of 350 milligrams per kilo was proposed.

BULLETIN 307

During the past year thirteen samples of dried fruits were examined for sulphur dioxide content with the results as shown in Table IV.

TABLE IV. SULPHUR DIOXIDE IN DRIED FRUITS.

No.	Manufacturer Apples: Hartmann Dried Fruit Co., Rochester, N. Y	SO ₂ , mgms. per kilo of fruit
40731 40706 39849 39835 39833 40734 40704	Apricots: Guggenheim & Co., California. Richmond Chase Co., San Jose, California F. H. Liggett & Co., New York California Packing Co., San Francisco Rosenberg Bros. & Co., California Rosenberg Bros. & Co., California C. C. Collins & Co., Santa Ana, California	492.1 982.4 554.3 885.1 1,185.0 1,470.0 2,152.0
40735 40707 39838 39836 40733	Peaches: R. Fair, Modesto, California. Napa Fruit Co., Napa, California. California Peach and Fig Growers' Association, Fresno, Cal. R. C. Williams, Inc., New York. Rosenberg Bros. & Co., California.	1,562.0 299.1 1,013.0 268.2 1,724.0

A limited amount of data on the sulphur dioxide content of dried fruits is found in a previous report from this laboratory¹ where it appears that the quantity found did not exceed 600 milligrams per kilo. The results obtained now show a wide range of variation, and in view of the fact that about one-half of the samples contain less than 1000 milligrams per kilo (0.1 per cent), amounts of from 50 to 100 per cent more than this would appear to be excessive.

PRESERVES.

Fifty-five samples of fruit preserves were examined for saccharin and preservatives. No saccharin was found and no preservatives were found except in two instances where declaration of benzoate of soda was made.

¹ Conn. Exp. Sta. Report 1912, p. 101.

and place of sale, but in view of the explanation made by Mr. Hertler and of our further information we are inclined to believe that this sample did not represent a product of his manufacture.

samples which are suspicious. Iodine tests made by him at the store or factory enable him to avoid the collection of a large number of unnecessary samples.

With proper declaration cereal or starchy material may be used in sausage provided the amount does not exceed 3.5%. Samples not properly branded are listed in the following summary.

No.	Retail dealer (not necessarily the manufacturer)	Remarks
38011 38012	Forestville: The Atlantic and Pacific Tea Co. The Atlantic and Pacific Tea Co.	Undeclared cereal and color Undeclared cereal and color
40907	New Canaan; P. Calaluca	Undeclared cereal
38013	Norwich: F. G. Thum	Undeclared cereal
38004	Torrington: O'Meara's Market	Undeclared cereal
40914	Winsted: J. P. Gagner	Undeclared cereal

Two samples were examined for moisture and nitrogen. From these values excess water in sausage can be estimated. It is permissible to use 3 per cent of water or ice in the manufacture of sausage and somewhat more in the case of those types of sausage which are smoked or cooked, but in no case should more water be added than is required to make the products palatable. The ratio of water to protein in the usual cuts of meat which are used in sausage making is about 4 to 1. In one of the samples above mentioned moisture was found to be 54.7% and protein (nitrogen x 6.25), 13.63%, and no added water was indicated. In the other sample 54.5% of water and 14.13% of protein were found which would indicate that not more than 2% of water had been added.

Skimmed milk powder if used in the manufacture of sausage requires a declaration. A sample said to contain about 5 per cent of such powder, and so labelled, was examined; and also a sample of the milk product used. The powder contained 49.5 per cent of sugar, calculated as lactose. The sausage on microscopic examination showed the presence of the milk product and direct reducing sugar was present in the amount to 1.9 per cent which would indicate approximately 4 per cent of milk product in the sausage.

In our report of a year ago¹ it appears that a sample of frankfurts purchased at the Reliable Market in New Haven were manufactured by Chas. Hertler of New Haven. This is the information as it appears on our records made by the inspector at the time

MILK, MILK PRODUCTS, ETC.

Two hundred and ninety-four samples of market milk have been examined of which 277 were submitted by the Dairy and Food Commissioner and the remaining samples (17), were examined for producers and consumers.

On analysis of 146 official samples the following classification is

made:

	No. of samples	Per cent
Not found adulterated	. 63	43.2
Adulterated by watering		21.9
Adulterated by skimming		2.0
Below standard: in solids and solids-not-fat in solids and fat in solids, fat and solids-not-fat	. 1	$21.9 \\ 0.7 \\ 10.3$
Totals	. 146	100.0

The list of adulterated samples is given in Table V.

Six samples of cream were tested for fat content; and two samples of human milk were examined for protein and fat.

Two samples of flavored milk product resembling so-called chocolated milk were submitted by the Dairy and Food Commissioner together with a syrup and a powder which were to be used in preparing the drink in the home. The liquids contained 14 and 14.9 per cent of solids respectively with 2.7 and 3.7 per cent of fat, largely milk fat. One sample was evidently made with milk of standard quality while in the other partially skimmed milk was apparently used. The flavor, both syrup and powder, consisted of cocoa, honey and malt and contained 13.5 per cent of protein and 4.9 per cent of fat when calculated to the water-free basis. In the proportion in which the flavor was added to milk (one teaspoonful to a glass of milk), food solids in the beverage would be about 10 per cent more than in the original milk.

A sample of Swiss Sterilized Milk and one of Swiss Cream were submitted by the Commissioner. So far as chemical analyses indicate the products meet the requirements of the standards for milk and cream in this State. The milk is not claimed to have been evaporated. It contains 3.7 per cent of fat and 12.5 per cent of solids. The cream contained 25.1 per cent of fat.

¹ Conn. Exp. Sta. Bull. 295, p. 317, 1928.

829

TABLE V. ADULTERATED MILK.

	CONTAINING ADDED WA	TER	
No.	Dealer WA	Solids	Fat
	Bridgeport	%	
40407	City Dairy Co.	10.23	% 3.0
40408	City Dairy Co.	8.94	2.2
40409	City Dairy Co.	10.67	3.1
40410	City Dairy Co.	9.01	2.3
40411	City Dairy Co.	9.83	2.8
40412	City Dairy Co.	10.32	3.1
40413	City Dairy Co.	9.22	2.5
40414	City Dairy Co.	9.49	2.7
40415	City Dairy Co.	9.87	2.6
40416 40417	City Dairy Co.	9.75	2.5
40417	City Dairy Co.	9.51	2.8
40419	City Dairy Co. City Dairy Co.	$9.76 \\ 10.01$	$\frac{2.8}{2.9}$
40420	City Dairy Co.	10.01	3.2
40421	City Dairy Co.	10.25	3.1
40422	City Dairy Co.	9.66	2.8
40995	Henry Foland	11.24	3.5
	Trong Toland	11.21	0.0
	Danbury		
37756	O. W. Starr	10.76	3.3
	T-:-C-11		
37758	Fairfield	0.45	0.0
37759	John Zadny	9.45	2.9
31109	John Zadny	9.45	3.0
	Gaylordsville	As a la	
38634	Walter Kilian	10.16	2.9
00044	Litchfield		
38811	John Walter	11.15	3.9
38812	John Walter	8.86	2.3
38813	John Walter	10.79	4.2
38814	John Walter	10.13	2.9
38815	John Walter	9.36	2.9
38816 38817	John Walter	11.35	3.7
20011	John Walter	10.46	3.3
	New Haven		
38488	Chas. Philips	10.51	3.3
40959	State Dairy Co.	11.28	3.6
40100	Old Saybrook	0.05	9.1
40168	Mrs. Grace Appleby	9.35	3.1
40169	Mrs. Grace Appleby	9.44	3.1
	SKIMMED MILK.		
	Southington		
39300	B. Yuekiewick	10.83	2.4
39301	B. Yuekiewick	10.48	2.4
	2. 2 dello mon		
	Address Unknown		
39991	Victory Restaurant	10.88	2.1

SPICES.

Nine samples of paprika were examined and no evidence of adulteration found. One sample somewhat exceeded the limit for ash, as set by the standard, and another exceeded the limits for total ash and acid insoluble ash. Two samples were examined for experimental purposes.

TEA.

Supplementing a study carried on by Mr. G. F. Mitchell, Supervising Tea Examiner of the United States, to determine the effect of various types of containers upon the keeping qualities of teas, analyses of fourteen samples of tea were made during the past year. Corresponding samples were examined in 1927 and the original teas which formed the basis of the study were analyzed in 1926. A summary of the analytical data is given in Table VI.

It is generally recognized that quality in tea as judged by the expert taster cannot be postulated in terms of definite chemical constituents so far as they have been determined, and the data here given probably reveals no definite and consistent relationship to changes in quality which have been observed by tasting methods. Moreover the proportions of constituents in the leaves are quite different from those in infusions upon which judgment of

quality is largely based.

The figures for moisture do not necessarily reflect the moisture conditions in the various packages, but rather that of the teas as prepared for analysis under the atmospheric conditions prevailing at the time. The total ash and the several constants thereof show no variations other than those incidental to analysis and sampling. Total nitrogen and caffeine remain remarkably constant. Variations in fiber are not significant. Results for tannin must be interpreted with some reservation because of the limitations of the method generally employed for its determination, but notwithstanding this the data show a consistent increase in this constituent group as the teas age. The observation of tea tasters that old teas are markedly astringent suggests a possible relation between this quality and the tannin increase shown. It might be questioned whether this relatively small increase in tannin would be reflected in the taste of the infusion; and whether the amount of tannin soluble in water is likewise increased. Materials soluble in petroleum ether decrease somewhat in the teas held for one and two year periods. This decrease amounting to about 50 per cent in the case of green tea appeared to be exaggerated but the value obtained for the original sample (2.82 per cent), was thoroughly checked and is not an abnormal value for green tea. Although total petroleum ether extract decreased, that portion of it which was lost on heating at 110° C showed a slight but consistent increase. An attempt was first made to determine volatile oil by

	IO.	Vol. oil; Loss at I C, basis of 40 I extraction	0.10	0.20	0.27 0.20 0.20	0.10	0.24 0.20 0.22	0.28 0.21 0.25
	sct	Pet. Ether Extraction	1.08	1.01	0.90	2.82	1.79 1.49 1.66	1.89 1.11 1.42
		ninnsT	6.16	8.01 6.65 7.29	9.35 7.97 8.46	5.87	7.54 6.61 7.03	9.11 7.20 8.26
TEAS		Fiber	9.89	10.48 9.06 9.76	10.15 9.73 9.93	11.0	10.61 9.77 10.20	11.10 10.57 10.78
PACKAGE		Caffeine, from N	2.78	2.84 2.71 2.76	2.84 2.74 2.80	2.15	2.45 2.12 2.21	2.19 2.13 2.16
		Nitrogen	4.20	4.21 4.15 4.18	4.22 4.06 4.16	4.37	4.44 4.31 4.34	4.38
EXPERIMENTAL		Alkalinity wa- ter-insol., cc N acid/100 gms.	34.5	37.5 34.0 34.9	40.5 35.0 36.9	31.8	28.0 26.5 27.3	30.5 27.8 29.1
OF EXF		Alkalinity wa. ter-sol., cc N acid/100 gms.	29.5	32.0 30.0 31.3	32.8 29.0 30.9	32.8	36.0 34.5 35.4	35.5 34.3 35.0
ANALYSES	ASH		0.07	0.25 0.05 0.10	0.14 0.05 0.09	0.20	0.28 0.19 0.24	0.32 0.17 0.23
SUMMARY OF ANA	A		2.25	2.35 1.98 2.13	2.69 2.06 2.22	2.26	2.18 1.92 2.01	2.13 1.97 2.05
			2.96	3.18 2.89 3.04	3.14 2.93 3.00	3.27	3.66 3.37 3.50	3.39
VI. Sun		IstoT	5.21	5.26 5.00 5.17	5.83 4.99 5.21	5.53	5.58 5.35 5.50	5.43
LABLE V		Water	5.03	6.28 5.68 6.07	7.23 6.01 6.61	3.23	5.65 4.11 4.71	5.74 4.50 5.01
T.		Sample Nos.	1926 Black	1927 Black—Maximum Minimum Average	1928 Black—Maximum Minimum Average	1926 Green	1927 Green—Maximum Minimum Average	Green—Maximum Minimum Average

the tentative method¹ recommended for tea but the results were unsatisfactory. Only minute quantities were obtained even on prolonged distillation. Loss on heating the petroleum ether extract at 110° C suggested itself as affording some measure of the volatile oil, but this procedure is not entirely satisfactory. The results obtained suggest that further study of volatile oil content of tea by more exact methods of measurement might be of interest and value.

VINEGAR.

Ten official samples of vinegar were examined for the Dairy and Food Commissioner and all were passed. Fourteen samples were submitted by producers of home made cider vinegar.

MISCELLANEOUS FOODS, ETC.

BEMAX.

This preparation made by or prepared for Vitamins Ltd. of London is claimed to be a concentrated extract of natural B

vitamin, the detoxicated embryo.

Wheat embryo is a commercial article and a well recognized source of vitamin B. Our sample of Bemax was not unlike commercial wheat embryo in general appearance and character. From the comparative analyses it is evident that the two articles are substantially alike in composition, particularly when compared on the water- and fat-free basis.

Feeding tests revealed no superiority of Bemax over our laboratory sample of commercial wheat embryo. All experimental animals failed on both products when amounts under 300 milligrams daily were fed and 400 milligrams in both cases were required for conspicuous gains.

Analyses are given in Table VII.

TABLE VII. ANALYSES OF "BEMAX" AND WHEAT EMBRYO.

	Bemax No. 678		Commercial Wheat embryo No. 679	
	Air dry	Water- and fat-free	Air dry	Water- and fat-free
	%	%	%_	%
Water	$\frac{4.88}{5.22}$	6.09	8.68 4.30	5.40
AshProtein (Nx5.7)	30.44	35.50	24.97	31.36
Fiber	. 2.45	2.86	2.18	2.74
Nitrogen-free extr	47.63	55.55	48.17 11.70	60.50
Fat	9.38		11.70	
Total phosphorus (P ₂ 0 ₅)	2.87	3.34	2.37	2.98

POTATOES.

Twenty-two samples of potatoes representing different stages of maturity were analyzed after digging in the fall and before planting in the spring. These analyses were made for the Storrs Station and results are for discussion elsewhere.

¹ A. O. A. C. Methods of Analysis, p. 340.

COLLABORATIVE WORK ON CHOCOLATE.

Crude fiber determinations were made on two samples of chocolate in a trial of methods suggested by the A. O. A. C. referee on cacao products. These results appear in the proceedings of the association.

DRUGS.

ASPIRIN.

Twelve samples of aspirin tablets were examined and the results are given in Table VIII.

TABLE VIII. ANALYSES OF ASPIRIN.

No.	Dealer	Mfr.	Aspirin, g per tab claimed	rains a	ee salicylic acid, grains per tablet found
38995 38996	Clinton Allen's Pharmacy, Neal's Pharmacy,	Davies Rose & Co., Boston McKesson & Robbins, New	5.0	5.1	none
		York	5.0	4.9	none
39247	Cromwell Hatchcock Pharmacy,	Hance Bros. & White, Philadelphia	5.0	4.9	0.02
39214	Devon Signor Shoppe,	Aspirin Co. of America, New York			
39521	Hartford State Pharmacy,	Brewer & Co., Worcester		5.6	0.02
	Jewett City	Diewer & Co., Worcester	5.0	5.0	trace
39515	Chas. R. Carey,	Norwich Pharm. Co	5.0	4.9	trace
39101	Meriden Broderick & Curtin,	A. D. S., New York		5.1	trace
39520	New Britain City Drug Store,	Squibbs	5.0	4.8	trace
39240	Norfolk Geo. T. Johnson,	United Drug Co., Boston	5.0	4.7	0.02
39143	Suffield Suffield Pharmacy,	Lilly's	5.0	4.9	0.02
39205	Torrington Collins & Collins,	United Drug Co., Boston		4.6	0.02
39234	Willimantic Curran & Flynn,	Albany Chem. Co., Albany, N. Y	5.0	4.7	0.04

In several instances our inspection records do not show the claimed dosage of aspirin but it is presumably 5 grains in each case. Conferences between committees representing manufacturers and Federal control officials have reached the conclusion that good commercial practice justifies a tolerance not exceeding 7.5 per cent above or below the dosage claimed for tablets of this kind. We have heretofore regarded 10 per cent variation as acceptable. All of the products here reported however come within the stricter limit except in one case which is also outside the more liberal tolerance.

BARBITAL, ETC.

DRUGS

Barbital and soluble barbital are new admissions to the pharmacopoeia. Barbital, sometimes called "veronal", is diethylbarbituric acid, and soluble barbital is the sodium salt of that acid.

Phenobarbital, also newly admitted to the pharmacopoeia, is phenylethylbarbituric acid and is sometimes known as "luminal".

Three samples of soluble barbital were examined and found to range from 99.2 to 99.8 per cent purity. The requirement is not less than 98.5 per cent. The samples were procured at the Halley Pharmacy and Leroy Tucker's drug store in Bristol and at the Case Drug Store in Winsted.

Five samples of barbital tablets, all declared to contain 5 grains of medicament, were analyzed and all were satisfactory, barbital dosages of from 4.7 to 4.9 grains being found. The samples were obtained at the Spaulding Co. and the Branford Drug Store in Branford, the Bridge Pharmacy in Windsor Locks, the Case Drug Store in Winsted, and the Walling Drug Co., Wallingford.

One sample of phenobarbital tablets, ½ grain, was purchased at Miner's Pharmacy in South Manchester and was satisfactory.

The tablets contained 0.52 grain of medicament.

BELLADONNA

Fluid extract of belladonna leaves should contain in each 100 cc not less than 0.27 gm. and not more than 0.33 gm. of the total alkoloids of belladonna leaves.

Tincture of belladonna should contain in each 100 cc not less than 0.027 gm. and not more than 0.033 gm. of total alkaloid of belladonna leaves.

Assays of three samples of fluid extract and three samples of tincture are given in Table IX.

	TABLE IX. ASSAY	s of Belladonna.	
No.	Dealer	Manufacturer (as stated)	Alkaloids gm/100 cc
	FLUID E	XTRACT.	
39534	Waterbury Ebbo Drug Co	Norwich Pharm. Co	0.25
39231 39233	Willimantic J. J. Hickey Drug Co Wilson Drug Co	Park, Davis & Co United Drug Co	$0.22 \\ 0.31$
	Tinct	URE.	
39813	Manchester E. J. Murphy		0.025
39802	Putnam E. H. Burt	Lilly	0.026
39820	Taftville Taftville Pharm	Sharp & Dohme	0.025

All samples were 90 per cent of respective standards or better, excepting one sample of fluid extract.

CINCHONA

Fluid extract of cinchona should vield not less than 4 gms. nor more than 5 gms. of total alkaloids of cinchona from each 100 cc. Tincture of cinchona should vield from like volume not less

than 0.8 gm. nor more than 1.0 gm. of alkaloids.

Compound tincture of cinchona should vield not less than 0.4 and not more than 0.5 gm. of alkaloids per 100 cc of tincture.

Both samples of fluid extract were below standard, but one of

them was within a tolerance of ten per cent.

All of the tinctures obtained were compound tinctures. None of them were within the U. S. P. limits and only three could be passed with a liberal tolerance. Nos. 39538 and 39817 are duplicates from the same source as are also 39540 and 39818. No second samples were obtained in the other cases.

Assays are given in Table X

	TABLE X. ASSAYS OF CINCHONA.	
No.	Dealer FLUID EXTRACT.	Alkaloids found gm/100 cc
	New Britain	
39519	Egan Pharmacy	3.71
38972	Rockville Crosby's Pharmacy	2.15
	COMPOUND TINCTURE.	
00045	Oakville	
39817 39538	Byrnes Drug Co	$0.10 \\ 0.20$
		0.20
39504	Seymour Geo. Smith & Son	0.57
	South Manchester	
39812	Quinn's Pharmacy	0.19
39816	Waterbury Apothecaries Hall Co	0.34
00010	Watertown	
39818 39540	Post Office Drug Store Post Office Drug Store	0.29
00010	Tost Office Ding Store	0.34

COLCHICUM.

The fluid extract of colchicum should yield from each 100 cc of solution not less than 0.36 gm. and not more than 0.44 gm. of colchicine.

The tincture should yield from 0.036 to 0.044 gm. from each 100 cc.

A sample of fluid extract from the J. H. Lee Pharmacy in Rockville yielded 0.34 gm. of colchicine per 100 cc and was of standard strength. One from the Chatham Pharmacy in East Hampton contained 0.27 gm. and was deficient.

One sample of tincture from Leary's Drug Store in Naugatuck vielded 0.038 gm. colchicine per 100 cc and was of standard quality. A sample from the W. P. Lynch Drug Store in Wallingford vielded only 0.016 gm. and was below standard. A second sample of this stock could not be obtained as the supply was exhausted.

DRUGS

TINCTURE OF FERRIC CHLORIDE.

Eighteen samples of tincture of ferric chloride were analyzed. The official preparation should contain not less than 4.48 gms. iron (Fe), per 100 cc of solution.

Two samples showed conspicuous excesses of iron possibly as a result of evaporation of alcohol. The others were reasonably close to the requirements of the standard.

Analyses are given in Table XI.

TABLE XI. ANALYSES OF TINCTURE OF FERRIC CHLORIDE.

I ADLE AL.	ANALYSES OF TINCTURE OF PERKI	CHLURIDE
No.	Dealer	Iron (Fe), gms/100 cc
110.	Ansonia	gms/100 cc
39507	S. W. Smith & Co	5.25
39216	Cheshire Gladding's Pharmacy Darien	4.78
39114	The Bell Pharmacy	5.60
39213	Devon J. L. Mallard Drug Co Fairfield	5.55
39118	Clampett's Pharmacy	4.25
39110	Greenwich Veandrey & Co., Inc Meriden	4.88
39102	Victor W. Schmalzer	4.78
39106	New Canaan Windt Pharmacy New London	6.55
38987	Downey's Pharmacy	4.79
39120	New Milford Harrison F. Bassett	5.33
39149	Simsbury The Lathrope Pharmacy	4.91
39107	Stamford Chas. S. Fine h Stonington	5.06
38980	Conner's Drug Store	5.16
39141	Thompsonville Thompsonville Drug Co Waterbury	4.98
39536 39537	Higgins & Glynn	7.88 5.24
39116	Westport The Bridge Pharmacy Willimantic	5.08
39229	The Nathan Hale Drug Store	5.48

Hydrastis

One sample of fluid extract and one of tincture of hydrastis were examined. The fluid extract should contain 1.8 to 2.2 gms. of ether-soluble alkaloids of hydrastis in each 100 cc. The tincture is no longer a U.S. P. preparation.

The fluid extract, from the Spaulding Co., Branford, yielded 1.86 gms. of alkaloids per 100 cc and was of standard strength. The tincture, from the Boulevard Pharmacy, Bristol yielded 0.32 gm. of alkaloids and was passed.

Hydriodic Acid

Diluted hydriodic acid should contain not less than 9.5 per cent

nor more than 10.5 per cent of hydriodic acid, HI.

In the inspection last year, out of four requests for this article only once did the inspector receive a product of the identity and strength called for. This year better results were obtained. Four samples were taken, three of which were within the limits of the standard and one was a little over 10 per cent over strength. The percentage ranged from 9.5 to 11.8.

Samples were taken at the following drug stores:

Town Hill Pharmacy (11.8%), Starr Bros., Inc. (10%), Nichols & Harris (10.2%), all of New London, and Claxton's Pharmacy (9.5%), of Torrington.

SYRUP OF HYDRIODIC ACID.

Syrup of hydriodic acid should contain not less than 1.3 mg. and not more than 1.5 gm. of hydriodic acid (HI), per 100 cc.

Eight samples were examined and all were within the limits of the standard with the exception of two which were reasonably close to the minimum.

Analyses are given in Table XII.

TABLE XII. ANALYSES OF SYRUP OF HYDRIODIC ACID.

	or in bright Heib.			
No.	Dealer	Hydriodic Acid HI, gms/100 cc		
39241	Deep River LaPlace Pharmacy Derby	1.3		
39543	Blume's Pharmacy	1.2		
38991	Nichols & Harris	1.4		
38973	Vincent's Pharmacy	1.5		
38992	Watson's Drug Store	1.4		
39238	F. S. Bunnell	1.3		
39236	Opera House Pharmacy Westbrook	1.2		
38994	Neidlinger's Pharmacy	1.4		

TPECAC.

DRUGS

The fluid extract of ipecac should yield from 1.35 to 1.65 gms.

of ether-soluble alkaloids per 100 cc of solution.

A sample from Callahan's Drug Store, New London, yielded 1.24 gms. per 100 cc. One from Notkin's Pharmacy. Waterbury vielded 1.80 gms. Another from the Bristol Drug Co. of Ansonia yielded 0.79 gm. None of the preparations were within the prescribed limits but the last named sample was notably deficient.

SOLUTION OF LEAD SUBACETATE.

This solution should contain lead subacetate equivlaent to not

less than 18 per cent of lead (Pb).

Four samples were examined and were found to equal or exceed this limit or to be within a reasonable tolerance of the standard. The analyses showed percentages ranging from 17.7 per cent to 24.4 per cent.

Samples were obtained from W. J. Dumphy, Waterbury; Central Drug Co., Bristol; J. J. Cody, New Canaan; and the Service

Drug Co., Meriden.

SOLUTION OF MAGNESIUM CITRATE.

The Pharmacopoeia requires that this preparation contain magnesium citrate corresponding to not less than 1.5 gms. of magnesium oxide (MgO), in each 100 cc of solution. Additional specifications require not less than 3.33 gms. of free citric acid and not less than 9.81 gms. of total citric acid in 100 cc.

An experimental sample prepared according to the directions given in the U.S. P. showed that these standards can easily be

met or closely approximated.

	Experimental sample	Standard
Free citric acid	3.31	3.33
Total citric acid		9.81
Magnesium oxide		1.50

In several instances the inspection samples bore labels showing that they were made according to the 9th revision of the pharmacopoeia instead of the 10th to which there is no objection if the composition of the product conforms to the standard indicated

by the label.

One product was labelled as "Aperient Magnesia". Our law permits substandard drugs to be sold provided their substandard character or true strength is indicated. Since "aperient" means "laxative" or "purgative" and applies to a standard product as well as to a substandard one, the term is not sufficiently descriptive. The label should bear the further statement "not a U.S. P product" or words of similar effect.

Of twenty-seven samples examined, four met or substantially equalled the requirements of the standard and two others met the U. S. P. IX as their labels indicated. All other samples were deficient in one or more particulars although many of them met the major requirement as to content of magnesium oxide.

Analyses are given in Table XIII.

TABLE XIII. ANALYSES OF SOLUTION OF CITRATE OF MAGNESIA.

		I OF CITRE	TIE OF WIF	IGNESIA.
No.	Dealer	Free citric acid, gms/100 cc	a.c.id.	Magnesium oxide, MgO,
	Derby	gms/100 cc	gms/100 cc	gms/100 cc
39545	Harding Drug Store	2.56	8.36	1 50
39544	Hotchkiss Pharmacy			1.58
00011	East Hampton	1.72	7.02	1.42
39245	The Death Dog			
00240	The Barton Drug Co	2.73	8.58	1.64
20110	Fairfield			
39119	Randall's Pharmacy	2.37	6.87	1.16
	_ Guilford			
39132	Frank E. Douden	3.19	9.07	1.54
39130	Monroe's Pharmacy	0.26	4.68	1.03
	Milford	0.20	1.00	1.00
39212	A. H. Botsford	2.25	7.89	1.51
39210	Milford Pharmacy	2.10		
39209	John T. Howes		7.93	1.62
00200	Manahastan	2.81	7.74	1.45
38968	Manchester-			
30300	North End Pharmacy	1.89	4.87	0.71
000 70	New Hartford			
38953	Marble's Pharmacy	4.10	8.72	1.21
	New London			
38986	E. Callahan's Drug Store	2.88	9.03	1.74
	New Milford	00	0.00	1.17
39121	Harison T. Bassett	2.77	7.21	1.20
	Norwich	4.11	1.41	1.20
39127	W. D. Ricker	3.15	0.00	
	Plantsville	5.15	8.38	1.46
39217	T' T II 11 1			
00211	F. J. Hallahan	2.72	7.52	1.27
20071	Rockville			
38971	<u>J.</u> H. Lee	3.20	8.73	1.51
38969	Est. F. E. Metcalf	2.16	6.64	1.20
	Seymour			
39506	The Corner Drug Store	1.88	6.97	1.39
	South Manchester	1.00	0.01	1.00
38965	Packard's Pharmacy	2.30	8.07	1.74
38961	Magnell Drug Co			
00001	Ctominator	2.02	6.24	1.12
38979	Stonington	0.10		
20313	Burtch's Drug Store	3.16	9.25	1.62
20007	Stafford Springs			
39227	E. H. Wicks, Est	3.39	9.41	1.65
	Torrington			
38958	North End Drug Store	1.81	6.43	1.22
	Union City			
3 500	E. J Sodlosky	1.82	7.63	1.57
	Windsor			1.0
39147	Charles E. Paxson	2.83	8.70	1.69
	Winsted	2.00	0.70	1.09
38956		3.82	9.67	1 64
00000	The Case Drug Store Place Unknown	0.84	9.07	1.64
39136		9.47	0 = 1	1 70
00100		2.47	8.54	1.72

MERCURIAL OINTMENT.

Mercurial ointment, stronger, contains not less than 49 per cent and not more than 51 per cent of mercury (Hg).

Mild mercurial ointment contains not less than 29 per cent and

more than 31 per cent of mercury (Hg).

Four samples of the stronger preparation and thirteen of mild ointment were examined and all found to be within the limits for the official preparations or reasonably close to the minimum requirements.

Analyses are given in Table XIV.

TABLE XIV. MERCURIAL OINTMENT.

No.	Dealer	Mercury %
	Stronger.	
39242	Essex W. H. Pond New Britain	49.47
39518	Packard Drug Co	49.08
39104	New Canaan Rinyon's Pharmacy Willimantic	49.11
39230	Wilson's Windham Pharmacy	47.34
	MILD.	
	Bristol	00.00
39529	Madden Drug Store	29.50
39239	Canaan Freeman Dempsey Collinsville	29.00
39201	McNamara's Pharmacy	29.87
39202	Valley Pharmacy	29.16
38999	Palace Pharmacy	29.44
39502	Olson's Drug Store New Milford	29.32
39122	Park Pharmacy	30.17
39546	Mahoney's Corner Drug Store Suffield	29.63
39142	Suffield Pharmacy	28.89
	Torrington	
38959	North End Drug Store Westport	29.29
39117	The Westport Drug Co	. 30.24
39232	Willimanțic Bay State Drug Co	28.93
	Mandeon Locks	
39144	R. J. Keefe	30.86

SPIRIT OF NITROUS ETHER.

This preparation is a solution in alcohol and should contain not less than 3.5 per cent and not more than 4.5 per cent of ethyl nitrite.

More than one-half of the twenty-four samples examined were below standard. These deficiencies are no doubt largely due to lack of necessary precautions in preserving the solution after it is made. The pharmacopoeia emphasizes that this product should be kept in "small, well-stoppered dark amber-colored bottles, in a cool, dark place, remote from fire."

Analyses of inspection samples are given in Table XV.

TABLE XV. ANALYSES OF SPIRIT OF NITROUS ETHER

TABLE 2	AV. ANALYSES OF SPIRIT OF NITROU	S ETHER.
No.	Dealer E	thyl nitrite %
00500	Ansonia	
39509	McQuade's Corner Drug Store Essex	3.48
39243	Veales Drug Store, Inc	1.99
39131	Guilford Frank E. Douden	3.07
39129	Monroe's Pharmacy	3.07
	Madison	
39128		2.83
	Manchester	
38967	Manchester E. J. Murphy.	3.90
	Meriden	
38998	Meriden N. P. Forcier	3.38
39211	Milford Primrose Drug Store	1.01
55211	Mastic	1.81
38981	Mystic Pharmacy	0.04
30301	Wagu I and an	2.94
38983	New London James Drug Store	0.00
38984	The Moon Dharmany	2.82
30304	The Moon Pharmacy	3.39
39516	Norwich Central Ave. Pharmacy	1.56
22210	Sanbach	1.56
38993	Saybrook A. L. James	0.70
00330	Seymour	2.78
39505	Seymour The Seymour Pharmacy	0.08
00000	South Manchastan	0.08
38966	South Manchester Packard's Pharmacy	3.52
00300		3.34
39115	Newbauer's Drug Store	3.75
00110	Stafford Springs	5,75
39228	Stafford Springs D. H. McCormick	3.74
00220	Stamford	3.74
39108	Stamford The Church Pharmacy	3.13
00100	Storington	5.15
38978	Stonington Burtch's Drug Store	0.00
00010	Thompsonville	0.08
39139	O'Brien's Pleasant St. Pharmacy	2.08
00100	Torrington	2.00
39204	Opperman's Drug Store	4.26
00201	Wallingford	4.20
39549	F. W. Marx	2.99
00010	Winsted	4.99
39237	Bannon's Drug Store	4.42
39235	The City Pharmacy	3.18
00200	The City Fharmacy	0.10

NIIX VOMICA

DRUGS

Tincture of nux vomica should yield from each 100 cc not less than 0.237 nor more than 0.263 gm. of alkaloids of nux vomica. Five samples were examined. None were within the U.S.P. limits noted above but two were within 10% of the minimum required and three were from 16% to 24% under the minimum. Assays are given in Table XVI.

TABLE XVI. ASSAYS OF NUX VOMICA.

No.	Dealer	Nux Vomica alkaloids gm/100 cc
	Bridgeport	
39218	Schines Pharmacy	0.18
39503	Naugatuck Drug Co	0.20
39815	E. J. Bordin	0.22
40701	Steele's Corner Drug Store Torrington	0.20
39206	Thourlough's Pharmacy	0.21

STRAMONIUM.

Tincture of stramonium should yield not less than 0.0225 and not more than 0.0275 gm. of alkaloids of stramonium from 100 cc. The one sample examined was obtained from the Sisson Drug Co., Hartford, and was of standard quality. It yielded 0.0230 gm. of alkaloid.

STRONTIUM SALICYLATE.

Two samples of strontium salicylate were tested and both found to be of standard quality. Both were over 99 per cent pure.

The samples were obtained from J. H. Quinn & Co., So. Man-

chester and from Edw. Prouty, Windsor.

A sample of strontium salicylate tablets, 5 grain, was obtained from Metcalf's Drug Store, East Haven, and passed as satisfactory. They contained 4.5 grains of strontium salicylate per tablet.

WITCH HAZEL.

Distilled extract of witch hazel or witch hazel water should contain not less than 14 per cent of alcohol by volume and, among other specifications, should not show the presence of denaturing substances such as wood alcohol, diethylphthalate, etc.

Fourteen official samples were examined. Of nine taken from various druggists all being the product of the Connecticut Chemical and Disinfectant Co. of New Haven, five were considerably under the required alcoholic strength due, as was later determined, to faulty methods of checking alcohol content in the 842

factory. No denaturants were found except in one sample which showed a trace of diethylphthalate. The remaining samples representing products of the Dickenson Co. of Essex, Pond's Extract Co. of Clinton, and the Williams and Carleton Co. of Hartford were all passed.

Nine unofficial samples were also tested in a comparative study

of methods for detecting denaturants.

ZINC CHLORIDE SOLUTION.

Solution of zinc chloride is an aqueous solution containing not less than 48.5 per cent nor more than 52.0 per cent of zinc chloride. ZnC12.

Two samples were obtained, one from the Boswell Drug Co. and one from the Greenwich Drug Store, Inc., both of Greenwich. Both samples were below standard. They contained 35.1 per cent and 36.9 per cent of zinc chloride respectively.

ZINC OXIDE OINTMENT.

Zinc Oxide ointment should contain about 19.8 per cent of zinc oxide assuming zinc oxide to be of U.S. P. purity-viz. 99%. Samples examined are listed in Table XVII.

All were passed as satisfactory.

TABLE XVII. ANALYSES OF ZINC OXIDE OINTMENT.

No.	Dealer	Zinc oxide, ZnO %
No.	Canaan	2110 /0
00105	Farnum's Drug Store	18.6
39125		19.4
39124	The Service Pharmacy	19.4
	Cheshire	10.0
39215	Edson N. Sperry	19.9
	Darien	
39113	Lombardi Drug Store	21.0
A LIVE AND SHAPE	Forestville	
39523	Kent's Pharmacy	20.4
33020	Pawcatuck	
38977	Higgins' Pharmacy	19.5
30311	Portland	10.0
00010	Conklin's Pharmacy	20.0
39246		20.0
	Simsbury	.00.0
39200	Hoffert's Pharmacy	20.0
	Thomaston	20.0
39207	Doyle's Drug Store	20.2
39208	G. A. Lemmon	20.3
00200	Waterbury	
39532	R. E. Holmes	20.3
33034	Watertown	
00500	D. G. Sullivan	19.2
39539	D. G. Sumvan	

PROPRIETARIES, ETC.

"VINDOR DIABETIC WINE."

This preparation was made by the Zarol Medical Research, West Haven, Conn. Analysis:

Sp. Gr. 20° C. 1.0106; solids 10.92 gms/100 cc; ash 1.07; extract (calc.) 9.46; acidity, as tartaric acid 0.74; invert sugar extract (car.) 9.40; actuary, as tartaite actu 0.74; invert signr 0.38; sucrose trace; iron and aluminum trace; calcium oxide 0.26; phosphoric acid (P_2O_5) 0.56; P_2O_5 in ash 0.40; total nitrogen 0.02; alcohol by vol. 17.74%. Sodium glycerophosphate (calculated from P_2O_5) 2.48. Aloes, quinine, glycerophosphates and saccharin present.

The label on the product stated, in part, that this wine "is a powerful tonic and nerve restorative highly recommended by leading physicians for diabetes, wasting diseases," etc.; and further, in part, "a valuable auxiliary in the treatment of diabetes and an aid in the disappearance of sugar in the urine."

Direct claims of curative properties were not made but the language was such as to convey the impression to the consumer that curative or mitigative effects were to be expected in cases of the disorders mentioned, whereas the substances contained in medicine are not recognized by authoritative opinion as likely to produce such results. The manufacturer of the article at a hearing before the Dairy and Food Commissioner readily agreed to thoroughly revise their label to omit false and misleading declarations and this has now been done.

SLENDS.

This is said to be "a delicious medicated gum". Made by Slends, Inc., New York.

The gum is in the form of pink, sugar coated lozenges with wintergreen flavor. Phenolphthalein equivalent to 1.2 grains per tablet was found but no alkaloids were found and no vegetable extractives were identified.1

ASPERGUM, DILLARD'S.

This product is made by the Health Products Corp., Newark, N. J., who are also the makers of Feen-a-mint, "the chewing laxative".

Aspergum is an orange flavored gum containing aspirin in the amount of about 3.5 grains per tablet according to our analysis.

The label on the package makes it plain that aspirin is present and directions are given for its use. The declaration is further made that the product is "a medicine not a confection". Under these circumstances it seems clear that the article must be classed

¹ See Jour. Am. Med. Assoc. 87, 1665 (Nov. 13, 1926) and 89, 138 (July 9, 1927) for other reports on Slends.

845

as a drug, vet so far as can be judged by the ordinary sense of taste Aspergum is merely a chewing gum with a delicious orange flavor—a very acceptable confection. The rather indiscriminate use of aspirin, as such, is prevalent enough and regarded with disfavor by medical authorities, and it seems unwise and even dangerous to encourage its unrestricted use by dispensing it in such a palatable form.

BULLETIN 307

It is true that many bitter or otherwise unpleasant drugs are frequently masked by added flavors or by chocolate or other palatable coatings, but in all such cases the medicinal character of the finished product remains evident to the taste, or the form of the article still suggests a medicine rather than a confection. Moreover there is not the same objection to the disguising of simple medicaments, such as certain laxatives, for example, that there is to the same practice in the case of more potent drugs.

TOBACCO.

In a previous report analyses of a number of brands of tobaccos of reduced nicotine content were given and for comparison the nicotine content of ordinary tobaccos was given based upon analyses made in this laboratory and upon some cited from the reports of other analysts. This work attracted some interest on the part of physicians and others and during the past year further analyses of tobaccos of both types have been made. For convenience the data already published together with additions made later are summarized in Table XVIII.

Through the courtesy of the Carl Henry Co. a sample of pipe mixture of reduced nicotine content and a sample representing the same tobacco prior to the nicotine-reducing process were examined thus affording direct evidence of the extent to which nicotine is removed. Without such data conclusions as to nicotine removal are necessarily based upon averages accepted as fairly representative of unprocessed leaves of various types and grades. Nicotine, basis of air-dry tobacco, was found as follows:

	Total nicotine	"Free" nicotine
Before treatment, No. 1861	2.09%	0.16%
After treatment, No. 1862		trace

TABLE XVIII. NICOTINE CONTENT OF SOME TOBACCO PRODUCTS. (Air Dry Basis)

	Total nicotine	"Free" nicotine
PIPE TOBACCO.	%	%
Ordinary (unprocessed)		
Black Bass (chewing and smoking).	2.46	
BL Light Plug	2.62	
Blue Boar	1.45	0.33
Craven Mixture	2.84	0.28
Gilbert's Mixture	2.09	0.45
Hudson's Bay Imperial Mixture	1.95	0.13
Lucky Strike Plug	1.76	

TABLE XVIII. NICOTINE CONTENT OF SOME TOBACCO PRODUCTS. (Air Dry Basis) - Continued

(Air Dry Basis)—	-Continued	
	Total nicotine	"Free" nicotine
PIPE TOBACCO.	%	%
Ordinary (unprocessed)	/0	70
Main Brace Cut Plug	1.29	
Old English Course Cut	1.94	
Old English Curve Cut	1.82	
Prince Albert		
Tuxedo	2.22	
Maximum		0.45
Minimum	1.29	0.13
Average	2.04	0.30
So-called "denicotinized"		
Dormy (Cestrada)	2.26	0.28
Henry, Carl	0.98	trace
O-Nic-O	0.97	0.21
Sackett		0.18
Dacketti	0.30	7.00126 0.10
M	2.26	0.26
Maximum		
Minimum		trace
Average	1.30	0.17
CIGARS		
Ordinary (unprocessed)		1.00
Evermore	1.82	1.36
Judges Cave		0.79
Knickerbocker (Osterweis)	1.62	0.75
Knickerbocker (Osterweis)		0.60
King Perfectos	0.91	0.37
Manilla		0.72
Partagas, Habana		1.11^{1}
		0.79
Reyes de Espana		0.13
Rosedale		
Seven-Twenty-Four	1.64	
		1.00
Maximum	1.90	1.36
Minimum	0.91	0.37
Average	1.51	0.76
0 11 141 1 1 11		
So-called "denicotinized"		
Girard	1.54	****
Haddon Hall ²	1.39	0.67
Henry, Carl	0.99	0.26
Henry, Carl	0.61	0.19
Henry, Carl	0.62	0.19
Sackett	0.67	0.18
Sano	0.87	
DW110	0.0.	
Maximum	1.54	0.67
	0.61	0.18
Minimum		
Average	0.95	0.30

 $^{^1}$ pH value 7.8 2 Our information is that these cigars were bought as "low in nicotine". It is not known that they are actually advertised as "denicotinized".

(Air Dry Basis)—C	ontinued	
	Total nicotine	"Free" nicotine
CIGARETTES.	%	%
Ordinary (unprocessed.)		
Benson and Hedges	1.26	0.17
Camel	2.21	0.42
Capstan Navy Cut	2.30	0.26
Chesterfield	2.53	0.45
Condax	1.06	
Egyptian	1.59	
Egyptian Arabs	1.35	
Egyptian Deities	1.28	0.15
Egyptian Luxury	1.60	
Egyptienne Straights	1.45	
Fatima	2.79	
Fifty-six	1.43	
Hassan	1.94	
Helmar	1.56	
Home Run	1.89	
Home Run	1.67	
Home Run	1.78	
La Lucbana	0.43	
Lucky Strike	1.88	0.41
Makaroff	1.21	
Marlboro	1.94	0.37
Mecca	2.17	
Melachrino	1.31	0.11
Mogul	1.45	
Mogul	1.52	
Murad	1.52	
Nebo	2.03	
Nebo	1.93	0.43
Old Gold	$\frac{2.17}{1.98}$	0.40
Omar	1.38	0.14
Pall Mall	1.48	0.11
Phillip Morris	1.40	0.17
Phillip Morris	2.89	0.37
Piedmont	3.34	0.01
Piedmont	1.73	
Rameses II	2.79	
Richmond Straight Cuts	1.47	
Royal NestorSchinasi	1.51	
Sweet Caporal	2.05	
Sweet Caporal	2.85	
Tareyton	1.75	
Turkish Trophies	1.44	
Toro, Porto Rican	1.06	0.37
Toro, Porto Rican	1.08	0.45
Zubelda	1.97	
	3.34	0.45
Maximum	0.43	0.11
Minimum	1.77	0.31
Average		

TABLE XVIII. NICOTINE CONTENT OF SOME TOBACCO PRODUCTS.

(Air Dry Basis)—Concluded.

MISCELLANEOUS DRUGS

(Conconded	
	Total nicotine	"Free" nicotin e
CIGARETTES	%	%
So-called "denicotinized".	the branches are the	70
Cestrada, Virginia	2.10	0.33
Dormy Blue Ribbon Turkish	1.19	0.15
Dormy Red Ribbon Turkish	1.19	0.19
Henry, Carl	0.95	0.16
Nestor Lord (Lord Nestor Gianaclis)	0.92	0.11
O-Nic-O	1.14	0.20
O-N1c-O	0.73	Reserved Market
U-N1C-U	0.95	
Sackett	1.07	0.20
Sackett	1.07	0.13
Sackett	0.97	
Sano	0.79	0.11
Maximum	2.10	0.33
Minimum	0.73	0.11
Average	1.09	0.18

MISCELLANEOUS DRUGS, ETC.

The following materials, nine in number, have been examined for the Dairy and Food Commissioner, health officers or other officials interested.

37129. Essence of Anice. Said to have been sold as such but analysis did not show it to be the article demanded. It contained no determinable amount of oil of anise, 17.3% of alcohol, 56.9% of solids, and 49.5% of sugar. Petroleum ether extract was colorless and crystalline (anethol?). Preparation may have been the elixer of anise but was not the essence or spirit of anise.

37133. Kelloids. (F. J. Kellogg & Co.) One grain tablets with sweetish taste. Mineral (ash) 10.35%, sugars 66.6%. Magnesium, sodium and potassium present in ash. Starch present. Iodine, alkaloids, phenolphthalein or vegetable cathartics not detected. Other medicament, if present, not identified.

7713. Medicine for Turkeys. Brown-white powder with odor of orris root. Starch grains resembled orris root starch. No ipecac detected. Borax or boric acid present. Sample appeared to be orris root with small amount of boric acid. No other medicament found.

9659. Paint, Liquid. Found pigment 59.7%, vehicle 40.33%. Pigment contained 61.2% basic lead carbonate and 35.2% of zinc oxide. Guaranteed pigment 60%, vehicle 40%. Pigment, 59% basic lead carbonate, 39% zinc oxide and 2% tinting materials.

3509. Painters' Savogan. Moisture 10.06%, ash 82.82%; total fatty acids 7.94%; free fatty acids 0.25%; sodium carbonate 79.79%. Calculated composition: water 10.06%, sodium carbonate 79.79%; soap as sodium stearate 8.28%; free fatty acids (as oleic acid) 0.25%; undetermined 1.62%.

.8293, 8322. Prescription. Prescription called for 1/10 mgm. (1/650 grain), of atropine sulphate per capsule, with sodium salicylate and acetphenetidine. Atropine sulphate found was approximately 1/12 grain per capsule, a dosage which is within the range regarded as dangerous. A second lot compounded on the same prescription was found to contain 1/110 grain which is in excess of the amount called for, but within the limits of safety. One capsule of the larger dosage produced alarming symptoms but the patient recovered.

8875. Prescription. Medicine prescribed for a dog. Nux vomica was among the ingredients and symptoms of strychnine poisoning were noted. Approximately .024 grain per capsule was found. Two capsules had evidently been administered, equivalent to about 1/20 grain of strychnine. The effect of this dosage would no doubt depend upon the size and condition of the animal. The usual dosage (for humans) is 1/12 to 1/60 grain.

8129. Spring water. Residue from evaporation of 20 quarts of spring water, source Hazardville, Conn. Wt. of solids 1.5 gms. equivalent to 75 p.p.m. in original water. Solids chiefly calcium and magnesium combined as carbonates and sulphates. Appears to have no unique value medicinally. (See Conn. Food Report 1900 p. 201 for discussion of Connecticut spring waters.)

Other Miscellaneous Materials, Examined for Poisons or Other Injurious Substances.

Thirty-one other samples, chiefly instances of suspected poisoning of domestic animals, have been examined but do not require individual discussion or comment. These examinations were made largely for the Commissioner on Domestic Animals or for local authorities charged with similar supervision. Some have been made also for the Dairy and Food Commissioner, for local Health officers and for individuals.

STATE WATER COMMISSION.

Six samples of trade waste liquors from manufacturing plants in the State have been examined in considerable detail and reported to Mr. Copeland, sanitary engineer to that Commission. This work is done by statutory provision which enlists the collaboration of this Station when desirable.

BABCOCK GLASSWARE, ETC.

The following tabulation summarized the work done under the statutes providing for the checking of glassware which is to be used in carrying out the Babcock test upon milk and cream and the checking of thermometers which are to be used for the control of pasteurization temperatures.

	Accurate	Rejected	Total
Babcock glassware, test bottles and pipettes	2561	13	2574
Thermometers	163	9	172

INDEX.

Aspergum, Dillard's, 843 Aspirin tablets, 832; analyses of, 832 Babcock Glassware, etc., 848 Barbital, etc., 833 Belladonna, 833; analyses of, 833 Bemax, 831; analysis of, 831 Butter, 821 Carbonated beverages, etc., 814 Catsup, 815 Cereal products, 815 Cinchona, 834; analyses of, 834 Coffee: Roma brand, 815 Sanka, 816 Kaffee Hag, 816 Colchicum, 834 "Diabetic", Special and Miscellaneous foods, 816, 817; analyses of 818, 819. Eggs and Egg products, 820 Fats and Oils, 821 Ferric chloride, 835; analyses of, 835 Fruits and fruit products, 823, 824 Hydrastis, 836 Hydriodic acid, diluted, 836 Hydriodic acid, Syrup of, 836; analyses of, 836 Honey, 825 Ice Cream, 825 Frozen Custard, 825 Ipecac, 837 Lard, 822; analyses of, 822 Lead subacetate, Solution of, 837 Magnesium citrate, Solution of, 837

Magnesium citrate, analyses of, 838 Maple Products, 825 Mercurial ointment, 839; analyses of. 839 Meat Products, 825 Milk, Milk products, etc., 827 Milk, human, 827 Cream, 827 Swiss milk, canned, 827 Swiss cream, 827 Chocolated, 827 Miscellaneous materials examined for poisons, 848 Nitrous ether, Spirit of, 839; analyses of. 840 Nux Vomica, 841; analyses of, 841 Oleomargarine, 821 Olive oil, 823 Paprika, 829 Proprietaries, 843 Slends, 843 Stramonium, 841 Strontium salicylate, 841 Sulphur dioxide in dried fruits, 824 Tea, 829; analyses of, 830 Tobacco, 844; analyses of, 845 Vindor Wine Tonic, 843 Vinegar, 831 Water, analyses of, 848 Witch Hazel Water, 841 Zinc chloride, 842 Zinc Oxide Ointment, 842; analyses of, 842

INDEX

Stead plant was

Street have a second of the second and the companies of the latest
PAGE
Acronycta auricoma
Adams, C. L., Co., feeds
Adelges abjetis 681, 689, 690, 692
pinicorticis
Advance Milling Co., feeds
Agriolimax agrestis
A grotis visilon 686
Allen E T Co feeds
Alsophila pometaria
Alybia octomaculata 083
American Agricultural Chemical Co., feeds
fertilizers, 7, 18, 19, 20, 21, 23, 24, 27, 33, 35, 37, 38, 40, 41, 42,
46, 51, 52, 53, 54, 58, 59, 64, 66, 84, 90
American Cyanamid Co., fertilizers
American Linseed Co., feeds
American Maize Products Co
Ammonium sulphate
Anastatus bifasciatus
Anomala orientalis
Anthrenus verbasci
A phrophora parallela
Apiary inspection 703, 712
A poria crataegi
Anotheraries Hall ('o sterilized steam hone
fertilizers, 8, 18, 19, 20, 21, 23, 24, 27, 33, 34, 35,
37 38 39 40, 41, 42, 45, 46, 48, 51,52, 53, 54,
58, 66, 84, 90
Apple aphid
Arcady Farms Manufacturing Co., feeds 480, 517, 524, 525, 539, 543 Archer-Daniels Midland Co., feeds
Archer-Daniels Midland Co., feeds
Archips rosana 683
7034004114
Argyresthia thuiella
53, 54, 66, 84, 90 Asiatic beetle
control
fertilizing and seeding treated lawns
in lawns
in nurseries
natural factors
description of stages
distribution 586
habits
history
insecticides for
life history
New Haven conditions
systematic position
report of work
fertilizers
Aspergum, Dillard's
(851)

	PAGE
Aspidiotus pernicosus	677
	832
	480, 570
A 11 / D -1-1-2 ~ () +0***********************************	0, 00, 00
Attagenus piceus	
Barbital	9, 19, 23
Basic slag	. 37
Basic slag Bay State Milling Co., feeds. Beacon Milling Co., feeds Beech Soap Co., feeds 479, 481, 517, 525, 526, 541, 543 Beech Soap Co., feeds 481	. 481, 510
Beacon Milling Co., feeds 479, 481, 517, 525, 526, 541, 543	, 544, 545
Beech Soap Co., feeds	526 545
Beers, Ira W., Ieeds	833
BelladonnaBelle Isle Creamery Co., feeds	481, 571
Belle Isle Creamery Co., leeds. Bemax	. 831
Bemax. Berkshire Chemical Co., fertilizers 9, 18, 19, 21, 25, 33, 34, 35, 41, 46, 48, 51, 52, 53, 54.	37, 39, 40,
Berkshire Chemical Co., fertilizers 9, 18, 19, 21, 23, 55, 61, 65, 41, 46, 48, 51, 52, 53, 54, Biorhiza forticornis	68, 84, 90
Biorhiza forticornis	703
Blatchford Calf Meal Co., feeds Board of Control, letter of transmittal	
	. 00,01
Bridge's Sons, Amos D., Inc., feeds.	. 481, 526
fertilizers	9, 68
Bristol Grain and Supply Co., feeds	482, 502
Bristol Grain and Supply Co., feeds Brode, F. W., Corp., feeds fertilizers	. 9, 20, 28
Buell, C. E., Inc., feeds	182, 571
Butter. C. W., Inc., feeds	
	. 000
	. 10,
Carbonated beverages	675
Case, H. A., Co., fertilizers.	19, 24
Castor pomace	. 690 815
Catsup Cereal products	678
Cereal products Ceutorhynchus rapae Chapin and Co., feeds 479, 482, 517, 527, 54	5, 546, 547
Chapin and Co., ieeds	

Chionaspis americana	E
002	2
### Pinifoliae	2
Chiorian coerateum	,
Cimbex americana)
Cinchona	Ł
fertilizers	
fertilizers	3
Coffee	
Roma Brand. 815 Sanka. 816	
Kaffee Hag816	Satisfica
Colchicum	
Coleophora laricella 680 Coles Co., feeds 482, 527, 539, 548, 549	
Collis Products Co., teeds	,
Collaborative work, department of analytical chemistry	
Commercial feeding stuffs registrations of	
registrations of	
terms used	
Composition of some commercial insecticides, fungicides, bactericides, rodenticides and weed killers	
Conkey, G. E., Co., feeds	
Conotrachelus crataegi	
nenuphar	
fertilizers	
Consolidated Rendering Co., feeds	
f-+11: 10 10 10 01 00 00 00 00 00	
Consolidated Rendering Co., feeds	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 Contarinia pyrivora	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 Control studies on the plum curculio, see "plum curculio" 686	
Contarinia pyrivora 40, 41, 46, 48, 51, 52, 53, 54, 84, 90 Control studies on the plum curculio, see "plum curculio" 686 Convention of entomological workers 505	
Contarinia pyrivora	
Contarinia pyrivora 40, 41, 46, 48, 51, 52, 53, 54, 84, 90 Control studies on the plum curculio, see "plum curculio" 686 Convention of entomological workers 505 Copeland Flour Mills, Ltd., feeds 483, 507 Corcyra cephalonica 686 Corn Products Refining Co., feeds 483, 513, 517	
Contarinia pyrivora 40, 41, 46, 48, 51, 52, 53, 54, 84, 90 Control studies on the plum curculio, see "plum curculio" 686 Convention of entomological workers 505 Copeland Flour Mills, Ltd., feeds 483, 507 Corcyra cephalonica 686 Corn Products Refining Co., feeds 483, 513, 517	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 Contarinia pyrivora 676 6	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 675 686 675 686 675 686	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 675 686 675 686 675 686	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 676 676 686 676 686	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 676 686	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 676 686 676 686 676 686	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 686 676 686	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 686 676 686	
40, 41, 46, 48, 51, 52, 53, 54, 84, 90 676 686 676 686	
## 40, 41, 46, 48, 51, 52, 53, 54, 84, 90 Control studies on the plum curculio, see "plum curculio" 686 Convention of entomological workers 505 Copeland Flour Mills, Ltd., feeds 483, 507 Coreyra cephalonica 686 Corn Products Refining Co., feeds 483, 513, 517 Cottonhull ashes 38, 42 Cottonseed meal 3, 20, 27 Cowles, C. A., feeds 483, 527, 549 Cox, Charles M., feeds 483, 505 Crataegus 690 Crioceris asparagi 677 Crosby Milling Co., feeds 483, 511, 527, 539, 549 C. & R. Sales Co., fertilizers 10, 70 Cryptorhynchus lapathi 683 Cylisus 690 Davey Tree Expert Co., fertilizers 10, 58, 70, 84, 90 Davis, R. G., & Sons, feeds 484, 517, 518, 527, 528, 539, 549 Decatur Milling Co., feeds 484, 517, 518, 527, 528, 539, 549 Decatur Milling Co., feeds 484, 517, 518, 527, 528, 539, 549 Delaware Mills, Inc., feeds 484, 514, 510, 510, 510, 510, 510, 510, 510, 510	
## 40, 41, 46, 48, 51, 52, 53, 54, 84, 90 ## Control studies on the plum curculio, see "plum curculio" 686 ## Convention of entomological workers 505 ## Copeland Flour Mills, Ltd., feeds 483, 507 ## Corcyra cephalonica 686 ## Corn Products Refining Co., feeds 483, 513, 517 ## Cottonhull ashes 38, 42 ## Cottonseed meal 3, 20, 27 ## Cowles, C. A., feeds 483, 527, 549 ## Cox, Charles M., feeds 483, 505 ## Crataegus 690 ## Crioceris asparagi 677 ## Crosby Milling Co., feeds 483, 511, 527, 539, 549 ## C. & R. Sales Co., fertilizers 10, 70 ## Cryptorhynchus lapathi 683 ## Cyllene caryae 682 ## Cytisus 690 ## Davey Tree Expert Co., fertilizers 10, 58, 70, 84, 90 ## Davis, R. G., & Sons, feeds 484, 517, 518, 527, 528, 539, 549 ## Decatur Milling Co., feeds 484, 517, 518, 527, 528, 539, 549 ## Delaware Mills, Inc., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 528, 540, 550 ## Devon Coal and Ice Co., feeds 484, 528, 540, 550 ## Devon Coal and Ice Co., feeds 518 ## Proceeds 518 ## Proceder Coal and Ice Co., feeds 518 ## Proceder Coal and	
## 40, 41, 46, 48, 51, 52, 53, 54, 84, 90 Contarinia pyrivora	
## 40, 41, 46, 48, 51, 52, 53, 54, 84, 90 ## Control studies on the plum curculio, see "plum curculio" 686 ## Convention of entomological workers 505 ## Copeland Flour Mills, Ltd., feeds 483, 507 ## Corcyra cephalonica 686 ## Corn Products Refining Co., feeds 483, 513, 517 ## Cottonhull ashes 38, 42 ## Cottonseed meal 3, 20, 27 ## Cowles, C. A., feeds 483, 527, 549 ## Cox, Charles M., feeds 483, 505 ## Crataegus 690 ## Crioceris asparagi 677 ## Crosby Milling Co., feeds 483, 511, 527, 539, 549 ## C. & R. Sales Co., fertilizers 10, 70 ## Cryptorhynchus lapathi 683 ## Cyllene caryae 682 ## Cytisus 690 ## Davey Tree Expert Co., fertilizers 10, 58, 70, 84, 90 ## Davis, R. G., & Sons, feeds 484, 517, 518, 527, 528, 539, 549 ## Decatur Milling Co., feeds 484, 517, 518, 527, 528, 539, 549 ## Delaware Mills, Inc., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 518, 519 ## Devon Coal and Ice Co., feeds 484, 528, 540, 550 ## Devon Coal and Ice Co., feeds 484, 528, 540, 550 ## Devon Coal and Ice Co., feeds 518 ## Proceeds 518 ## Proceder Coal and Ice Co., feeds 518 ## Proceder Coal and	

	PAGE
Dianthus	
Dichelonyx elongata	680
Dichomeris marginellus	683
Director report	110
Ditain simila	n/9 n91
Dominion Flour Mills, Ltd., feeds.	484, 505, 507
Dominion Flour Mills, Ltd., feeds. Drug products, report	813
Dry ground fish	484
Dry Milk Co., feeds	484
Duluth-Superior Milling Co., feeds.	484
East Coast Trading Co., feeds	484 571
Eastern Grani Co., reeds	feeds 484 502 519 528 529 550 551
Eastern States Parmers Exchange,	484, 571 feeds, 484, 502, 519, 528, 529, 550, 551 fertilizers, 10, 11, 18, 19, 21, 22, 23, 33
Edwards S T & Co feeds	485, 572
Edward Eggert fertilizers	11, 38, 42
Face and eag products	820
Elmore Milling Co., feeds	485, 507, 519, 529, 542, 551
Emphytus cinctus	485, 507, 519, 529, 542, 551
Emboa rosae	0/0
Embusa muscae	
Entomologist report	008
Ebeira trimittata	
Epitrix cucumeris	677, 690
Ebigoninis gemaila	085, 702
Friococcus azalae	684
Friosoma lanigerum	
Eshelman, J. W., & Sons, feeds	485, 507, 511, 519, 529, 540, 551, 552
Essex Fertilizer Co	11, 70
Fulia binatuhana	0/3
European corn borer Evans Milling Co	
Evans Milling Co	683
Exoascus	691
Exobasidium	691
Poinshild Milling Co	485, 505, 50
Fairfay Milling Co	485, 511
Fairmont Creamery Co	486
Farmers' Feed Co	480, 515, 510
Fate and oils	84.
Fenusa bumila	673, 680, 690, 692
Ferric chloride	
Dontiligor	
analyses of mixed	58
check samples	
classification of samples analys	ed
containing nitrogen and phosp	horic acid
containing nitrogen and potast	1
containing phosphoric acid and	d potash
containing ammonia, phosphor	re acid and potash
gratuitous analyses	
inspection	
law	
miscellaneousprecautions in drawing sample	
precautions in drawing sample	S
registrationreport	
report	486, 519, 552, 55
Flory Willing Co	

	DACE
	PAGE
Food products, report	813
Forbes, A. W	11
Foul brood, American	705, 706
	704, 705
Four Seasons Fertilizer Co.	11
Frisbie, L. T., Co., feeds	486 572
fertilizers	53, 54,72
Frozen custard	825
Fruit insects	674
	823, 824
Fungicides, analyses	208
Fusicladium saliciperdum	443
Gash-Stull Co., fertilizer	11,72
Gillettea cooleyi	689, 690
Gipsy moth	712
appropriation	712
parasites	725
quarantine	726
work	712
Glypta rufiscutellaris	733, 734
Gnomonia ulmi	691, 692
Grain Belt Mills Co	486, 519
Grandin, D. H., Milling Co	530, 553
Grapholitha (Laspeyresia) molesta	
Grasselli Chemical Co., fertilizer	11,72
Hales and Hunter Co., feeds. 486, 519, Halisidota tessellaris. 486, 519	530, 553
Hallstaota tessellaris	675 799
	675, 729
ulmi	$\begin{array}{c} 679 \\ 486 \end{array}$
Havana seed tobacco	480
topping and suckering	99
Hecker-H-O Co., Inc., feeds	
Hecker-Iones Iewell Milling Co. 487 505	507 511
Hecker-Jones-Jewell Milling Co	600
Heliopsis	690
Heliothis obsoleta	677
Hemerocampa leucostigma	679
Hennepin Mill Co	508. 511
Honey	825
Hormaphis hamamelidis	684
Hubinger, J. C., Bros., feeds	487, 513
Hudson, L. W., feeds	553, 554
Humphreys-Godwin Co., feeds	487, 503
fertilizer	0, 28, 29
Hydrastis	836
Hydriolic acid, diluted	836
syrup of	836
Hylemyia brassicae	678
Hypermallus villosum	682
Hyphantria cunea	679
Ice cream	825
Idocerus scurra	682
Illinoia pisi	687
Insecticides, analyses	187, 520
Insecucius, analyses	207

	PĀGE
Insect pests	
appropriation	viii
flowers and greenhouse	
fruit	
miscellaneous	
ornamental shrubs and vines	
stored vegetable products	
vegetables	
Inspection, entomology apiaries	703
niirceriec	009
raspberry plantations	. 699
International Agricultural Corn feeds	487
fertilizers 12, 18, 22, 38	, 42, 43,72
International Milling Co	
Ipecac	
되는 보통하는 것이 되는 경험을 받아 없는 것이 되는 사람들이 살아가는 내가 없었다. 그리고 있는 것이 없는 것이다.	
control work	737
quarantine	. 739, 740
Iohn Iovnt, fertilizers	12, 38, 44
Juniberus communis	. 083
virginiana	. 683
Kalmia latifolia	. 700
Kansas Flour Mills Corp	. 487, 505
Kasco Mills, Inc., feeds	, 530, 531
Kellogg Co., feeds	. 487, 514
fertilizers	12 19 26
Kelloggs & Miller, Inc., feeds	487
Kermes	. 682
King, H. H., Flour Mills Co	488, 511
TT: 35'11 35'11 C	
King Midas Mill Co	. 488, 508
King Midas Mill Co	. 488, 508), 531, 554
Krause, Charles A., Milling Co	. 488, 508), 531, 554 . 488, 554
Krause, Charles A., Milling Co	. 488, 508 0, 531, 554 . 488, 554 . 676
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard Larrabee Flour Mills Co.	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822 . 488, 505
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Largoa crispata Lard. Larrabee Flour Millis Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822 . 488, 505 1, 554, 555
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum.	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822 . 488, 505 1, 554, 555 . 686
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata Lard Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum. Lasbevresia molesta.	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 686 675, 731
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta brunivora.	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 686 675, 731 675 837
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53. Lasioderma testaceum. Laspeyresia molesta. prunivora Lead subacetate, solution of Lecanium corni.	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822 . 488, 505 1, 554, 555 . 686 . 675, 731 . 675
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata Lard Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53. Lasioderma testaceum. Laspeyresia molesta. prunivora. Lead subacetate, solution of Lecanium corni. Lebidosnophes ulmi	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 686 675, 731 675 837 677
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata Lard Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53. Lasioderma testaceum. Laspeyresia molesta. prunivora. Lead subacetate, solution of Lecanium corni. Lebidosnophes ulmi	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 686 675, 731 675 837 677
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta prunivora Lead subacetate, solution of Lecanium corni Lepidosaophes ulmi Limestone Liming in tobacco production, see "soil reaction".	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 686 675, 731 675 837 677 684 84, 92
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta. prunivora Lead subacetate, solution of Lecanium corni. Lepidosaophes ulmi Limestone. Liming in tobacco production, see "soil reaction". Ling scripta	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 675, 731 675 837 677 684 84, 92
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum. Laspeyresia molesta. prunivora Lead subacetate, solution of Lecanium corni. Lepidosaophes ulmi Limestone. Liming in tobacco production, see "soil reaction". Lines cripta. Lines C. W. Co., feeds. 488	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822 . 488, 505 1, 554, 555 . 686 . 675, 731 . 675 . 837 . 677 . 684 . 84, 92
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata Lard Larrabee Flour Mills Co. Larrowe Milling Co., feeds 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta. prunivora. Lead subacetate, solution of Lecanium corni. Lepidosaophes ulmi Limestone. Liming in tobacco production, see "soil reaction". Lina scripta. Lines, C. W., Co., feeds 488	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 686 675, 731 675 837 677 684 84, 92
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta prunivora. Lead subacetate, solution of Lecanium corni. Lepidosaophes ulmi Limestone. Liming in tobacco production, see "soil reaction". Lina scripta. Lines, C. W., Co., feeds Linseed meal Litchfield County Co-op, Asso., feeds. 48	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 675, 731 675 837 677 684 84, 92 690 8, 531, 555 20, 32 8, 531, 555
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta. prunivora Lead subacetate, solution of Lecanium corni. Lepidosaophes ulmi Limestone. Liming in tobacco production, see "soil reaction". Lina scripta. Lines, C. W., Co., feeds Linseed meal Litchfield County Co-op. Asso., feeds Lithhocolletis hamadryadella Long Hill Feed Store.	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822 . 488, 505 1, 554, 555 . 686 . 675, 731 . 675 . 837 . 677 . 684 . 84, 92 . 690 8, 531, 555 . 20, 32 8, 531, 555 . 8, 531, 555 . 680 8, 531, 555
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta. prunivora. Lead subacetate, solution of Lecanium corni. Lepidosaophes ulmi Limestone. Liming in tobacco production, see "soil reaction". Lina scripta. Lines, C. W., Co., feeds Linseed meal. Litchfield County Co-op. Asso., feeds Lithocolletis hamadryadella Long Hill Feed Store. Langistigma carroee	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 675, 731 675 837 677 684 84, 92 690 8, 531, 555 680 8, 531, 555 682
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta prunivora Lead subacetate, solution of Lecanium corni Lepidosaophes ulmi Limestone Liming in tobacco production, see "soil reaction". Lina scripta Lines, C. W., Co., feeds Linseed meal Litchfield County Co-op. Asso., feeds Lithocolletis hamadryadella Long Hill Feed Store Longistigma caryae Longistigma caryae Longistigma caryae Longistigma caryae Longistigma caryae	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 675, 731 675 837 677 684 84, 92 690 8, 531, 555 20, 32 8, 531, 555 680 8, 531, 555 682 488, 514
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata. Lard. Larrabee Flour Mills Co. Larrowe Milling Co., feeds. 488, 503, 516, 520, 53 Lasioderma testaceum. Laspeyresia molesta. prunivora. Lead subacetate, solution of. Lecanium corni. Lepidosaophes ulmi. Limestone. Liming in tobacco production, see "soil reaction". Lina scripta. Lines, C. W., Co., feeds. 48 Linseed meal Litchfield County Co-op. Asso., feeds. 48 Lithocolletis hamadryadella. Long Hill Feed Store. 48 Longistigma caryae. Louisville Milling Co., Inc. Lovitt I. R and Co. feeds.	488, 508 0, 531, 554 488, 554 676 822 488, 505 1, 554, 555 686 675, 731 677 684 84, 92 684, 531, 555 20, 32 8, 531, 555 680 8, 531, 555 680 8, 531, 555 680 8, 531, 555 684 488, 534
Krause, Charles A., Milling Co. 488, 514, 520 Labieniec, S. F., feeds. Lagoa crispata Lard Larrabee Flour Mills Co. Larrowe Milling Co., feeds 488, 503, 516, 520, 53 Lasioderma testaceum Laspeyresia molesta prunivora. Lead subacetate, solution of Lecanium corni. Lepidosaophes ulmi Limestone. Liming in tobacco production, see "soil reaction". Lina scripta. Lines, C. W., Co., feeds Linseed meal. Litchfield County Co-op. Asso., feeds Lithocolletis hamadryadella Long Hill Feed Store Langistiama carvae.	. 488, 508 0, 531, 554 . 488, 554 . 676 . 822 . 488, 505 1, 554, 555 . 686 . 675, 731 . 675 . 837 . 677 . 684 . 84, 92 . 690 8, 531, 555 . 20, 32 . 20, 32 . 680 . 680 . 682 . 488, 514 . 488, 514 . 488, 503 . 12

Lucilia caesar	PAGI 763
sericata	76
Sylvarum	76
Lygidea mendax	67
Lygus caryea	73
omnivagus	730
pratensis	5 73
guercalbae	6, 730
Macrodactylus subspinosus.	684
Macronoctua onusta	68.
Macrosiphum solanifolii Magnesium citrate	678
Malacosoma americana.	7, 838
Mamestra dissimilis	674 703
DICIO	001
Manchester, E., and Sons, feeds. 489, 508, 511, 53 Mann Brothers Co., feeds. 48 Mapes Formula & Peruvian Guano Co. 12, 18, 21, 53, 54, Maple products analyses	1 55
Mann Brothers Co., feeds	9 504
Mapes Formula & Peruvian Guano Co 12, 18, 21, 53, 54.	72. 74
Maple products analyses Maritime Milling Co., Inc 489, 511, 512, 520, 531, 540, 5 Markham, A. G. and Co., feeds	82
Maritime Milling Co., Inc 489, 511, 512, 520, 531, 540, 5	56,55
Markham, A. G. and Co., feeds	9, 572
Tertilizers	12, 74
Marsh, George E., Co., feeds.	489
Martenais, C. J., Grain Co	9, 516
Meat products. Meech and Stoddard, Inc., feeds	828
fortilizara 10	0, 557
fertilizers	84, 90
Mercurial ointment	839
Middleport Flour Mills, Inc.	490
Wilk	827
chocolated	827
cream	827
human	827
Swiss cream	827
Swiss milk, canned.	827
	5, 521
Moon Coorse O and Co. 1 400 707 700 710 710 710 710 710 710 710 7	0,505
Minneapolis Milling Co	7, 558
Morse, Fred C. feeds	0, 558
Morse, James F., and Co., feeds	79 579
Mosquito appropriation	
control work.	753
Mount Vernon Milling Co	514
Myzus ribis National Cottonseed Products Corp. National Milling Co.	677
National Cottonseed Products Corp	509
1 vacional willing Co	5 512
Natural Guano Co	84, 90
Nebraska Consolidated Mills Co. 400 FO.	
Nematus erichsoni	762
iveourprion teconter	679
pinetum New England By Products Corp. foods	679
New England By-Products Corp., feeds 479, 490 New England Fertilizer Co. 479, 490	
Newman Brothers Grain Co	13,74
Newman Brothers Grain Co. 49 Newsome Feed and Grain Co. 49 Newston Food Co. 49	1, 559
101 536	1, 509
Niagara Falls Milling Co	3, 500
31, 000	, 000

PAGE
하는 그들이 하는 사람이 하나 그리다는 것이 없는 것이 없는 사람들이 되었다. 그런 사람들은 사람들이 하는 사람들이 하고 있다면 가는 것이 없다면 하는 것이 없었다. 그리
Nitrate of soda
Nitrophoska
Nitrous ether, spirit of
Norton Tallow Co., feeds 491, 573
Notolophus antiqua
Nowak Milling Corp., feeds
Nursery dealers
Connecticut firms
inspection
pests
stock, imported 701 N. W. Consolidated Milling Co 491, 506, 509, 512
N. W. Consolidated Milling Co 491, 506, 509, 512
Nux vomica
Nux vomica
Olds & Wimpple, Inc., Ierunzers, 15, 18, 19, 21, 25, 55, 54, 55, 57, 59, 41, 45,
46, 48, 53, 54, 58, 74, 84, 90 Oleomargarine
Oleomargarine
Ontario Milling Co., Inc
Oriental peach moth
Ormenis pruinosa
Oryzaephilus surinamensiss
Osborne, S. V., Estate, feeds
Ctiorhynchus ovatus
sulcatus
Pachypsylla celtidis
Pacific Manure and Fertilizer Co
Papaipema nitela
Papilio podalirius
Paprika
Paratetranychus pilosus
ununguis
Parmenter & Polsey Fertilizer Co
Patent Cereal Co
Pecos Valley Alfalfa Mill Co
Pegomyia hyoscyami
Pelopaeus cementarius
Pemphigus ulmifusus
vagabundus
Peridroma margaritosa var. saucia
Periodical cicada
control
distribution
habits
injury
mic miscory
Periplaneta americana 686 Philonix pezomachoides 681
Phloeosinus dentatus
Phobetron pithecium
Phomobsis juniberi 691
Photinia villosa
Phlyctaenia ferrugalis 089
Physicaenia ferrugalis
Phlyctaenia ferrugalis

PAG	E
Phylloxera caryaecaulis	2
rimosalis	
Phymatodes variabilis	2
Piedmont Mount Airy Guano Co. 13, 18, 21,7	6
Pillsbury Flour Mills Co. 492, 493, 506, 509, 512, 513, 53 Pipe organ wasp. 75	4
Pissodes approximatus. 682, 76	1
317001	9
FILLSDILLA FIALE CLASS CO. TEEDS	
Platt, Frank S., Co., feeds	1
Flagiodera versicolora	1
Plum curculio	
arsenical residue on fruit	1
abundance	1
control	1
control studies	
damage	HT SELEC
ho hita	
life history	
life history, 1928	
life periods, 1924-25	
Datasites	557 m
SDraving experiments	
recommendations for control in Connecticut apple or-	J
chards	2
Timena macunpennis	
Poecuocapsus imaetus	
Folson, materials examined for	8
1 0mphopaea sayt	2
Pontia rapae	7
Popilliae japonica 68 Postum Co., Inc., feeds 493, 515, 53	6
Potash 493, 515, 534	4
carbonate of	_
munate of	
sulphate of	
r Otash-magnesia	~
I Utiel. W. IV. and Sons Inc. teeds	
100 1 000 00	i
riemier Poultry Manure Co.)
Prunus pissardi	
Psila rosae	3
Pteronidea rihesi 676	;
Psylla pyricola 678 Pteronidea ribesi 672, 676, 734 Publications of entomology department 670 Puffer H. C. Confoods 670	ŀ
Puffer, H. C., Co., feeds 670)
Puffer, H. C., Co., feeds	
Pulvinaria vitis	,
Purtularia vitis. 682 Pyrausta nubilalis 679 Quaker Oats Co 494, 506, 515, 522, 534, 541, 542, 562, 563 Rackliffe Brothers Co., Inc., fertilizers 14, 18, 22, 33, 35, 76 Ralston Purina Co 479, 494, 495, 522, 535, 542, 563 Reardon, John, & Sons., feeds 495, 573 Recurvaria 495, 573	
Quaker Oats Co	
Rackfille Brothers Co., Inc., fertilizers 14, 18, 22, 33, 35, 76	
Reardon John & Sons ford 479, 494, 495, 522, 535, 542, 563	
Recurparia. 495, 573	
Recurvaria 495, 573 Red Wing Milling Co 680 405 405)
405	

INDEX

	PAGE
Registrations	470
commercial feeding stuffs	479
fertilizers	
Report Board of Control, letter of transmittal	v
commercial feeding stuffs	477
fertilizers	3
director	116 ix
in account with mosquito appropriationin account with tobacco appropriation	X
in account with white pine blister rust appropriation	xi
drug products	813
food products	813
entomologist	669
tobacco stationeffect of fertilizers on the combustion of tobacco	166
effect of sulphur, ammonium sulfate and aluminum sul-	
phate on reaction of soil	181
field experiments with chlorine, sulphur and magnesium	198
influence of the season on combustion	178 178
magnesia hunger, or sand-drownpotash fertilizer experiments	146
treasurer	vi, vii
in account with insect pest appropriation	Viii
Reticulitermes flavibes	686
Riverdale Products Co., feeds:	573 675
Rhagoletis pomonella	684
Physiciania huoliana	683
Phomohites hisolar	684
Pohin Hood Mills Ltd	06, 509
Rockwille Grain and Coal Co	208
Rodenticides, analyses	73. 574
fertilizers 14, 18, 22, 33, 35, 37, 40, 53, 54, 76,	84, 90
Rogers and Hubbard Co., feeds	95, 564
Royal Milling Co., feeds. Royster, F. S., Guano Co	495
Royster, F. S., Guano Co 14, 18, 20, 22, 31, 33, 35, 55	06 513
Russell-Miller Milling Co. 495, 5 Russia Cement Co. 4	
Russia Cement Co	706
Sacbrood. Saint Albans Grain Co., 479, 496, 497, 509, 511, 513, 515, 516, 5	23, 535
550, 557, 541, 542, 545, 505, 5	00, 001
St. Lawrence Flour Mills Co	95, 507
Schaefer, Charles, & Son, feeds. 4 Schizura concinna. 4	675
Carlastas anadrichinosus	682
Sacia whododendri	684
Saymour Grain & Coal Co	35, 565 679
Shade and forest tree insects	84, 70
Sheep manure	95, 565
Shelton Feed Co	, 58, 78
Slends	843
Slends. Smith, Winchell, feeds. Southwestern Milling Co., Inc. Soil reaction and liming in tobacco production. 495, 5 495, 5	96 506
Southwestern Milling Co., Inc.	773
black root-rot in relation to liming	778

Soil control of and and	PAG
Soil control of soil reaction	
crop conditions in relation toeffect of fertilizers	79
effect of lime on combustion of tobacco	
on composition of	
field experiment	79
field tests	
greenhouse experiments	79
methods for measurement	
previous investigations	
Sphinx drupiferarum	67
Spratt's Patent, feeds	49
Springfield Rendering Co., feeds	
Stoler A. F. Mf. C. fertilizers	15,7
Staley, A. E., Mfg. Co., feeds	496, 51
Stanley, John T. Co., Inc., feeds. Standard Milling Co. of Canada, Ltd.	406, 507, 50
Stickell, D. A., & Sons, Inc., feeds	406 56
Stoff, David, Flour Mills, Inc.	406 51
Stramonium	
Strontium salicylate	84
Struven, Charles M., and Co	496 57
Sill phir dioxide in dried triffe	00
Superphosphate (acid phosphate)	33 3
Swift & Company Fertilizer Works	\dots 15, 7
Synthetic Nitrogen Products Corp	15, 18, 19, 22, 7
Swift & Company Fertilizer Works Synthetic Nitrogen Products Corp Syracuse Milling Co. 479, 497, 51 Talcott, D. L., feeds Tankage	0, 523, 537, 541, 56
Tarcott, D. L., feeds	
Tankage	51, 5
Tarsonemus latuspallidus	765, 76
Tea	684, 765, 76
Tenebroides mauritanica	60
Tennessee Copper and Chemical Corp., fertilizer	
1 etraleurodes mori	
maculata	
Tetralopha robustella	68
Tetranychus bimaculatus	76.
telarius	76
telarius	5, 53, 55, 58, 59, 78
	84 9
Thomaston Supply Co., feeds	497, 537, 56
Thompson Milling Co	0.00000000000000000000000000000000000
Tibicina septemdecim	682 74
Tibicina septemdecim. Tioga-Empire Feed Mills, Inc., 497, 498, 507, 523, 53 Tmetocera ocellana	7 538 543 567 566
Tmetocera ocellana	67
analyses	844, 84
appropriation	
"denicotinized"	844, 84
appropriation. "denicotinized". soil reaction and liming in production.	
station report	14!
topping and suckering experiments on Havana se	ed 00
Topping and suckering of Havana seed tobacco	99
Toumeyella liriodendri	685
Transper cellunity	498
Tremex columba	600
	688

Connecticut Agricultural Experiment Station New Haven, Connecticut

The Control of the Asiatic Beetle in Lawns

R. B. FRIEND

The Asiatic beetle (Anomala orientalis Waterhouse) in its grub stages is a serious enemy of lawns. In the Westville section of New Haven and

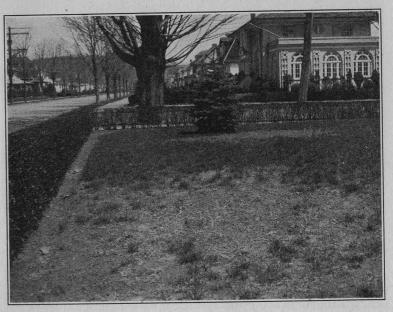


FIGURE 1. Lawn on McKinley Avenue, showing injury by grubs.

in a small region of West Haven upwards of 200 lawns have been injured to such an extent that the grass has been killed over all or part of the property. In certain instances, the owners have remade their lawns two or three times at great expense. The larvae of this insect are probably

present in greater or less numbers in all lawns in the infested territory, whether the grass is killed or not, and the best means of control as yet known entail the use of the right insecticides applied in the proper manner. It is the purpose of this bulletin to give brief information regarding the pest and directions for treating the lawns to protect them against future attack by the larvae according to the best methods devised thus far.

LIFE HISTORY AND HABITS

The eggs are laid in the soil, from three to nine inches below the surface, during July and August (Fig. 2). They hatch in 24 to 28 days, and the

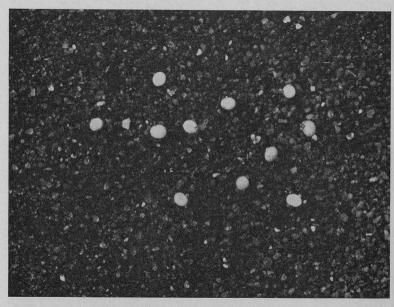


FIGURE 2. Eggs. Enlarged four times.

young larvae come close to the surface of the ground to feed on the dead organic matter and living grass roots found there. These larvae are about one-sixth of an inch in length when first hatched, but they grow to a length of about one inch before pupating. In appearance they are very similar to the larvae of the May beetle, called white grubs, but are smaller (Fig. 3). If at all numerous, they eat the grass roots to such an extent that the plants are killed and a large part or all of the lawn may turn brown in September (Fig. 1). An examination of the lawn at this time will reveal the partly grown larvae in the top inch of soil. About the middle of October the larvae begin to go more deeply into the soil to hibernate, and by the middle of December there are none to be found near the surface. Hibernation usually occurs at a depth of between ten

and fifteen inches. About the last of April, the larvae come up close to the surface and resume feeding, but at this time of the year the grass is usually in a vigorously growing condition and the feeding of the larvae is not so extensive as during the previous fall; hence, the spring injury to the lawns is not so great. During the first part of June the larvae go down into the soil to a depth of three to nine inches and remain quiescent about a week. During this time they do not move about in the soil, but remain in one place and by moving the abdomen back and forth hollow out a cell in which pupation takes place (Fig. 4). The pupal period which follows immediately lasts about two weeks, and adult beetles begin to emerge from the soil the last of June.



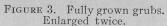




FIGURE 4. Pupa in cell in earth.
Natural size.

Most of the adults are found during the month of July, although they occur during August and a few may be found the first part of September. They feed to a slight extent on the petals of various flowers and are quite common on roses, although the injury they cause is negligible. Much of the adult life is spent in the ground, and the beetles are frequently found occupying burrows about an inch deep. They fly very little and then for short distances only. This may account for the slowness with which the insect is spreading from the original center of infestation. These beetles are about three-eighths of an inch in length and vary in color from pure black to almost entirely straw (Fig. 5). Most of them have black marks on the thorax and wing covers, the ground color being straw, and the marks on the wing covers characteristically U-shaped.

TREATMENT OF LAWNS

In order to prevent injury to lawns when this insect is present, it is necessary to kill the larvae before they reach the destructive stage in August and September. This may be accomplished by the use of arsenate of lead or carbon disulfide emulsion without injury to the grass, if the proper precautions are taken. The arsenate of lead gives better results and is more safely handled, for the carbon disulfide emulsion is not only very explosive, but will injure the grass if carelessly applied.

Lawns may be treated with arsenate of lead any time except during the cold winter months when there is frost in the ground, but if the treatment is delayed until after the first of August the grass may be severely

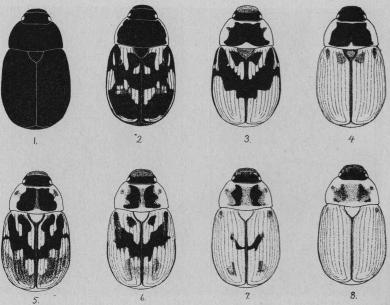


FIGURE 5. Color variation of the adults. Enlarged about three times.

injured by the insects. It is essential, therefore, that all treatment be completed by this time if arsenate of lead is used.

PROTECTION OF LAWNS NOT SEVERELY INJURED

If the grass in the lawn is in good condition and it is desired to protect it against future injury, arsenate of lead should be applied before August 1. Mix three pounds of arsenate in about twelve gallons of water for each 100 square feet. Put the necessary amount of water in a barrel or other suitable container and stir in the required amount of lead arsenate. As this material settles fairly rapidly in water, the mixture should be thoroughly stirred frequently to keep it uniform. Sprinkle this over the lawn slowly and evenly so that it soaks in without running off or collecting in pools. Before the poison dries on the surface of the ground or the grass, the area should

be sprinkled in the same manner with about the same amount of water in order to wash the poison into the soil. This treatment may be conveniently made with a garden watering can.

If the lawn slopes so that water runs off or collects in pools, the arsenate of lead should be mixed with a small amount of very slightly moist (not wet) earth and this should be spread evenly over the surface. Use the same amount of arsenate for the same area as above.

RE-MAKING OF LAWNS IN WHICH GRASS IS KILLED

If the grass has been killed by the larvae, it is advisable to turn over the soil in order to get rid of weeds and ensure a good turf. After this is done, smooth the ground with a rake and apply two pounds of lead arsenate evenly over each 100 square feet. In order to get an even distribution of poison, the arsenate should be applied by sifting through a 14-mesh screen, but if a wind is blowing, it is best to mix it with a small amount of very slightly moist earth and spread this mixture over the ground. After the poison is spread, it should be worked into the soil to the depth of one inch with an iron rake. The ground may then be smoothed and seeded.

Where the infestation of larvae is not too heavy, a good control might be effected by raking over the infested area in the spring, seeding it and then, after the grass is growing well, applying lead arsenate in water in the manner described above. There is, however, the likelihood that the larvae will kill off the grass before it gets a good start and that weeds will crowd out the lawn grasses.

The lawn should be treated with lead arsenate in water as above described for a distance of about five or six feet around the area in which the grass was killed. One treatment with arsenate of lead should last several years, according to the experience of Federal entomologists in controlling the Japanese beetle which has similar habits, although experiments with the Asiatic beetle have covered one season only. If the lawn slopes very steeply, so that it must be re-turfed with sod, the sod should be treated with a suspension of lead arsenate in water in the manner described above a few weeks before being used. Cut the poisoned sod into sections and lay in the usual manner.

USE OF TOP-DRESSINGS

When it is desirable to top-dress the lawn with loam, enough arsenate of lead should be mixed with the top-dressing to be equivalent to two pounds for each inch of loam covering an area of one hundred square feet. If one-fifth of one inch of top-dressing is applied, the appearance of the lawn will not be marred, and this may be repeated as often as the growth of the grass will permit, about once every seven or eight weeks, until a total of five applications has been made. The result will be about one inch of poisoned soil on the surface of the lawn at the end of the treatments. Each of these five applications will require six ounces of lead arsenate in 2,880 cubic inches (= 12.5 gallons or 1.34 bushels) of loam. If the entire inch of loam is to be placed on the lawn at once, two pounds of lead arse-

nate should be mixed with 8.3 cubic feet of loam for each 100 square feet of lawn surface. This is slightly less than one-third of one cubic yard of loam. The arsenate and loam may be conveniently mixed by placing the latter on a smooth wood or concrete floor in a layer about six inches deep, spreading the arsenate evenly over the top of this layer, and then shoveling the whole over four or five times. The arsenate should be sifted through a fine screen (such as used for windows) before using.

USE OF CARBON DISULFIDE

Carbon disulfide emulsion may be obtained in the concentrated form which contains 70 per cent carbon disulfide. There has lately been placed on the market a miscible carbon disulfide of the same strength but with superior keeping qualities, not being injured by cold weather or long storage, to both of which the emulsion is very susceptible. Both of these insecticides are very explosive and must be kept away from hot pipes, fires and so forth. Both must be diluted 200 times with water and applied to the infested area at the rate of three pints of diluted material per square foot of surface. This should kill all larvae which are within two or three inches of the surface when the treatment is made. The soil should not be extremely dry nor yet full of water. The application should be made the latter part of August. The material must be applied to the lawn so slowly that it does not run off and does not collect in pools. The former condition will result in a poor kill of larvae and the latter condition will kill the grass. Since the carbon disulfide tends to evaporate rapidly from the diluted material, the nozzle of the sprinkling device must be held close to the ground. A common garden watering can may be used for small areas. For large areas special apparatus is desirable. The use of this material requires some experience if good results are to be attained, and its effect is but temporary, since no poisonous material remains in the ground after a few days.

FERTILIZING AND SEEDING

Fertilizer should be applied to the lawn after the arsenate has been on at least a week and after the grass is growing well if the area has been reseeded. There is some danger of injury to the grass if the fertilizer and arsenate are applied at the same time. Any good lawn fertilizer not too high in phosphoric acid is suitable. Ammonium sulfate is also safe. This, as well as a complete fertilizer, has been used in our experiments.

The grass mixtures commonly sold in New Haven for seeding lawns give a good turf on arsenated soils if the soil is fertile. It is best to seed rather heavily. The germination of the seeds may be retarded somewhat by the insecticide, but no other effect has been noted.

IDENTIFICATION OF LARVAE

There are many species of white grubs which very closely resemble the larvae of the Asiatic beetle in appearance. If any doubt exists as to the identy of beetle larvae found in a lawn, specimens may be sent to the Connecticut Agricultural Experiment Station for determination.

Connecticut Agricultural Experiment Station

Nem Haven, Connecticut

The European Corn Borer A Menace to Corn, Vegetable and Garden Plants

W. E. BRITTON

INJURY TO CROPS

The European corn borer, Pyrausta nubilalis Hubn., has a dirty white larva an inch or less in length marked with scattered black dots. It



Fig. 6. A sweet-corn patch in eastern Massachusetts heavily infested with borers. The stalks are so weakened by the feeding of the borers that they soon break over. (After Mass. Dept. of Agriculture.)

tunnels all through the stalks and ears. It first injures corn, especially sweet corn, and may cause such economic damage that the crop cannot be grown with profit. When heavily infested, the stalks soon break down as shown in Fig. 6. After the corn has become thoroughly infested, the borers may enter celery, rhubarb, bean, beet, dahlia, gladiolus, chrysanthemum, aster, zinnia, and other cultivated herbaceous plants and many of the larger weeds. In New England there is danger that the borers of the two-brooded area may be transported in the stalks of vegetables and certain kinds of cut flowers, and therefore these materials are included in the quarantine regulations.

PRESENT CONDITIONS IN CONNECTICUT

During the season of 1928, Federal scouts found the European corn borer present in 34 towns in Connecticut—all in the eastern and south-eastern portion except Suffield which is in the northern central portion of the State. Quarantined areas are shown in Fig. 7.

Though the percentage of infested stalks was not large in any corn field in 1928, the intensity of the infestation is greatest in Stonington and will increase throughout the State. If not held in check by the destruction of corn stalks and stubble, it will soon cause serious losses. Over one-half of Rhode Island in 1928, the corn borer caused a commercial loss in the corn crop and the same will soon be true in Eastern Connecticut unless the pest can be held in check.

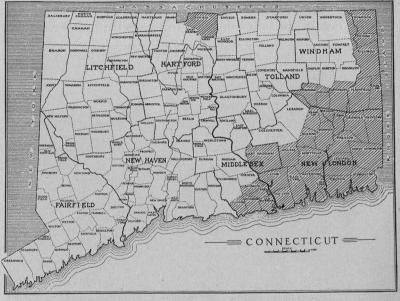


Fig. 7. Map of Connecticut showing areas now under State and Federal quarantine on account of the European corn borer.

DISCOVERY AND SPREAD IN THE UNITED STATES

The European corn borer was first discovered in the United States in Eastern Massachusetts, near Boston, in 1917, and this infestation has now spread into Maine, New Hampshire, Rhode Island and Connecticut. Two broods or generations occur each year in this area.

In 1919, there was discovered an infestation just west of Albany, N. Y., one south of Buffalo, N. Y., and a third at Girard, Pa., near Lake Erie.

In 1920, two infestations were found in Ontario, Can., one just across the Niagara River from Western New York, and the other farther westward along the shore of Lake Erie with its center near St. Thomas. These infestations in New York and westward have only one generation each year.

In 1921, the insect was found in Ohio along the south shore of Lake Erie. In 1923, small infestations were found in Connecticut and Brooklyn, N. Y.

By 1928, the one-generation area included nearly all of Ohio, the entire state of Michigan, a portion of Indiana, northern and western Pennsylvania, New York, a portion of Vermont, western Massachusetts, a few towns in New Jersey, Staten Island, the western end of Long Island, and the town of Suffield, Conn., which is an apparent spread of this infestation eastward through western Massachusetts. In Eastern Connecticut there are two generations annually.

METHODS OF CLEAN-UP AND CONTROL

For the past five years, the stalks, stubble and weeds have been burned in and around each separate infestation in Connecticut at the expense of the State and Federal governments and in many cases no borers were found the next season. With the large number of towns infested, appropriations are inadequate to continue this system, and the grower must control the pest in his cultural operations. As the borers pass the winter in corn stalks, stubble and weeds, the following methods of handling the infested crop will greatly reduce the injury next season:

- 1. Corn stalks should be cut just as early as possible after maturity and put in the silo or fed out to cattle. When fed out, uneaten portions of stalks should be destroyed. If allowed to stand, such stalks furnish a favorable shelter for borers.
- 2. If cut close to the surface of the ground, very few borers will be contained in the stubble. If cut 6-12 inches high, the stubble may furnish enough borers to ruin the crop the following year, and such stubble should be plowed under cleanly, or pulled and burned.
- 3. Corn stalks which are not cut and used for silage or fodder should be burned in the field or cleanly plowed under. The larger weeds in the fields and around its margins should also be burned.
- 4. By clean plowing in the fall, a large percentage of the second-brood borers are killed during the winter. Fall plowing is somewhat less effective against the single-brooded borers, but against both one-generation and two-generation borers, early spring plowing (during April) is beneficial, especially if all debris is covered deeply. There are now plows and attachments devised to facilitate the clean plowing under of standing corn stalks, and your county agent can advise you regarding them.
- 5. Small patches of sweet corn in back yard gardens can perhaps be pulled and burned to best advantage. If not cleaned up, such places will produce enough borers to infest the entire countryside.

QUARANTINE

After due notice and a public hearing at the Station February 25, the following quarantine order was issued, effective March 25, 1929. This is in accord with Federal quarantine No. 43, sixth revision, effective March 1, 1929.

BULLETIN OF IMMEDIATE INFORMATION No. 64

STATE OF CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

Ouarantine Order No. 21

CONCERNING THE EUROPEAN CORN BORER

The fact has been determined that the European corn borer, Pyrausta nubilalis Hubn., has spread to such an extent as to make it necessary to extend the area restricted by State Quarantine Order No. 13, effective June 1, 1927, and likewise to bring it into conformity with Federal Quar-

antine No. 43, sixth revision, effective March 1, 1929.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station, do hereby proclaim the following towns (including those affected by Quarantine Order No. 13) to be under quarantine and subject to the restrictions and regulations made a part of Federal Quarantine No. 43, as revised, and effective March 1, 1929:

REGULATED AREAS

Two-Generation area: Clinton, East Haddam, Essex, Old Saybrook, Saybrook, and Westbrook in Middlesex County; Bozrah, East Lyme, Franklin, Griswold, Groton, Ledyard, Lisbon, Lyme, Montville, New London, North Stonington, Norwich, Old Lyme, Preston, Salem, Sprague, Stonington, Voluntown and Waterford in New London County; Canterbury, Killingly, Plainfield, Putnam, Scotland, Sterling, Thompson and Windham, in Windham County.

One-Generation area: Suffield, in Hartford County.

MOVEMENT OF RESTRICTED PLANTS

Until further notice, unless accompanied by a certificate or permit issued by an authorized inspector of the State or Federal Plant Quarantine and Control Administration, the following plants and plant materials cannot be allowed movement from the restricted areas to points outside, or from the two-generation area into the one-generation area or from the or from the two-generation area into the one-generation area or from the one-generation area into the two-generation area: corn, broom corn, sorghum and sudan grass including all parts of leaves and stalks throughout the year; from the two-generation area all cut flowers and entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, gladiolus and dahlia (except gladiolus and dahlia bulbs without stems) and for the period between June 1 and December 31, all celery, green beans in the pod, beats with toos rhuberh out and rye straw as such or when used as beets with tops, rhubarb, oat and rye straw as such or when used as

No restrictions are placed on the movement of shelled corn in packages weighing two pounds or less; larger quantities must be certified.

This order shall take effect March 15, 1929.

W. L. SLATE.

Director. Connecticut Agricultural Experiment Station

Approved:

JOHN H. TRUMBULL, Governor.

For additional information, address.

- W. E. BRITTON, State Entomologist, Agricultural Experiment Station, New Haven, Conn. In charge of State regulatory work.
- H. N. BARTLEY, 1188 Main St., Bridgeport, Conn. In charge of Federal work in Connecticut.

Connecticut Agricultural Experiment Station New Haven, Connecticut

The Japanese Beetle Quarantine

W. E. BRITTON

The Japanese beetle, Popillia japonica Newman, a serious pest of native and cultivated trees and shrubs, is now present at several widely separated

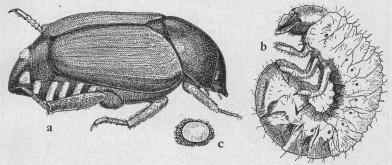


Fig. 8. The Japanese beetle. a, adult beetle; b, grub or larva; c, egg, all enlarged about five times.

points in Connecticut. The egg, grub and beetle are shown in Fig. 8. The eggs are white and are laid in the soil. The grubs are white and feed upon grass roots in the soil. The beetles are bright, shining green, with copper-colored wing-covers. There are two white patches on the tip of the abdomen beyond the wing covers, and five on each side of the abdomen, all composed of white hairs. The beetle is about half an inch in length and flies about actively in the warm sunshine. It feeds upon the tender foliage of fruit, shade and woodland trees, grape vines, roses and many shrubs and plants. It is present from late June until late September, but is most abundant about the middle of July.

DISCOVERY AND SPREAD IN THE UNITED STATES

Originally from Japan, this insect was discovered to be present at Riverton, N. J. in 1916. Since then it has spread in all directions and at present infests the state of New Jersey, the eastern third of Pennsylvania, Delaware, a small portion of Maryland, Alexandria, Virginia, District of Columbia, Long Island, and Westchester County, N. Y., and a portion of Connecticut as shown in Fig. 9.

OCCURRENCE AND SPREAD IN CONNECTICUT

The Japanese beetle was first found in Connecticut at Stamford by Federal scouts, late in the summer of 1926. Only eighteen adults were taken, mostly in two rear yards on the south side of Broad Street nearly opposite the end of Franklin Street. In July, 1927, beetles were found in Bridgeport at eight different centers, well distributed over the city. They were much the most abundant, however, just south of Washington Avenue, where about 186 were taken. One was found in Darien and one in New Canaan. In 1928, Federal scouts found small infestations in New Haven, Hartford and New London, and a larger one at Springfield, Mass.

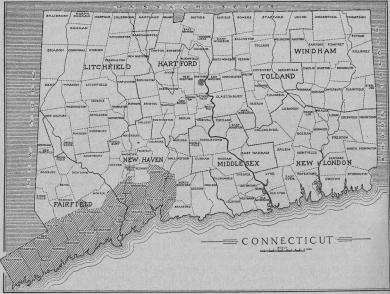


Fig. 9. Map of Connecticut. Shaded areas indicate territory quarantined on account of Japanese beetle.

METHODS OF CONTROL

The Japanese beetle is a difficult pest to control, though foliage and fruit may be protected by spraying heavily with coated lead arsenate. Small trees and shrubs may be protected by covering them with netting. The beetles may be attracted by certain chemical odors and then killed by a contact spray which has been devised containing oleoresin or pyrethrum and a sodium oleate soap. The grubs in lawns may be killed by applying an emulsion of carbon disulphide, or by treating the surface layer with lead arsenate, at the rate of three pounds per 100 square feet.

QUARANTINES

On account of the distribution of the beetle, Federal quarantine No. 48 (Fifth revision) extends the Bridgeport area to include New Haven and surrounding towns. The State quarantine coincides with the Federal quarantine (Fig. 9), but places additional restrictions on certain areas in Hartford and New London as shown in Figs. 10 and 11. The Quarantine Order follows:

STATE OF CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

Quarantine Order No. 20

CONCERNING THE JAPANESE BEETLE

The fact has been determined that the Japanese beetle, *Popillia ja-ponica* Newman, has been found in the cities of New Haven, New London and Hartford, and to prevent the further spread of this pest it is necessary

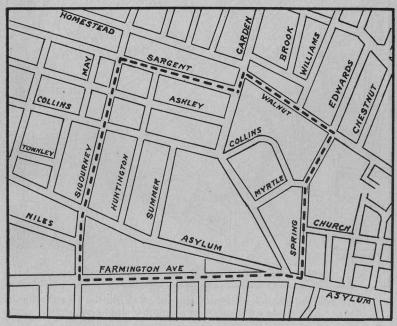


Fig. 10. Map of Section of Hartford. The dotted line surrounds area under State quarantine on account of Japanese beetle.

to extend the quarantine restrictions over certain additional areas, regarding which a public hearing was held in New Haven, February 25, 1929. Federal quarantine No. 48 has also been revised, effective February 15, 1929, to include eleven additional towns in New Haven County.

Now, therefore, I, William L. Slate, Director of the Connecticut Agricultural Experiment Station, under authority conferred by Chapter 31, Public Acts of 1927, do hereby proclaim the regulated area fixed by State Quarantine Order No. 16, and by the rules and regulations supplemental to Federal Quarantine No. 48 (Fifth Revision), effective on and after April 1, 1927, as amended effective on and after November 1, 1927, namely, the towns of Bridgeport, Darien, Easton, Fairfield, Greenwich, New Canaan, Norwalk, Shelton, Stamford, Stratford, Trumbull, Weston, Westport, and Wilton, in Fairfield County, to be extended to include the eleven towns of Ansonia, Derby, East Haven, Hamden, Milford, New Haven, North Haven, Orange, Seymour, West Haven and Woodbridge, in New Haven County.

BULLETIN OF IMMEDIATE INFORMATION No. 65

Also, that that portion of the City of Hartford bounded by Farmington Avenue, Spring Street, Walnut Street, Sargent Street, and Sigourney Street, is hereby quarantined.

Also, that that portion of the City of New London bounded by Huntington Street, Bristol Street, Williams Street, Manwaring Street, Hempstead Street, Franklin Street, Cottage Street, and Broad Street, is hereby

quarantined.

The rules and regulations supplemental to Federal Quarantine No. 48 (Sixth Revision), effective on and after February 15, 1929, or any subsequent amendments thereto, restricting the interstate movement of quarantined articles from the regulated areas, are hereby declared to be in full force and effect with respect to the intrastate movement of quarantined

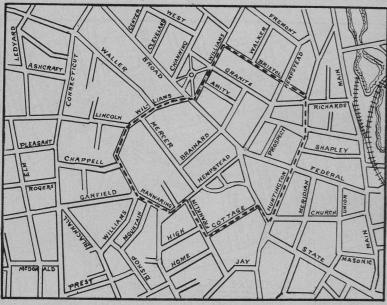


Fig. 11. Map of Section of New London. The dotted line surrounds area under State quarantine on account of Japanese beetle.

articles from the herein designated regulated areas of Connecticut to unregulated portions thereof.

This order shall be effective on and after April 1, 1929.

W. L. SLATE,
Director, Connecticut Agricultural
Experiment Station

Approved:

JOHN H. TRUMBELL, Governor.

For further information regarding the Japanese beetle, apply to:

W. E. Britton, State Entomologist, Agricultural Experiment Station, New Haven, Conn.

or J. P. Johnson, Hurley Building, Shelton, Conn.

For inspections and certificates, shippers should apply to:

J. P. Johnson, Hurley Building, Shelton, Conn. (Telephone, Derby 2974).

Connecticut Agricultural Experiment Station New Haven, Connecticut

The Asiatic Beetle Quarantine

W. E. BRITTON

The Asiatic beetle, Anomala orientali Waterh., is a serious pest of lawns, as the grubs devour the grass roots. This beetle is probably a native of

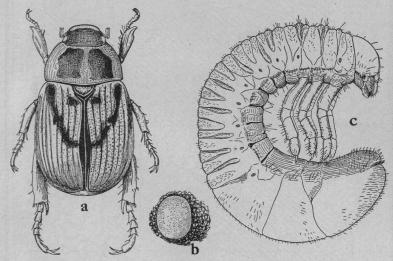


Fig. 12. The Asiatic beetle. a, adult beetle; b, egg; c, grub or larva.

All enlarged about five times.

eastern Asia, and was first taken in the United States at New Haven, Conn., in July, 1920. It now occurs at New Haven and West Haven, Conn., on Long Island, and at several points in Westchester County, N. Y., and at several points in New Jersey. This beetle has one generation each year and is shown in Fig. 12. The beetles are not very active feeders or fliers, consequently the chief means of spread is by transporting the grubs in soil or turf, in soil about the roots of plants, garden litter, and the beetles in cut flowers. The control of this insect in lawns is treated in Bulletin of Immediate Information No. 62, of this Station, March 1, 1929.

QUARANTINES

Federal quarantine, No. 66, places restrictions on the movement of plants and certain materials from New Haven and West Haven. The

State quarantine conforms with the Federal regulations, but places additional restrictions on certain areas in these towns as shown in Figs. 13, 14 and 15. The Quarantine Order follows:

STATE OF CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

Quarantine Order No. 22

CONCERNING THE ASIATIC BEETLE

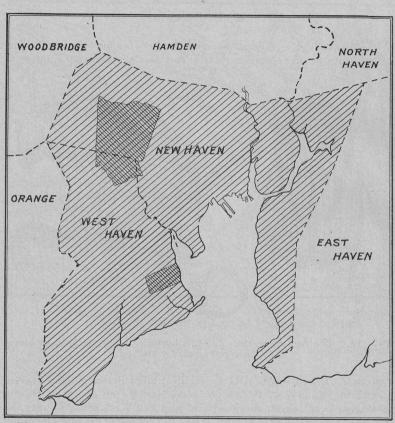


Fig. 13. Map of New Haven and West Haven now under quarantine on account of Asiatic beetle. Darker shaded sections show infested areas, upon which additional restrictions have been placed by State quarantine.

The fact has been determined that the Asiatic beetle, Anomala orientalis Waterhouse, now occurs in the towns of New Haven and West Haven and it seems advisable to revise the regulations and the restricted areas. A public hearing regarding the matter was held in New Haven, February 25, 1929.

Now, therefore, I, William L. Slate, Director of the Connecticut Agricultural Experiment Station, under authority conferred by Chapter 31, Public Acts of 1927, do hereby proclaim the towns of New Haven and West Haven subject to the restrictive regulations of this quarantine.

Also, the movement of all quarantined articles designated in the regulations supplemental hereto are further restricted from any point within the hereinafter designated control areas to other portions of the towns of New Haven and West Haven or to points outside thereof.

The following control areas are hereby designated:

Westville Area: Bounded by Whalley Avenue, Blake Street, Ruby Street, Moreland Road, Ellsworth Avenue, Derby Avenue, Boulevard, Oak Street, Forest Road, Florence Avenue from a point about 400 feet

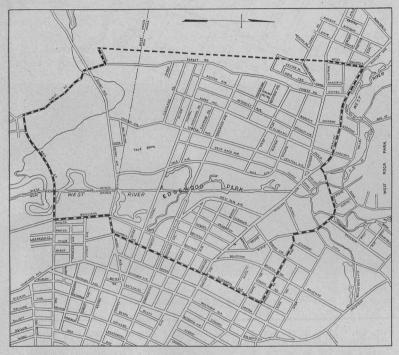


Fig. 14. Map of the Westville section of New Haven. The area enclosed by dotted line is infested and under special State quarantine restrictions.

west of Forest Road, in a straight line northward to West Prospect Street to Whalley Avenue, and all territory within these boundaries, being partly in New Haven and partly in West Haven.

West Haven Area: -Bounded by Center Street, New Haven Harbor,

Brown Street, and Campbell Avenue.

Until further notice the movement of certain articles and materials as designated below will not be permitted except where inspection or treatment is practicable and permits are issued by duly authorized agents of the State or the United States Department of Agriculture.

The articles and materials restricted during the entire year are as fol-

lows:

1. Sand, soil, earth, peat, compost and manure;

2. Nursery, ornamental and greenhouse stock, and all other plants; 3. Turf or sod trimmings, lawn or shrub clippings, ground litter, and weeds.

BULLETIN OF IMMEDIATE APRIL 15, 1929 INFORMATION No. 66

The articles and materials restricted only between June 15 and October 15, inclusive, are as follows:

- 1. Cut flowers
- 2. Hay and straw (freshly cut)

The rules and regulations supplemental to Federal Quarantine No. 66. effective on and after March 15, 1922, or any subsequent amendments thereto, restricting the interstate movement of quarantined articles from the regulated areas, are hereby declared to be in full force and effect with

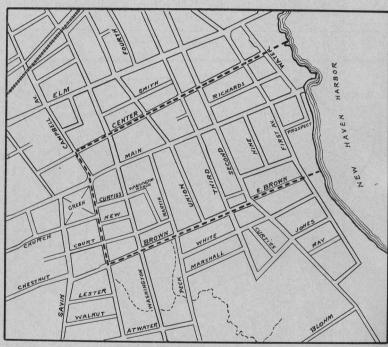


Fig. 15. Map of section of West Haven. The area enclosed by dotted line is infested and under special State quarantine restrictions.

respect to the intrastate movement of guarantined articles from the herein designated areas of Connecticut to portions thereof.

This order shall be effective on and after April 1, 1929.

W. L. SLATE Director, Connecticut Agricultural Experiment Station.

Approved:

JOHN H. TRUMBULL, Governor.

For additional information and for shipment permits wholly within the towns of New Haven and West Haven, apply to

W. E. BRITTON, State Entomologist, Agricultural Experiment Station, New Haven, Conn.

For shipment permits to points outside of New Haven and West Haven, apply to

J. P. Johnson, Hurley Building, Shelton, Conn. (Telephone Derby

Connecticut Agricultural Experiment Station

Nem Hauen, Connecticut

The Satin Moth Quarantine

W. E. BRITTON

The satin moth, Stilpnotia salicis Linn, was first discovered in the United States in June, 1920, a few miles north of Boston, Mass., whence

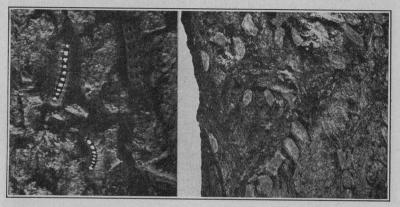


Fig. 16. The satin moth. At left, caterpillars, and at right, winter cases (After Burgess and Crossman, Dept. Bull. 1469, U. S. Dept. of Agriculture).

this European pest of willow and poplar has spread until it now occupies the eastern three-fourths of Massachusetts, the whole of Rhode Island, the eastern half of Connecticut, southern New Hampshire, southwestern Maine, and a few towns in southeastern Vermont.

In 1922, this insect was found at Bellingham, Washington, on the Pacific coast, and it now occupies nearly all of the western half of that State.

OCCURRENCE IN CONNECTICUT

In 1926, Federal scouts found the satin moth in two towns in Connecticut, Thompson and Stonington, which were placed under Federal quarantine. In 1928, State gipsy moth scouts found the insect in various towns scattered throughout the eastern portion of the State and in Suffield and Hartford, west of the Connecticut River.

INJURY AND REMEDY

The caterpillars feed upon the foliage of willow and poplar trees, often defoliating them. The remedy is to spray with lead arsenate in May, as soon as the trees are in full foliage.

CHARACTERISTICS OF THE INSECT

Both male and female moths are satiny white, without markings, and with a wing-expanse of nearly two inches. The eggs are laid in July on the bark in oval silvery-white patches about half an inch wide and three-fourths of an inch long, each containing an average of about 300 eggs.

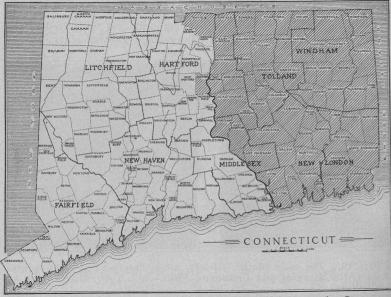


Fig. 17. Map of Connecticut. Shaded portion is now under State and Federal quarantine on account of the satin moth.

The caterpillars pass the winter when partially grown, in silk cases in cracks of the bark. In spring, they emerge and feed upon the unfolding leaves, becoming fully grown in June. They are then about one and one-half inches in length, reddish-brown in color, with two narrow broken white lines lengthwise the back with a central row of white spots somewhat dumbbell-shaped, as shown in Fig. 16. They make their cocoons in folded leaves, crevices of the bark, in rubbish and on fences and buildings. The moths come forth about ten days later.

OUARANTINE

Since November 15, 1926, Federal Quarantine No. 53, has covered the towns of Thompson and Stonington, but no State quarantine has hereto-

fore been established on account of the satin moth. The present quarantined area is shown in Fig 17, and the quarantine amounts to an absolute embargo. The movement of willow and poplar trees is not allowed as the difficulty of detecting the winter cases is so great that inspection is not attempted. The quarantine order follows:

STATE OF CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

Quarantine Order No. 19

CONCERNING THE SATIN MOTH

The fact has been determined that the Satin moth, Stilpnotia salicis Linn., a pest of poplar and willow trees is now present in various towns in Connecticut, and that Federal Quarantine No. 53 has been revised, effective, January 1, 1929, to include all towns in Connecticut east of the Connecticut River, and the towns of Hartford and Suffield, west of the Connecticut River. After due notice a public hearing was held at the Station in New Haven, February 25, 1929.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station under authority conferred by Chapter 31, Public Acts of 1927, do hereby proclaim that a State quarantine is placed on all towns east of the Connecticut River, and the towns of Hartford and Suffield west of the Connecticut River, and that it shall be unlawful to move any poplar or willow trees or parts thereof capable of propagation, from the restricted area designated above to any other portion of the State.

This order shall take effect March 15, 1929.

W. L. SLATE,

Director, Connecticut Agricultural

Experiment Station.

Approved:

JOHN H. TRUMBULL. Governor.

Connecticut Agricultural Experiment Station

Nem Haven, Connecticut

Control of Ant Invasions*

By W. E. BRITTON, Entomologist.

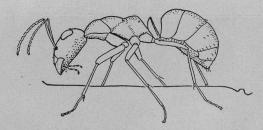


Fig. 18. Side view of a worker ant, greatly enlarged.

During every summer season a large number of inquiries are received at the Station regarding ants and how to exterminate them. Each year ant colonies are reported from some localities as making ant hills on the lawn, injuring plants, entering houses, or perhaps tunneling in trees or timbers.

Ants belong to the Order Hymenoptera and are social insects living in colonies containing queens, males and workers. In general ants are considered as beneficial rather than injurious as they work over the soil much like angle worms, and they devour particles of animal and vegetable matter, thus destroying many dead, and some living, insects. Certain species are distinctly injurious and are mentioned in the following pages.

The object of this bulletin is to give brief information about the habits of ants and to indicate how ants may best be controlled.

NESTING PLACES OF ANTS

Most of our common species of ants nest in the ground where they form ant hills, or reside under stones and pieces of wood. Certain species have large colonies and bring to the surface of the ground particles of sand and gravel, bits of wood and other materials, forming large ant hills. These ants cut off the roots of plants which happen to be where they make their galleries. Certain small species like the Argentine ant now present in our Southern States and the little red house ant or Pharaoh's ant, occasionally found in Connecticut, may nest in houses. The large black ant or carpenter

^{*}Revised edition of Bulletin of Immediate Information No. 17, July, 1922.

ant makes its nest inside the trunks of trees, old logs, stumps, fence posts, and in the structural timbers of buildings and bridges, often honeycombing and weakening the wood. The so-called white ants, or termites, have nesting habits similar to those of the large black ants, and often do considerable damage to structural timbers.

CONNECTICUT EXPERIMENT STATION

ANTS ON PEONIES

Ants nearly always crawl about on peonies, though I have never known them to cause any injury. Peony buds are said to have nectar glands which attract ants, and this seems to be the most reasonable explanation of their presence on the plants, for as a rule peonies are not infested with aphids. Control measures are therefore not necessary, though in some

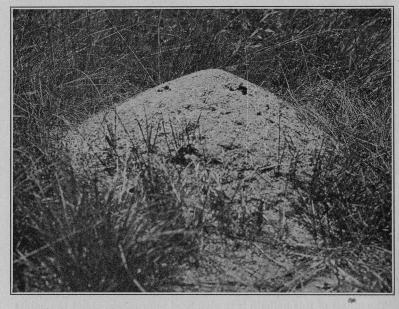


Fig. 19. Characteristic ant hill of Formica exsectoides Forel.

cases it may be possible to keep them away from the plants by mulching the latter with air-slaked lime, fine sifted coal ashes, or by wrapping the stems with sticky fly paper.

ANTS AND PINE TREES

In young white pine plantations, it has been noticed that the trees always die near the large ant hills, as shown in Fig. 19, and recent studies by Mr. H. B. Pierson² show that the ants kill the trees which are in danger

of shading their nests. This is true not only of the pines planted, but also of native seedlings and sprouts of hardwood trees which spring up near the nests. Consequently in young forest plantations, the ants in such nests should be killed by fumigating with carbon disulphide, or "cyanogas".

ANTS AND APHIDS ON TREES AND PLANTS

Except certain species of ants which nest in trees, those crawling about on the leaves and up and down the stems and branches are in search of food. An important article of ant food is the substance called honey dew exuded by certain insects, particularly aphids, psyllids, aleyrodids, tree hoppers and scale insects. Aphids are called the "milch cows" of the ants and the latter are known to take care of certain species of aphids to the extent of carrying them in fall to the roots and in spring back to the foliage. The ants are present, therefore, not to injure the plants but to obtain foods from the aphids or scale insects which may be sucking sap from the plants. On account of the distinctly injurious nature of these insects which are fostered by the ants, the latter are considered enemies of mankind.

In such cases, probably the best treatment is to spray the trees or plants thoroughly with a contact insecticide like nicotine solution and soap to kill the insects.

ANTS IN GARDENS AND LAWNS

Ants often make small ant hills on lawns, especially in sandy soil, by bringing sand and fine gravel from their burrows to the surface of the ground. These are unsightly and interfere with the work of cutting the grass, especially with the edge on the knives of the lawn mower. They are also a nuisance by bringing particles of sand to the surface in cracks of walks and drives.

Where ants emerge through small cracks, carbon disulphide may be injected through the nose of an oil can and the hole stopped with soil. For nests in lawns, a hole should be made fifteen to eighteen inches deep with a crowbar, iron rod or stake, and the carbon disulphide poured into the hole. A half teacupful will be enough for the larger nests and the smaller ones may be given two large spoonfuls. As some of the ants will be out of the nest at the time of treatment, it may be necessary to repeat as soon as the ant colony resumes activity. The fumes of this ill-smelling liquid are volatile and will permeate the galleries and kill the ants in them. As carbon disulphide is inflammable, it should not be used near any form of fire, particularly in or around buildings or wooden structures. It comes in pound bottles or cans and may be purchased from druggists and dealers in insecticides. "Cyanogas" may be used for the same purpose, but it usually kills the grass around the hole, and hence is not so desirable for use in lawns.

ANTS IN HOUSEHOLDS

Most of the ant invasions in dwelling houses come from the colonies established in the garden or soil outside, and the destruction of these colonies will bring relief. The ants are after food and usually visit the

¹ Formica exsectoides Forel.
² Mound Building Ants in Forest Plantations, Journal of Forestry, Vol. 20, page 325, April, 1922.

kitchen and the pantry, where they gather crumbs of bread, cake, meat and particles of sugar to carry away to their young. Usually they enter the house or cellar at a certain place, and all of the individuals travel along this path or runway. Many methods of getting rid of ants in houses have been recommended. Most of them fall into the classes of repellents, traps and poisons.

REPELLENTS: Borax, naphthalene, paradichlorobenzene, camphor, oil of cedar, tobacco, sulphur, powdered cloves, mustard and insect powder. It is said that ants can be poisoned by feeding them on borax and sugar. Extracts of insect powder are also used to kill ants in some of the proprietary liquid insecticides on the market, such as "Flit", "Verm-o-Spray", etc. However, most of the substances mentioned above are repellents, and may be scattered along the runways and on the shelves, floors, and points of entrance will often drive away the ants within a few hours. A free use of naphthalene flakes in such places will usually drive away most species.

TRAPS: Ants may be trapped by plates greased with lard: the ants will congregate there in great numbers, and may be killed with hot water. Ants are also attracted by sugar and bits of ham. A favorite trap consists of a coarse sponge saturated with sugar and water; after permitting the ants to crawl into it, they may be killed by immersing the sponge in hot water.

Poisoned Bait: Sometimes there are cases where the ants nest in houses, as do the Argentine ant¹ which is now present in the Gulf States and the little red house ant or Pharoah's ant² which occurs in Connecticut when the foregoing described methods of control are not effective, and it may be necessary to use a poisoned bait to exterminate the colonies. The object of the bait is not only to kill the ants which collect and carry the sirup back to the nests, but also the young and the queens in the nest which feed upon it.

Tarter emetic mixed with about twice its bulk of sugar and enough water to make a thick syrup, placed on a piece of cardboard, is an excellent poison for certain kinds of ants.

The following formula was recommended by the U. S. Bureau of Entomology in Farmers' Bulletin No. 740, and has proved satisfactory against Pharaoh's ant³ in a dwelling house in Hartford:

POISONED BAIT FOR ANTS

Sugar	 	1 pound
Arsenate of Sod		
Water	 	1 quart
Honey	 	1 tablespoonful

Dissolve the sugar in the water, and add the arsenate of soda: boil until both are well dissolved, then add the honey which is said to attract the

ants. When cool, use with bits of sponge in small shallow dishes, or on pieces of cardboard, and place two or three in each room.

The baits have been used successfully against various kinds of ants both in the house and out of doors. The poison should be put in protected places where young children, domestic animals and birds cannot reach it but where the ants will have access to it.

ANTS TUNNELLING IN WOOD

BLACK ANTS

The large black ants commonly known as carpenter ants1 nest in galleries which they eat in old logs, stumps, fence posts, rails, props and trees, and they occasionally eat away the timbers of houses to make their nests. They also gather sweets from kitchen and pantry. They both enter the house from outside, and in some cases nest in the structural timbers which soon may be considerably weakened.

Perhaps the best way to kill this species is to bore holes from the outside into the galleries and by means of a funnel, and rubber tube if necessary. pour in enough carbon disulphide to kill all ants inside the burrows. The hole should then be plugged to prevent the fumes from escaping. These large ants can also be trapped in sweetened sponges and can be fed with the poisoned bait if desired.

WHITE ANTS

There is in Connecticut another wood-eating species called the white ant or termite,2 which is white in its immature stages but brown in the adult stage. These white ants are only remotely related to the true ants and belong to a different order (Isoptera). They are social and nest in wood and swarm at a certain time in early summer. They do not visit the pantry and kitchen in search of food like the true ants, and so far as I know are not attracted by sweets. They often breed in stumps, fence posts. board edges of tar walks, old trees and sometimes in the timbers of houses and bridges. Other species in the tropics do a tremendous amount of damage by destroying buildings and there are records of large structures collapsing because weakened by the feeding of these termites. There are many records in the United States and some in Connecticut of buildings having been injured by termites. In 1909, an old house in South Norwalk,3 and in 1915 a house in Ridgefield,4 had the timbers and finish boards eaten by them. Trees and herbaceous plants in the field and greenhouse are occasionally attacked and injured. In 1914,5 the author received geranium plants from New Rochelle, N. Y., where more than two hundred plants had been ruined by these insects which tunneled out the inside of the stems. In 1916, shot gun cartridges were received at the Station which had been eaten by white ants in a store in Wichita, Kans. In 1921,6 a colony of these

¹ Iridomyrmex humilis Mayr.

² Monomorium pharaonis Linn. ³ Report of the Connecticut Agricultural Experiment Station for 1917, page 314.

Camponolus herculeanus pennsylvanicus De Geer.
 Reculitermes flavipes Kollar.
 Report of the Connecticut Agricultural Experiment Station for 1909, page 373.
 Ibid., 1915, page 187.
 Ibid., 1914, page 196.
 Ibid., 1921, page 199.

insects chewed off the insulation from the telephone wires in the basement of a large office building in New Haven.

There are also records of injury to food stuffs and other stored material, to fruit, nut, shade and forest trees, to field crops, garden vegetables, vineyards, nursery stock, shrubs, flowers and greenhouse plants. Where white ants are tunneling in structural timbers, a free use of carbon disulphide as advised for the carpenter ant, is the best remedy. Probably creosote poured into the galleries afterward may have a tendency to prevent reinfestation. Some of the timbers near the ground may need replacing with cement concrete which is proof against injury.

WINGED ANTS AND WINGLESS ANTS

In most of our species of true ants the workers are wingless, and the males and queens have wings.

The queen breaks off her wings (or the workers do it for her) soon after mating and after the swarming flight is over. It is the workers without wings which invade our houses, run over our trees and plants, make ant hills in the lawn, and tunnel in wood. Sometimes winged ants are seen at swarming time flying in the air or resting or crawling upon objects, but by far the most striking cases occur with our common white ant.¹ Often late in May, brown winged males and females may be seen emerging in large numbers from a fence post, old stump or log, side of an old building or board along the edge of a tar walk. They fly through the air in swarms, mate, and migrate to new localities in this manner. A swarm will alight, the wings are broken off, and a new colony is started. We have all seen these wings upon the ground and supposed that birds or other animals had devoured the ants in a swarm, leaving only the wings, but such is not the case. The wings are broken off at a point near the body, and it is done by the ants themselves.

SUMMARY OF CONTROL MEASURES

Kill ants in their nests by fumigating with carbon disulphide, or with "cyanogas".

Drive them out of houses by scattering naphthalene flakes or some other repellent on shelves and floors, particularly along the runways; trap them with lard, ham, sugar, or in sponges moistened with sweetened water. If these measures are not successful, use one of the poisoned baits described on page xxviii.

On trees and plants destroy the aphids or other insects which attract ants.

¹ Reculitermes flavipes Kollar.