This insect also attacks to a lesser degree the other species of birches.

The bronze birch borer, *Agrilus anxius* Gory, has been responsible for the recent death of cut-leaf and other European white birch trees in all parts of the State. Several in New Haven and Derby have died during the past year. Though the native birches are not immune from the attacks of this insect, they are much less susceptible to injury than the European white birch, which most people persist in planting.

The injury caused by the arbor vitae leaf miner, *Argyresthia thuiella* Pack., described in last year's Report, page 157, was much less in evidence in 1922, though causing apprehension in some localities. The work of this insect was observed around Norwalk, New Canaan, New Haven and Hamden, and specimens were received from New Canaan, and Wakefield, R. I.

The tupelo or sour gum leaf miner or case bearer, *Antispila nyssaefoliella* Clemens, caused conspicuous injury to black gum trees in the town of Orange just west of New Haven. Several trees had nearly every leaf mined and had turned brown on September 20.

Miscellaneous Insects

Ants were unusually troublesome in houses and gardens in 1922, and many complaints and inquiries were received at the Station. To supply information to correspondents, Bulletin of Immediate Information No. 17 was issued. This Bulletin is reproduced on page 361 of this Report.

There were also the usual number of complaints regarding damage by clothes moths, and of cockroach infestations.

The iris weevil, *Monychus vulpeculus* Fabr., was reported as injuring iris blossoms at South Meriden.

The juniper webworm, *Dichomeris marginellus* Fabr., has caused serious injury to low junipers in ornamental plantings in Keney Park, Hartford, Greenwich and New Canaan. Spraying heavily with lead arsenate is the remedy.

The rhododendron borer, *Sesia rhododendri* Beut., has caused serious injury to plantings of rhododendrons, especially *Rhododendron maximum* in New Haven, Fairfield, Greenwich, Hartford and South Manchester.

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The more important of the above-mentioned insects as well as many other species are treated in detail in the following pages of this Report.

INSPECTION OF NURSERIES

The annual inspection of nursery stock as required by law was commenced on July 24, and completed September 30. Mr. M. P. Zappe had charge of this work and was assisted by Messrs. F. D. Luddington and J. Leslie Rogers. Mr. Walden inspected four nurseries and helped in two others. Dr. Garman helped inspect one and Dr. Britton inspected one.

The unusual amount of rainy weather interfered with the work of inspection, as did the dusting and spraying experiments which required that the fruit be scored at time of harvest. There were many days when the entire force was engaged in scoring fruit.

For the most part the nurseries were fairly clean and in good condition. Some are always well cared for and others neglected. Where infestations of serious pests were found the stock had to be destroyed or treated before a certificate was granted. In certain cases a signed agreement to treat at the proper time (such as spraying after the leaves have dropped) was accepted in good faith in lieu of performance, and the certificates issued.

Pests

In 36 nurseries no pests were found. These were mostly small or newly established nurseries, or nurseries specializing in some line of stock not commonly attacked by insects or plant diseases. The chief pests found with the number of nurseries infested by each are as follows:

Insects: Oyster-shell scale, 44; San José scale, 19; scurfy scale, 9; pine leaf scale, 6; Euonymus scale, 5; rose scale, 4; elm scale, 4; tulip tree scale, 2; *Lecanium* on oak, 1; West Indian peach scale, 1; spruce gall aphid, *Chermes abietis,* 21; *Chermes cooleyi,* 5; white pine weevil, 19; woolly apple aphid, 2; green apple aphid, 2; Oriental peach moth, 2; rhododendron lace bug, 2; borers in lilac, 3; borers in peach, sawfly larvae on pine, blister mite on pear, mites on apple, mites on spruce, apple and thorn skeletonizer, poplar leaf beetle, one each.

Plant Diseases: Poplar canker, 31; blister rust on *Ribes,* 9; crown gall, 2; fire blight, 2; apple rust, apple scab and raspberry leaf curl, one each.

In comparison with similar figures obtained last year, the oyster-shell scale again leads in being the most prevalent pest found in nurseries, 44 cases this year instead of 36 cases last year. San José scale was found in 19 nurseries as against 28 last year. The other scale insects were present in about the same proportions as last year, though tulip tree scale was less prevalent. Spruce gall aphid occurred in 21 nurseries instead of 31 last year, but white pine weevil was reported from 19 nurseries instead of

only one last year. Of the plant diseases, poplar canker was the most prevalent, occurring in 31 nurseries instead of 21 last year, and blister rust was found in nine nurseries instead of two last year. In 1921, 25 nurseries were without pests, and this year 36 were found to be uninfested.

Three nurseries have gone out of business since last year, two have changed name and ten new nurseries have started. Three of these were inspected in the spring and certificates issued, in addition to the annual inspection in August and September. These were marked (2) after the names on the list.

Forty-eight separate parcels of nursery stock have been inspected and certificates granted, in addition to the quarantine inspections on account of the gipsy moth.

The nurserymens' list for 1922 contains 101 names, as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1922

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Barnes Bros. Nursery Co.	Yalesville	150	Aug. 25	1279
Barnes Nursery & Orchard Co.	Wallingford	45	Aug. 12	1268
Barton Nursery	Hamden	1	Sept. 12	1298
Beattie, Wm. H.	New Haven	1	Sept. 25	1320
Benbow, A.	Norfolk	1	Sept. 28	1330
Bertolf Bros.	Sound Beach	25	Sept. 30	1334
Brainard Nursery & Seed Co.	Thompsonville	10	Sept. 23	1315
Braley & Co.	Burnside	1	Sept. 2	1294
Bretschneider, A.	Danielson	2	Aug. 11	1265
Bristol Nurseries, Inc.	Bristol	12	Oct. 2	1338
Burr & Co., C. R.	Manchester, Ellington and Durham	500	Aug. 23	1273
Burroughs, Thos. E.	Deep River	3	Aug. 30	1281
Chapman, C. B.	Groton	1	Sept. 1	1285
Chapman, C. E.	No. Stonington	4	Sept. 1	1284
Conine Nursery Co.	Stratford	50	Sept. 30	1333
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Aug. 12	1267
Conn. Agr. Exp. Sta. (W. O. Filley, Forester)	New Haven	1	Sept. 30	1336
Connecticut Nursery Co. (E. M. Chadwick, Prop.)	Colchester	1	Sept. 1	1291
Crofut & Knapp Farm	Norwalk	20	Dec. 1	1358
Cross Highway Nurseries	Westport	6	Nov. 4	1345
Dallas, Inc., Alexander	Waterbury	2	Nov. 4	1346
Dowd, F. C.	Madison	1	Nov. 4	1344
Dunlap, Daniel S.	Cromwell	1	Sept. 26	1322
Edgewood Nursery, Vidal, Inc.	Stamford	5	Sept. 21	1312
Elm City Nursery Co., Woodmont Nursery, Inc.	Woodmont and New Haven	155	Sept. 9	1296
Evergreen Nursery Co.	South Wilton	11	Sept. 1	1283
Fairfield Landscape & Nursery Co.	Cannondale	5	Nov. 11	1350

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)	Litchfield	1	Sept. 28	1331
Gardner's Nurseries	Rocky Hill	5	Sept. 26	1321
Geduldig's Greenhouses	Norwich	1	Sept. 1	1289
Glenn Terrace Ornamental Nursery (James H. Everett, Prop.)	Mount Carmel	6	Sept. 1	1293
Heath & Co.	Manchester	5	Aug. 11	1262
Hilliard, H. J.	Sound View	1	Sept. 1	1286
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	8	Aug. 11	1260
Holcomb, Irving	Simsbury	1	Aug. 24	1278
Horan & Son, Jas.	Bridgeport	1	Sept. 23	1316
Houstons' Nurseries	Mansfield	4	Aug. 12	1266
Hoyt's Sons Co., Inc., The Stephen	New Canaan	300	Sept. 29	1332
Hunt & Co., W. W.	Hartford	10	Sept. 12	1297
Isselee, Charles	Darien	10	Nov. 21	1353
Jones, William	Norwalk	1	Sept. 19	1309
Kajok, George	New Haven	1	Dec. 16	1360
Kelley, James J.	New Canaan	1		
Kellner, Herman H.	Danbury	1	Sept. 28	1327
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 27	1325
Ladd & Nichols, Inc.	Greenwich	2	Sept. 22	1314
Laddin's Rock Nursery (W. L. Marks, Prop.)	Stamford	5	Nov. 6	1347
Langenbach, F. J.	Norwich	1	Sept. 1	1287
Larkin, P. J.	New London	1	Oct. 23	1340
Mallett Co., George A.	Bridgeport	1	Nov. 3	1343
Maplewood Nurseries (T. H. Peabody, Mgr.)	Norwich	1	Sept. 9	1295
Marigold Farm (H. Kelley, Prop.)	New Canaan	6	Oct. 25	1341
Meier, A. R.	West Hartford	1	Sept. 12	1301
Millane Tree Expert Co., The	Middletown	1	Nov. 21	1354
Munro, Charles	New Haven	1	Aug. 23	1275
New Haven Nurseries Co., The	New Haven	10	Sept. 27	1326
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Nov. 6	1348
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London	1	Sept. 1	1288
New London County Nurseries (W. J. Schoonman, Prop.)	New London and Stonington	7	Sept. 16	1305
North-Eastern Forestry Co.	Cheshire	20	Aug. 11	1261
Norwalk Nursery	Norwalk	7	Sept. 21	1310
Oakland Nurseries	Manchester	5	Aug. 11	1263
Outpost Nurseries (L. D. Conley, Prop.)	Ridgefield	16	Aug. 30	1282
Ouwerkerk & Van der Stam	Yalesville	8	Aug. 15	1270
Park Gardens	Bridgeport	1	Sept. 19	1308
Pequod Nursery Co.	Yalesville	15	Aug. 11	1264
Phelps, J. Wesson	Bolton	1	Nov. 11	1349
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Sept. 16	1304
Pierson, A. N., Inc.	Cromwell	65	Aug. 19	1272

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Polish Orphanage (Rev. L. Bojnowski, Mgr.)	New Britain	1	Sept. 23	1317
Pomeroy, Edwin C.	Northville	1	Sept. 28	1329
Quality Seed Store	Stamford	2	Nov. 18	1352
Reck, Julius	Bridgeport	1	Sept. 19	1307
Richards, Warren	Clinton	1	Aug. 23	1276
Rockfall Nursery Co. (P. Marotta, Prop.)	Rockfall	20	Sept. 15	1302
Ryther, O. E. (2)	Norwich	6	Oct. 25	1342
Saxe & Floto	Waterbury	1		
Scheepers, Inc., John	Sound Beach	10	Sept. 22	1313
Schleichert, J. L.	Bridgeport	1	Nov. 23	1355
Scott, J. W.	Hartford	5	Nov. 18	1351
Seely, C. H.	Darien	1	Sept. 21	1311
Sierman, C. H.	Hartford	5	Sept. 19	1306
South Wilton Nurseries	South Wilton	5	Sept. 1	1290
Stannard Hill Greenhouse (J. E. Brooks, Prop.)	Westbrook	1	Aug. 17	1271
Steck, Charles A.	Bethel and Newtown	2	Sept. 28	1328
Stratfield Nursery Co.	Bridgeport	5	Dec. 12	1359
Stratford Rose Nurseries (John Barrow, Prop.)	Stratford	3	Sept. 25	1318
Traendly & Schenck	Rowayton	2	Aug. 12	1269
Upson, R. E.	Marion	1	Sept. 30	1335
Vanderbrook & Son, Chas. L. (2)	Manchester	5	Sept. 12	1299
Van Wilgen & Co.	Branford	6	Aug. 23	1274
Verkade's Nurseries	New London	8	Aug. 29	1280
Vidbourne & Co., J.	Hartford	7	Sept. 12	1300
Wallace Nursery	Wallingford	2	Sept. 26	1324
Watrous, Arthur J.	Meriden	1	Sept. 26	1323
Wild, Henry	Riverside	1	Oct. 10	1339
Wilson & Co., C. E.	Manchester	30	Sept. 16	1303
Woodruff, C. V. (2)	Orange	1	Oct. 2	1337
Yale University Forest School	New Haven	1	Sept. 25	1319
Young, Mrs. Nellie A.	Pine Orchard	1	Sept. 1	1292
Zack, Harry J.	Deep River	1	Aug. 23	1277
Total acreage		1,719		

INSPECTION OF IMPORTED NURSERY STOCK

The number of separate shipments of imported nursery stock inspected in 1922 was about fifty per cent. greater than in 1921, though the number of cases was only twenty-five per cent. greater; the number of plants, however, increased sixty-two per cent. over 1921. The following table shows the number of shipments, cases and plants inspected in Connecticut for the years 1920, 1921 and 1922:

Year	No. of Shipments	No. of Cases	No. of Plants
1920	17	87	814,491
1921	21	126	1,228,560
1922	30	159	1,997,595

About seventy per cent. of the shipments inspected in 1922 were Manetti rose stock and the remaining thirty per cent were young fruit seedlings. All of the rose and fruit stock is imported for the purpose of grafting and budding, in order to grow named varieties.

Nearly all of this inspection work was done by Mr. Zappe, Messrs. Walden, Garman and Sealy assisting at times. The time required to inspect this stock aggregates 260.5 hours or 1.34 months of 26 working days of seven and one-half hours each. The total cost of this work including time of men and traveling expenses amounted to $301.01.

The sources of this imported nursery stock are as follows:

Sources of Imported Nursery Stock, 1922-1923

	No. Shipments	No. Cases	No. Plants
France	13	92	1,459,200
Holland	12	54	390,395
England	5	13	148,000
	30	159	1,997,595

It is interesting to note how the sources of imported stock entering Connecticut have changed during the past few years. Before the world war when all kinds of nursery stock were permitted to enter the United States, Holland and Belgium each furnished three or four times as many shipments and cases as France. After the devastation of Belgium by the German army, the supply from Belgium dropped off until in 1917-1918, no shipments were received direct, though undoubtedly much stock was carried to Holland and shipped from there. No direct shipments have been received from Belgium since.

In 1918-1919, just before the Federal embargo was placed upon the entry of miscellaneous nursery stock, 98 shipments and 937 cases were received from Holland and only 14 shipments and 73 cases from France. Of course, most of the shipments from Holland contained ornamental plants, and particularly many conifers, rhododendrons, azaleas and boxwoods. Since all plants except rose and fruit tree stocks for propagation were prohibited in 1919, a major proportion come from France, though there are nurseries in Holland which furnish rose and fruit tree stocks.

The following table shows the quantity of stock as inspected by months:

Month	No. Shipments	No. Cases	No. Plants
December	4	19	120,000
January	5	36	672,900
February	11	70	838,340
March	4	9	41,490
April	6	25	324,865
	30	159	1,997,595

In addition to the stock reported above, one shipment of three cases containing 30,000 fruit stocks was reshipped to Dansville, New York, and was not inspected in Connecticut. Two shipments of two cases containing 600 lily bulbs, and 21 shipments of 24 cases of seeds entered Connecticut but were not inspected.

Of the 30 shipments inspected, 17 shipments or fifty-seven per cent. were found to contain insects or other animals or plant diseases, some of which are well-known pests. Details regarding these infestations are given below:

Pests Found on Imported Nursery Stock.

17 Shipments Infested

INSECTS

Agrilus galls on Manetti rose. (1 shipment) V. Lebreton's Nursery, La Pyramide, France.

Diprion cocoon on fruit stock. (1 shipment) Georges Benard, Orleans, France.

Emphytus cinctus Linn., on Manetti rose. (11 shipments) R. H. Bath, Ltd., Wisbech, England; M. Gielen, Oudenbosch, Holland; S. Bide & Sons, Farnham, England; H. H. Woldering, Veendam, Holland; Georges Benard, Orleans, France; V. Lebreton's Nursery, La Pyramide, France; Fa. As. Ouwerkerk, Boskoop, Holland; N. Levavasseur & Fils, Ussy, France; Societe Nurseries Louis Leroy, Angers, France; Arthur Charlton & Sons & Rotherfield, Tunbridge Wells, England.

Euproctis chrysorrhoea Linn., Brown-tail nest on apple. (1 shipment) Aubert Hemeray, Orleans, France.

Noctuid cocoon on Manetti rose. (1 shipment) N. Levavasseur & Fils, Ussy, France.

Rhabdophaga salicis Schrk. galls on tying willows. (1 shipment) M. Gielen, Oudenbosch, Holland.

Spider's eggs on fruit stock (1 shipment) Georges Benard, Orleans, France.

PLANT DISEASES

Crown Gall on Manetti rose. (10 shipments) R. H. Bath, Ltd., Wisbech, England; S. Bide & Sons, Farnham, England; Georges Benard, Orleans, France; V. Lebreton's Nursery, La Pyramide, France; H. H. Woldering, Veendam, Holland; Societe Nurseries Louis Leroy, Angers, France; W. Fromow & Sons, Windlesham, England; Association Flora, Boskoop, Holland.

INSPECTION OF APIARIES

During 1922, this work was carried on in the same manner as in preceding years, Mr. H. W. Coley of Westport serving as inspector in Fairfield, New Haven, Middlesex and New London Counties, and Mr. A. W. Yates of Hartford serving as inspector in Litchfield, Hartford, Tolland and Windham Counties, each being paid six dollars per day and expenses. This work required

a total of 157 man days, and the entire cost for the season was $2,062.77.

More apiaries were inspected in 1922 than in 1921, and a much larger number of colonies. In fact, a noticeable feature of this work was the greater average number of colonies per apiary than in the preceding two years. The following figures show the number of apiaries and colonies inspected, and the average number of colonies per apiary for the past three seasons:

Year	No. Apiaries	No. Colonies	Average No. Colonies Per Apiary
1920	762	4,797	6.5
1921	751	6,972	9.2
1922	797	8,007	10.04

In 1922, inspections were made in 125 towns as against 122 towns in 1921. No apiaries have ever been inspected in the towns of Union (Tolland County) and Eastford (Windham County).

In 1922, inspections were made in the following 26 towns not visited in 1921:

Fairfield County: Bridgeport, Darien and Weston; *New Haven County*: Bethany, East Haven and West Haven; *New London County*: Colchester and Lyme; *Litchfield County*: Bridgewater, Canaan, Cornwall, Goshen, Kent, New Milford, Norfolk, North Canaan, Salisbury, Sharon and Torrington; *Hartford County*: Bloomfield; *Windham County*: Brooklyn, Canterbury, Killingly, Plainfield, Scotland and Sterling.

On the other hand in 1921 inspections were made in the following 23 towns not visited in 1922: *Fairfield County*: Danbury, Ridgefield, Stratford and Trumbull; *New Haven County*: Ansonia, Derby and Meriden; *Middlesex County*: Cromwell, East Haddam, Haddam, Middlefield, Middletown and Portland; *New London County*: Lisbon; *Litchfield County*: Harwinton, New Hartford and Watertown; *Hartford County*: Farmington and Marlborough; *Tolland County*: Stafford; *Windham County*: Chaplin, Putnam and Thompson.

European Foul Brood:

Out of the 797 apiaries and 8,007 colonies inspected in 1922, 33 apiaries and 68 colonies were found infested with European foul brood. This gives a ratio of 4.14 per cent. of apiaries and .85 per cent. of colonies infested, against 3.99 and 1.26 per cent. respectively in 1921. With this exception, European foul brood has gradually decreased in Connecticut since the inspection work began in 1909. In 1922 this disease was found in each county in the State, and in the following 22 towns: *Fairfield County*: Greenwich and Fairfield; *New Haven County*: Milford, Naugatuck, Wallingford and West Haven; *Middlesex County*: Durham; *New London County*: Groton, Norwich, Old Lyme and

Stonington; *Litchfield County*: Thomaston and Torrington; *Hartford County*: Bristol, East Granby, Glastonbury, Newington, Southington, West Hartford and Windsor; *Tolland County*: Ellington; *Windham County*: Killingly.

American Foul Brood:

Of the 797 apiaries and 8,007 colonies inspected in 1922, 11 apiaries and 22 colonies were infested with American foul brood. This is a ratio of 1.38 per cent. of apiaries and .27 per cent. of colonies infested, as against 2.5 and .56 per cent. respectively in 1921. American foul brood was not found during the early years of inspection and was not discovered in the State until 1914. Since then, there has never been very much of this disease, but the percentage is spasmodic and erratic. It fluctuates irregularly, and has shown no such gradual change as has been the case with the decrease in the European foul brood.

In 1922, this disease occurred in all except New London and Windham Counties, and was found in the following seven towns: *Fairfield County*: Greenwich; *New Haven County*: Wallingford; *Middlesex County*: Durham; *Litchfield County*: Washington and Winchester; *Hartford County*: New Britain; *Tolland County*: Mansfield.

The statistics of the apiaries inspected in each of the 125 towns visited, arranged by counties, are given on the following pages, and summarized on page 289.

APIARIES INSPECTED IN 1922

	No. Apiaries		No. Colonies		Foul Brood		
Fairfield County:	Inspected	Diseased	Inspected	Diseased	American	European	Sacbrood
Bethel	3	0	41	0	0	0	0
Bridgeport	1	0	44	0	0	0	0
Darien	9	0	103	0	0	0	0
Easton	3	0	82	0	0	0	0
Fairfield	5	1	95	3	0	3	0
Greenwich	12	3	110	6	3	1	2
Monroe	3	0	18	0	0	0	0
New Canaan	8	0	69	0	0	0	0
Newtown	1	0	42	0	0	0	0
Norwalk	6	0	65	0	0	0	0
Redding	1	0	31	0	0	0	0
Shelton	1	0	31	0	0	0	0
Stamford	14	0	193	0	0	0	0
Weston	4	0	44	0	0	0	0
Westport	10	2	152	3	0	0	3
Wilton	9	1	125	1	0	0	1
	90	7	1,245	13	3	4	6

	No. Apiaries		No. Colonies		Foul Brood		
New Haven County:	Inspected	Diseased	Inspected	Diseased	American	European	Sacbrood
Beacon Falls	2	0	4	0	0	0	0
Bethany	5	0	10	0	0	0	0
Branford	5	0	40	0	0	0	0
Cheshire	7	0	75	0	0	0	0
East Haven	5	0	25	0	0	0	0
Guilford	2	0	24	0	0	0	0
Hamden	5	0	44	0	0	0	0
Madison	4	0	30	0	0	0	0
Middlebury	3	0	23	0	0	0	0
Milford	7	1	77	1	0	1	0
Naugatuck	7	2	35	3	0	1	2
New Haven	7	0	49	0	0	0	0
North Haven	1	0	90	0	0	0	0
Oxford	3	0	33	0	0	0	0
Prospect	9	0	77	0	0	0	0
Seymour	2	0	24	0	0	0	0
Wallingford	33	9	212	11	3	5	3
Waterbury	10	0	119	0	0	0	0
West Haven	1	1	6	1	0	1	0
Woodbridge	6	0	59	0	0	0	0
	124	13	1,056	16	3	8	5
Middlesex County:							
Chester	6	0	52	0	0	0	0
Clinton	3	0	28	0	0	0	0
Durham	9	4	166	7	3	4	0
Essex	3	1	41	1	0	0	1
Killingworth	2	0	13	0	0	0	0
Old Saybrook	2	0	23	0	0	0	0
Saybrook	5	1	12	1	0	0	1
Westbrook	1	0	7	0	0	0	0
	31	6	342	9	3	4	2
New London County:							
Bozrah	2	0	26	0	0	0	0
Colchester	6	0	24	0	0	0	0
East Lyme	2	0	3	0	0	0	0
Franklin	2	0	18	0	0	0	0
Groton	8	1	36	2	0	2	0
Lebanon	4	0	53	0	0	0	0
Lyme	1	0	36	0	0	0	0
Montville	2	0	14	0	0	0	0
New London	7	1	72	1	0	0	1
No. Stonington	1	0	1	0	0	0	0
Norwich	9	1	562	1	0	1	0
Old Lyme	3	2	43	8	0	8	0
Preston	6	0	68	0	0	0	0
Stonington	1	1	22	2	0	2	0
Waterford	3	0	28	0	0	0	0
	57	6	1,006	14	0	13	1

	No. Apiaries		No. Colonies		Foul Brood		
Litchfield County:	Inspected	Diseased	Inspected	Diseased	American	European	Sacbrood
Barkhamsted	3	0	98	0	0	0	0
Bridgewater	5	0	67	0	0	0	0
Canaan	7	0	38	0	0	0	0
Colebrook	2	0	16	0	0	0	0
Cornwall	5	0	20	0	0	0	0
Goshen	1	1*	37	1*	0	0	0
Kent	2	0	9	0	0	0	0
Litchfield	6	0	31	0	0	0	0
Morris	6	0	55	0	0	0	0
New Milford	10	0	118	0	0	0	0
Norfolk	4	0	15	0	0	0	0
North Canaan	9	0	112	0	0	0	0
Plymouth	1	0	18	0	0	0	0
Salisbury	8	0	110	0	0	0	0
Sharon	4	0	103	0	0	0	0
Thomaston	2	1	8	1	0	1	0
Torrington	10	1	113	2	0	2	0
Washington	6	1	133	5	5	0	0
Winchester	16	2	108	3	3	0	0
	107	6	1,209	12	8	3	0

* Paralysis.

Hartford County:							
Avon	1	0	6	0	0	0	0
Berlin	20	0	285	0	0	0	0
Bloomfield	1	0	22	0	0	0	0
Bristol	14	5	101	16	0	15*	0
Burlington	1	0	4	0	0	0	0
Canton	6	0	57	0	0	0	0
East Granby	6	1	61	3	0	3	0
East Hartford	11	0	78	0	0	0	0
East Windsor	12	0	119	0	0	0	0
Enfield	6	0	56	0	0	0	0
Glastonbury	22	3	178	5	0	4	1
Granby	11	0	99	0	0	0	0
Hartford	19	0	135	0	0	0	0
Manchester	16	0	84	0	0	0	0
New Britain	16	1	159	1	1	0	0
Newington	12	1	93	4	0	4	0
Plainville	3	0	4	0	0	0	0
Simsbury	10	0	70	0	0	0	0
Southington	18	1	135	1	0	1	0
South Windsor	1	0	5	0	0	0	0
Suffield	11	0	98	0	0	0	0
West Hartford	25	1	206	2	0	2	0
Wethersfield	1	0	7	0	0	0	0
Windsor	11	1	59	2	0	2	0
Windsor Locks	4	0	29	0	0	0	0
	258	14	2,150	34	1	31	1

* 1 Paralysis.

	No. Apiaries		No. Colonies		Foul Brood		
Tolland County:	Inspected	Diseased	Inspected	Diseased	American	European	Sacbrood
Andover	5	0	42	0	0	0	0
Bolton	3	0	23	0	0	0	0
Columbia	1	0	5	0	0	0	0
Coventry	8	0	74	0	0	0	0
Ellington	16	2	80	3	0	3	0
Hebron	2	0	15	0	0	0	0
Mansfield	4	2	61	4	4	0	0
Somers	2	0	16	0	0	0	0
Tolland	1	0	13	0	0	0	0
Vernon	7	0	37	0	0	0	0
Willington	18	0	97	0	0	0	0
	67	4	463	7	4	3	0

Windham County:							
Ashford	2	0	12	0	0	0	0
Brooklyn	2	0	78	0	0	0	0
Canterbury	2	0	19	0	0	0	0
Hampton	8	0	36	0	0	0	0
Killingly	11	1	41	2	0	2	0
Plainfield	16	0	77	0	0	0	0
Pomfret	7	0	92	0	0	0	0
Scotland	4	0	54	0	0	0	0
Sterling	2	0	7	0	0	0	0
Windham	6	0	75	0	0	0	0
Woodstock	3	0	45	0	0	0	0
	63	1	536	2	0	2	0

SUMMARY

		No. Apiaries		No. Colonies		Foul Brood		
County	No. Towns	Inspected	Diseased	Inspected	Diseased	American	European	Sacbrood
Fairfield	16	90	7	1,245	13	3	4	6
New Haven	20	124	13	1,056	16	3	8	5
Middlesex	8	31	6	342	9	3	4	2
New London	15	57	6	1,006	14	0	13	1
Litchfield	19	107	6*	1,209	12*	8	3	0
Hartford	25	258	14*	2,150	34*	1	31	1
Tolland	11	67	4	463	7	4	3	0
Windham	11	63	1	536	2	0	2	0
	125	797	57	8,007	107	22	68	15

* One colony with paralysis.

	No. Apiaries	No. Colonies
Inspected	797	8,007
Infested with European foul brood	33	68
Per cent. infested	4.14	.85
Infested with American foul brood	11	22
Per cent. infested	1.38	.27
Sacbrood	11	15
Bee paralysis	2	2
Average number of colonies per apiary		10
Cost of inspection		$2,062.77
Average cost per apiary		$2.60
Average cost per colony		.257

Registration of Bees

Chapter 174 of the Public Acts of 1919 provides that all beekeepers shall register their apiaries with the town clerk in the town where the bees are kept each year before October 1. Evidently this law is misunderstood, as many beekeepers seem to think that if they register once, that it fulfills the requirements. Unless enforced, this law is of little or no value.

REPORT OF WORK IN SUPPRESSING THE GIPSY AND BROWN-TAIL MOTHS

Season of 1921-1922

By W. E. Britton and John T. Ashworth

In carrying on this work there has been no marked change or departure from the methods developed in the preceding years. The brown-tail moth has been absent throughout the State so that no measures against it were necessary except to destroy a few larvae in their nests when found on shipments of imported nursery stock. Consequently this report applies almost entirely to suppressing the gipsy moth. As in the past, there has been cordial and complete co-operation between the Federal authorities and our forces in attempting to control this insect, and we wish here to express our appreciation and thanks to Mr. A. F. Burgess, in charge of moth work, and to Mr. H. L McIntyre, in charge of field work, both of the Federal Bureau of Entomology.

The report of this work for the year ending June 30, 1921, was printed in Bulletin 234 of the Connecticut Agricultural Experiment Station, page 132.

Extensive Wind-Spread

When the preceding report was sent to the printer (1921) the gipsy moth situation in Connecticut was very hopeful, but after scouting in the fall of that year, we found that there had been an extensive wind-spread which not only scattered the colonies throughout the area already known to be infested, but extended it over many towns to the west and south, which had not hitherto been infested. This discovery necessitated scouting many new towns, and for this purpose additional time and men were needed. It has been known for several years that a warm wind blowing just after the young caterpillars emerge from the eggs, will carry them long distances. Such wind-spread occurs only occasionally, and may not happen again for several years, but this one is perhaps the most extensive one known in Connecticut since the State became infested. Before the winter was over, evidence of the pest was found scattered all over Tolland and Hartford Counties, in five towns in Litchfield County, and in two towns each in New Haven and Middlesex Counties. New London County is all infested except four towns, Colchester, East Haddam, Lyme and Old Lyme, on its western border. Windham County has been infested for several years, except the town of Ashford. As yet the gipsy moth has not been found anywhere in Fairfield County.

Methods of Work

During this year while scouting was being done in outside towns (towns which have not heretofore been infested with gipsy moths), the people being unfamiliar with the work were suspicious of the men walking over their property. The following description of how the work is carried on will be made as plain and simple as possible so that anyone who reads it may fully understand about it.

Scouting

The female moths deposit their eggs in July and August. Scouting may then begin, but can be done better in the fall after the leaves have dropped. A crew is made up of one foreman and four scouts, and each crew works in a separate town. The foreman is given a blue-print map of the town, showing all roads, and the scouts work one side of a road at a time until the entire town is covered. In several places in this report the terms "woodland" and "roadside scouting" have been used. The following will explain the difference and how each is done.

Woodland Scouting:—In scouting woodland, the scouts are lined up about fifteen feet apart in a straight line across one end of the block of woodland to be scouted; each man is guided by the man on his left, and scouts all growth in his strip of fifteen feet. When the line gets to the end of the block, it wheels to the right, the man on the extreme right going back on a line parallel with that which he has just made. All the others guide right this time, and this is repeated until the woodland is finished.

Roadside Scouting:—Roadside scouting is done differently in sections where the degree of infestation is thought to be light or heavy. In territory that is lightly infested, attention is paid more particularly to oaks and apple trees, as the gipsy moth prefers these two kinds of trees both for food and for hibernating. The scouts work one side of the road at a time and examine all trees in the open, around houses, and along woodland edges. If oak trees grow in the edge of the woodland, the men will follow as far as the oak growth extends. Sometimes they find infestations one-half to three-quarters of a mile from the road. If a wooded road, they scout a strip about one hundred feet back from the road. In a full crew, two men would do this strip and the other two would work what is called the back line; this means to work diagonally back and forth and inspect all the oak growth back of the one hundred-foot limit as far as the foreman thinks necessary.

If the town is badly infested the scouts generally meet their marks, that is, they scout from one road until they meet the back line of the road opposite.

Marking Trees

Each man has an identifying mark which he scratches in the outer bark of each tree that he examines; this is the same as signing his name, as no other man uses the same mark. The reason for this is that if the foreman or anyone else should find an egg-mass on the tree, it is easy to ascertain who was to blame for missing it. The foreman is required to put his mark on every tree which he examines behind the scouts, and he is held responsible, the same as the men, for all trees carrying his mark. Some of the most common marks used are ⅂ L V Λ and X

If egg-clusters are found, the colony or infestation is marked with a red dot on the map, and a description of the colony with the owner's name and address written on the back of the map, so that the colony can be found readily by any man working on the force, though not present when the infestation was discovered. The infested trees are marked with white paint with the last number of the year in which the infestation was found; thus for colonies found last year, the trees would be marked "1". At the center of the colony a tree would be marked with what is called the total, thus $\frac{1/4}{21}$ indicates to any scout that the colony was found in 1921 and that four trees were found infested with a total of 21 egg-clusters. Each colony in the town is numbered, beginning with one and numbered successively until the town is finished. This number is placed on a tree near where the total is marked; then if the colony is back from the road it is indicated by white

painted arrows pointing from the numbered post or tree on the roadside to the colony, and placed on trees about 100 feet apart. This system of marking enables any man on the force to find any given colony in any town at any time.

Spraying and Banding Trees

In the spring before the larvae have hatched, all infestations on high and wind-swept locations are visited and the trees banded with "raupenleim" or "tree tanglefoot," to prevent the little caterpillars from going up the trees to feed, and then being blown by the wind to other territory.

After the leaves are half size, spraying may be started. For this purpose the Department has two hand sprayers, one horse-drawn power sprayer and two auto truck power sprayers. The horse-drawn and auto sprayers each have tanks that hold 400 gallons. The system of spraying practiced with these machines is called solid stream spraying; the mixture is pumped through the nozzle in a solid stream with force enough to throw it high over the trees to be sprayed. The stream then breaks into a fine mist which is carried through the foliage by the wind. Thus the work is done quickly. The inside of the trees is also sprayed instead of only the outside. These machines are so constructed that they can pump the water needed from wells, brooks and rivers anywhere, thus saving much time that otherwise would be needed to drive to hydrants or to dip up water to fill the tanks. Where conditions have been favorable, 14 tanks have been pumped over a territory of 10 to 12 acres of woodland in one day, the amount and area depending upon the accessibility and the tree growth.

People observing the scouts at work often remark that the men cannot thoroughly examine a tree so quickly and see anything as small as a gipsy moth egg-cluster. Before the men are sent out into the field on scouting work, they are given a course of training. Each is placed in what is called a "breaking-in crew" in thickly infested towns, and are trained to work slowly at first, then to increase their speed as their eyes become accustomed to the work. By following this method day after day, they are soon able to spot an egg-cluster very quickly.

The foreman of each crew is supplied with a letter of authority and identity, signed by the State Entomologist, which he is required to show when challenged by any property owner.

Labor Conditions

In gipsy moth field work as well as all other kinds of work, the labor question has become a serious problem. It was expected that after the war ended help would be plentiful, but conditions

have changed but very little. The men that make the best scouts are farm or country brought-up boys, but owing to the coal shortage these men in some sections of New England are being paid as high as four dollars per day for cutting cord wood, so it can readily be seen they are not willing or ready to leave home and pay board for a smaller rate of pay. This is only one instance of the labor situation. Factory employees, as a rule, make very poor scouts, and have to be tried out and in many cases discharged as unfit for the work; this, of course, takes time and money, but under present conditions has to be done. Another item of contention among the men is the board question. A large number of private companies allow their help subsistence, and this gives the boarding house keeper a chance to put the price of board far above that of four or five years ago. For example, a scout getting $20.64 a week and paying $12.00 for board has not much left after paying for his clothes and laundry. These figures are given to show what we are up against in regard to help. Owing to the large increase in territory that had to be scouted this year on account of the wind-spread occurring in the spring of 1921, it will be necessary to add a number of scouts to the force now working to cover all the infested territory this next winter.

Equipment

During this year very little new equipment was purchased or needed. Some of the old sprayer hose began to give out the first part of the spraying season, so 1,000 feet of rubber-covered hose were purchased from the Acme Rubber Company of Boston, Massachusetts. The couplings were cut from all the old hose that had been saved from year to year and were used on the new hose, thus saving between four and five dollars on each length of 50 feet. This outlay covers practically all of the money spent on equipment during this fiscal year.

The gipsy moth department now has one Buick six touring car, one Ford touring car, four Ford light trucks, two Netco auto power sprayers, one horse-drawn gasoline power sprayer, two "Double Forester" hand pumps, eight bicycles for patrolling near-by infestations, about 3,800 feet of one-inch hose, nine 25-foot lengths of two and one-half inch suction hose, and the necessary small tools for repairing automobiles, cleaning out infestations, etc.

Details of Work in Each Town.

The details such as number and location of infestations, number of egg-clusters, banding, spraying, etc., for each of the infested towns, arranged by counties, are given in the following pages, and in tabular form on page 310. It will be seen from the summary on page 313, that work was done in 64 infested towns, 1,008 infestations and 12,446 egg-clusters found and treated; 360 infestations sprayed, also 1,793 other trees sprayed by Federal men, 380 trees banded and 7,025 larvae killed by hand soon after hatching around the infestations. Though our State records give the number of infestations sprayed, the Federal method was to record the number of trees in open country or orchards or the number of acres in woodland sprayed. Thus if these could be reduced to a common measure, the account of the work would be more complete and comprehensible.

Windham County

Ashford—78 Infestations, 166 Egg-clusters

Ashford was scouted by Federal men this year, and 78 infestations were found scattered over all parts of the town. However, all but 23 were single egg-cluster colonies, and none of these were large. One colony of 17 egg-clusters was about one and one-half miles northwest of Ashford post office, and another of 13 egg-clusters on the north side of Westford Hill. The other colonies were all small and not considered dangerous. One and one-half acres of woodland were sprayed by Federal men during the spring.

Brooklyn—22 Infestations, 396 Egg-clusters

Brooklyn was scouted by State men during January and the first part of February. Twenty-two colonies of over five egg-clusters each were found. None of these colonies were very large or dangerous. The largest contained 65 egg-clusters and was found on a white oak and stone wall in a pasture owned by Mr. Well located about one-half mile south of the State road and one mile from the Killingly line. Seventeen of the infestations were sprayed by State men, 3,000 gallons of lead arsenate mixture being used. The men found 103 larvae at the colonies and destroyed them while checking up, most of them being found before the spraying season.

Canterbury—5 Infestations, 309 Egg-clusters

Canterbury was scouted by State men the first of the season and five colonies were located. Of these, two were large enough to be mentioned. The worst one was found in an oak and stone wall on land owned by Mr. Drakes in the northwestern part of the town about one-fourth of a mile from the Hampton line. The scouting records of the past two years have shown that a large colony was situated somewhere in this vicinity and was discovered this year. It contained 10 new and 181 old egg-masses.

This colony and all the others were sprayed by the State crew, 127 pounds of arsenate of lead being used. The other colony was found on an apple tree located on the main road north from Westminster about one and one-half miles from Brooklyn town line, and consisted of 24 new and 23 old egg-clusters. Here 52 larvae were found and destroyed before spraying, but none afterward.

Chaplin—6 Infestations, 120 Egg-clusters

Chaplin was scouted during November and the first of December by State men, six colonies being found, none of which were considered dangerous. The worst one was on land owned by C. W. Morey of Hampton. This was a woodland colony located in the northeastern part of the town at the Hampton line, and contained 28 egg-clusters. All six colonies were sprayed by one of the State machines in the spring, 4,240 gallons of mixture being used. Altogether 11 larvae were found and destroyed.

Eastford—31 Infestations, 466 Egg-clusters

Eastford was one of the first towns scouted by State men this season, 31 colonies and 133 single egg-clusters being found. The only colony that is worthy of mention contained 40 egg-clusters. This colony was on a large pasture white oak on land owned by Mr. B. A. Bosworth, about one-half mile from the Woodstock line. One other might be mentioned. This colony was in an apple orchard owned by Mr. M. Spinks on the north side of the road running east from the cemetery to Ragged Hill, and about one-half mile from the Pomfret line. Twenty-five egg-clusters were found here. Twenty-eight of these colonies were sprayed by State men, 11,400 gallons of mixture being used. During the season both before and after spraying, 127 larvae were found and destroyed.

Hampton—5 Infestations, 134 Egg-clusters

Hampton was scouted by a State crew the last of November and first of December, five colonies and 66 single egg-masses being found. The largest colony was found on an oak in a pasture owned by Mr. Colvin, and situated about one and one-half miles northwest of Hampton village near the Robinson Hill district. It contained 29 egg-clusters. Three of the five colonies were sprayed by the State crew, 700 gallons of spray mixture being used. Two hundred thirty-one larvae were found, practically all of which were found before spraying was done.

Killingly—66 Infestations, 1,201 Egg-clusters

Killingly was used this year as a school to break in new men, therefore it took much longer to scout than in previous years. The results showed 66 colonies and 524 single egg-clusters found. They were evenly distributed over the entire town. Two woodland colonies were scouted in the early fall, one in the extreme northeastern corner of the town on land owned by Mr. C. Pariza, containing 65 egg-masses and extending over about 12 acres; the other was situated about one mile east of Ballouville on land owned by Mr. William Young, where 94 egg-clusters were found scattered over about 15 acres. One orchard infestation might be mentioned. It was located in an orchard owned by Mr. Dan Burlingame and 40 egg-clusters were found. This orchard is located at the State line, about one and one-half miles north of the Providence State road, Fifty-eight colonies were sprayed by State crews in the spring, 162,400 gallons of mixture being used. At two of the woodland colonies, 2,800 gallons were used at each place. One thousand ninety-eight larvae were found and destroyed, most of which were found before spraying.

Plainfield—7 Infestations, 166 Egg-clusters

Plainfield was scouted by State men during December and January. Seven colonies and 98 single egg-masses were found. The largest contained 19 egg-clusters in an apple tree in a pasture owned by Mr. Edward Allen, located between the railroad and State road just north of Plainfield Center. All seven of the colonies were sprayed in the spring by State men, and 17 larvae were found and destroyed.

Pomfret—24 infestations, 507 Egg-clusters.

Scouting was started by State men November 4, and finished January 16. Twenty-four colonies and 174 single egg-clusters were found. The infestation is general throughout the town. Two colonies might be mentioned: one contained 51 egg-clusters found in two white oaks and stone wall on land owned by Mr. Seth Kimball. This colony is located in the section of the town known as Elliotts. The other was found in Mr. A. B. Lapsley's orchard, 36 egg-clusters occurring on 18 trees. This orchard is near the Brooklyn line on the road running south from what is known as the Haskell stand, or the road connecting the villages of Pomfret and Brooklyn. Nineteen of the colonies were sprayed by State men, 5,200 gallons of spray liquid being used, and 226 larvae were found and destroyed during the season.

Putnam—32 Infestations, 776 Egg-clusters

Some woodland scouting was done in Putnam in the early fall, and six colonies were found. Scouting was resumed January 14 and completed February 14, a total of 32 colonies and 210 single egg-clusters being found. One large woodland infestation spread over about 29 acres was found on land owned by Mrs. Leveret Burrill in the northeastern corner of the town; it contained 77 egg-masses. One other containing 95 egg-clusters was found in an apple tree and wall in Mr. Henry Apply's yard on the road leading from Shippee Hill to Putnam Heights. Twenty-six colonies were sprayed by State men, 5,400 gallons of mixture being used, and 2,406 larvae were found and destroyed.

Scotland—7 Infestations, 10 Egg-clusters

Scotland was scouted by Federal men and seven colonies were found, five being single egg-masses. Of the other two, one had three and the other two egg-clusters. No spraying was done, as it was not thought necessary.

Sterling—16 Infestations, 245 Egg-clusters

Sterling was scouted by State men between September 15 and November 2. In all, 16 colonies and 114 single egg-clusters were found. None of the colonies were large or dangerous, the largest containing only 19 egg-clusters on two apple trees in a dooryard owned by Mr. Henry Eskelinen, on the road running north from the State road near the Rhode Island line. The rest were small infestations ranging from five to 12 egg-clusters. Fourteen infestations were sprayed by State men, 2,900 gallons of mixture being used, and 122 larvae were found and destroyed during the season.

Thompson—157 Infestations, 4,045 Egg-clusters

Thompson was scouted by State men. As in preceding years, Thompson proved to be the worst infested town in the State, although even in the present state of infestation, the town is in better condition than in 1917, when there were 275 colonies and 7,255 egg-clusters. By comparing these figures, it can readily be seen that the pest has been kept under control. There are three large colonies, one of 156 egg-clusters, found in 10 apple trees, on oak, maple and stone wall on land owned by Mr. C. H. Brown, situated almost at the Massachusetts line about two miles east of New Boston village. The other two were woodland colonies on land owned by Mr. Allen Bixby, bordering the Midland Division railroad just west of the Brandy Hill State road, 170 egg-clusters being found at one and 139 at the other. The town is generally infested throughout the entire township. Thompson was the last town to have spraying done in it this season; both State and one Federal truck sprayer were used to try and spray as much as possible before the larvae had grown too large and stopped feeding. In all, 89 colonies were sprayed, 30,800 gallons of mixture being used, and 4,803 larvae found and crushed, most of them before the spraying was done.

Woodstock—75 Infestations, 2,067 Egg-clusters

Woodstock was scouted by State men, 75 colonies and 626 single egg-clusters being found. Woodstock is next to Thompson in degree of infestation, and is generally infested throughout. Four colonies may be mentioned as large and dangerous; two are woodland and two orchard infestations. The largest was found in woodland owned by Mr. Allen Kenyon in the Woodstock Valley district, containing 203 egg-masses. The second woodland colony on two large oaks had 82 egg-clusters and is located about one mile southeast of the colony just mentioned above. The largest orchard infestation contained 120 egg-clusters and is located very near the center of the town, on land owned by Mr. C. F. Colcord. Ninety-six egg-clusters were found on two apple trees in an orchard owned by Mr. William Bates in the southwest corner of the town near the Eastford line. During the summer, 58 of the colonies were sprayed by one of the State crews, 21,800 gallons of mixture being used in the operation. In looking over the colonies, both before and after spraying, 1,271 larvae were destroyed, most of them before spraying.

NEW LONDON COUNTY

East Lyme—1 Infestation, 1 Egg-cluster

Forty-seven miles of roadway were scouted by Federal men, and one single egg-mass found on a maple tree on land owned by Mrs. William Roberts in the village of Niantic. This was an old or last year's infertile egg-cluster, so no further work was done in the town.

Griswold—13 Infestations, 30 Egg-clusters

Griswold was scouted by State men, and although 51 miles of roadway were scouted, the town was not completed. Of the 13 colonies, all but two were singles. One of these on an apple tree in a pasture owned by Mr. S. G. Norman contained nine egg-masses. This colony is located on the north side of Geer Hill. The other was in three white oaks in woodland owned by Mr.

W. A. Sullivan, where 10 egg-clusters were found. This colony is in the northeastern corner of the town near the Plainfield line. The woodland colony was sprayed by State men in the summer. The apple tree had been cut down, and as no brush or trees were near, no spraying was done. Nine hundred and one larvae were destroyed by the men.

Groton—7 Infestations, 8 Egg-clusters

There are two groups of colonies in Groton, one in Noank, and the other in Groton village. All the infestations were single egg-clusters, except one which had two egg-clusters found in Mr. T. C. Montgomery's yard at Noank. No spraying was thought necessary. The scouting in this town was not completed on account of the lateness of the season and pressure of work in other towns.

Ledyard—2 Infestations, 16 Egg-clusters

Owing to the lateness of the season, the scouting in this town was confined to the areas found infested last year. In all, 13 miles of roadway were scouted. Two colonies were found, both on the east side of the road running north and south on the east side of Rose Hill. One of these colonies was in an apple orchard owned by Mr. Leon Zakin, and contained 15 egg-clusters. The other was a single egg-mass in an apple orchard owned by Mr. Conrad Keiney. Both colonies were sprayed by State men in the summer and one larva was found and destroyed.

Montville—5 Infestations, 3 Egg-clusters

The work in Montville was done by Federal men this year. The entire town was not scouted, but 41 miles of roadway were covered in the eastern half of the town. Five infestations were found, three of which were female pupae, one had two egg-clusters and the other one. The colony of two egg-clusters was on a willow tree on land owned by Mr. G. A. Bullard in the Trading Cove district. No spraying or other work was thought necessary in this town.

New London—3 Infestations, 4 Egg-clusters

New London was scouted by Federal men and three infestations were found. Two of these were single egg-clusters and the other had two egg-masses. No spraying was done, as no larvae were found at the colonies in the early summer.

North Stonington—10 Infestations, 126 Egg-clusters

By the time the men were able to scout North Stonington, the season was so far advanced that only the territory around last year's infestations could be examined. Ten colonies were found, one a woodland colony near the Westerly (R. I.) line, on land owned by Miss Doris G. Lewis, where 106 egg-masses were found. The other colonies were all small; one of 10 egg-clusters was found in an orchard owned by Mr. Frank Minor on Wintechog Hill. Both of these colonies were sprayed by State men in the summer, 5,300 gallons of mixture being used, most of it at the woodland colony. Six larvae were found and destroyed.

Preston—4 Infestations, 11 Egg-clusters

The same methods were used in Preston as in North Stonington. It was only partly scouted by State men. Four colonies were found, three of which were single egg-clusters. One of eight egg-clusters was found in two apple trees near the roadside on land owned by Mr. Wyspan near the Lisbon line about one-half mile east of the Quinebaug River. This colony was sprayed by State men in the summer.

Salem—1 Infestation, 1 Egg-cluster

About two-thirds of the town or 32 miles of roadway, were scouted by Federal men. One single egg-mass was found in an apple orchard owned by Mr. A. G. Shorten about one mile west of Gardner Lake. No further work was done during the year.

Stonington—74 Infestations, 127 Egg-clusters

Both State and Federal men worked in Stonington this year. Mr. William Ahearn, Federal Lumber Inspector for this district, scouted during spare time in the Stillmanville and Stonington districts. The State men scouted in areas around last year's infestations. The results show that both villages are generally infested. Most of the colonies were single egg-cluster infestations. Two colonies may be mentioned, one of 10 egg-masses, found in apple trees owned by Mr. A. R. Stillman in Stillmanville, and the other one of eight egg-clusters on roadside elm and maple on south side of State road going west just out of Stillmanville. Ten of the colonies were sprayed by State men in the summer, 55 larvae being found and destroyed. Spraying was done at all places where larvae were found.

Voluntown—6 Infestations, 33 Egg-clusters

The same methods were used in scouting Voluntown as were used in scouting Preston, Griswold and North Stonington. Six infestations were discovered. One colony of 26 egg-clusters was found in a pasture oak owned by Mr. Myron Kinnie, located in the southwestern part of the town near the Griswold line. This oak was cleaned (the loose bark taken off) and watched in the early summer for larvae, but as none were found, it was not sprayed, as the owner, Mr. Kinnie, had no other pasture for his cattle. The other infestations were all singles, except one which had two egg-masses. No other work was done in the town this year.

Waterford—5 Infestations, 7 Egg-clusters

Waterford was scouted by Federal scouts, and 65 miles of roadway, or seven-eighths of the town, covered. Five infestations were found, all of which were in the southeastern part of the town. Three were singles, and two had two egg-clusters each. No spraying or other work was done.

TOLLAND COUNTY

Columbia—10 Infestations, 14 Egg-clusters

The work in Columbia was all done by Federal men. Ten infestations were found, all of which were single egg-clusters except one containing five egg-clusters found on land owned by Mr. George Chowanice. The trees were banded and watched.

Coventry—14 Infestations, 93 Egg-clusters

Coventry was scouted by Federal men. Two large colonies were found, one of 64 egg-clusters in woodland owned by Mr. A. Anderson in the extreme southeastern corner of the town, the other of 23 egg-clusters in an oak on land owned by Mr. H. C. McKnight in the western part of the town. The other infestations were all small. Fifty-four trees were banded at different colonies where it was thought necessary. Three-fourths of an acre of woodland was sprayed, also 42 other trees at places where it was necessary. This work was all done by Federal men.

Hebron—2 Infestations, 5 Egg-clusters

Thirty-seven miles of roadway were scouted by Federal men. One colony and one single egg-mass were found. The colony contained four egg-clusters, and was on land owned by Mr. D. H. Hodge. No other work was thought necessary in this town.

Mansfield—48 Infestations, 157 Egg-clusters

The work in Mansfield was also done under Federal supervision. One large colony of 33 egg-clusters was found in an orchard in Eagleville, owned by Mr. Andrew Vogel. One of eight egg-clusters was found in an orchard about a mile east of the State College at Storrs, owned by Mr. M. Ostiozorky. The other 46 infestations were mostly single egg-masses. In the summer 176 trees at different infestations were sprayed where it was thought most necessary.

Tolland—19 Infestations, 56 Egg-clusters

The scouting in Tolland was not completed, 67 miles of roadway or about two-thirds of the town being covered. Of the 19 infestations, the largest was a colony of 11 egg-clusters in woodland owned by Mr. Karl Tobiassen about one-half mile from the Coventry line. The other infestations were all small; 16 trees were banded with raupenleim where the colony was high and wind-swept. Spraying in this town as well as scouting was done by Federal men. In all, one and one-half acres of woodland and 44 separate trees were sprayed.

Union—94 Infestations, 425 Egg-clusters

As stated in the Report of this Station for 1921, page 134, Union was in the path of the wind-spread of the preceding year, and single egg-cluster infestations were found over the entire town. A similar condition was found last year, and the town is now generally infested. Scouting began on September 15, and was finished on October 26, 94 gipsy moth colonies being found, 45 of which were of one egg-cluster each; 24 colonies contained five or more egg-clusters each. Three of these should be mentioned. The first containing 47 egg-clusters was found in the orchard of Mr. William Kunheardt, in the northwestern corner of the town, about half a mile from the Massachusetts line. The second of 28 egg-clusters was in two apple trees in a field owned by Mr. G. W. Thayer at the junction of the roads from North Ashford and Black Pond. The third was about half a mile northeast of the second, in an orchard owned by Mr. H. M. Lamson, and contained 21 egg-clusters. Twenty-four of these colonies were sprayed in the summer, and 4,500 gallons of spray mixture applied. Both scouting and spraying were done by State men.

Willington—40 Infestations, 145 Egg-clusters

The scouting in Willington was done by Federal men, but the work was not completed. That portion north of a line drawn across the town from East Willington to West Willington, and

containing 58 miles of road, was scouted. Three colonies might be mentioned as dangerous. One of 24 egg-clusters was found in apple trees about one and one-fourth miles from the Stafford line near Roaring Brook, owned by Mr. John Malack. Another of 15 egg-clusters was on apple trees owned by Miss Mary Larar in the Moose Meadow district; and the third colony had 12 egg-clusters in apple trees, owner unknown, in the extreme northeastern part of the town. One hundred thirty-seven trees were sprayed by Government men in the summer.

HARTFORD COUNTY

Berlin—4 Infestations, 18 Egg-clusters

The scouting in Berlin was done by State men, and four infestations found. These were in two groups of two infestations each. One group was in the Kensington district and the other in the southeastern part of the town. The first group mentioned was on land owned by the Shuttle Meadow Golf Club and Mr. James Cimms, and had 10 and five egg-clusters respectively. Fifty-four bands of raupenleim were put on the trees at these colonies and later both were sprayed by Federal men.

Bloomfield—3 Infestations, 32 Egg-clusters

All work done in Bloomfield this season was done by Federal men, but there was not time to complete the town. Three colonies were found. The first one had 16 egg-clusters on an oak owned by Mrs. K. A. Gabb, about one-half mile east of the Bloomfield post office. The second colony of five egg-clusters was found in an oak on land owned by Mr. George F. Woodford about one mile east of the post office. The third colony of 11 egg-clusters was in apple trees owned by Mr. Carl D. Mexcur, about two and one-half miles north of Bloomfield post office. Fifteen trees were banded and 125 trees sprayed in the early summer.

Bristol—1 Infestation, 40 Egg-clusters

One colony was found in Bristol, in apple trees and scrub oaks on land owned by Mr. W. M. Harding about one mile east of the Bristol Reservoir, containing 40 egg-clusters. These were creosoted, three trees were banded, and 82 trees sprayed. This work was all done by Federal men.

Burlington—1 Infestation, 4 Egg-clusters

In Burlington 36 miles of roadway were scouted by Federal men. One colony of four egg-masses was found on land owned

by Mr. E. P. Spencer, and bordering Phelps' Brook, near the New Hartford line. Three trees were banded and 32 sprayed in the season by Federal men.

Canton

Canton was scouted by Federal scouts and nothing found.

East Granby—13 Infestations, 118 Egg-clusters

The infestations in East Granby are scattered all over the entire eastern half of the town. One of 63 egg-masses was found in apple trees owned by Mr. H. Nichleson near the East Granby post office. Two other colonies of nine egg-clusters each were found in the Copper Hill district on land owned by Mr. A. Phelps and E. Kellog. One other colony of nine egg-clusters was found in the southern part of the town near the Windsor line, on an oak owned by Mr. F. Phelps. Three-fourths of an acre of woodland and 85 other trees were sprayed in the season. All work in this town was done by Government men.

East Hartford—2 Infestations, 11 Egg-clusters

All work done in East Hartford this year was under Government supervision. Two infestations were found, one a single and the other a 10 egg-mass colony, the latter in apple trees owned by W. S. and H. J. Honington, and located in the village of East Hartford. Five trees were banded and 50 trees sprayed in the early summer.

East Windsor—2 Infestations, 5 Egg-clusters

Forty-eight miles or about two-thirds of the roadway of this town were scouted. Two infestations were found, both small; they had two and three egg-clusters respectively. No further work was done, as it was not thought necessary. The work in this town was done by Federal men.

Farmington—1 Infestation, 1 Egg-cluster

Federal men scouted a part of Farmington this season, finding one single egg-cluster in an orchard on the bank of the Farmington River near the Unionville post office. No further work was done this year.

Glastonbury—6 Infestations, 37 Egg-clusters

The scouting in this town was done by State men, two colonies and four small infestations being found. One of 15 egg-clusters was found in an orchard near Minnechaug Mountain owned by

Mrs. Hale, another of 17 egg-clusters in an orchard a little east of South Glastonbury owned by the late J. H. Hale. Fifty-five trees were banded, and 195 trees sprayed at these infestations. The banding and spraying were done by Federal men.

Granby—5 Infestations, 5 Egg-clusters

The work in Granby consisted of scouting alone, as only five single egg-clusters were found, three of which were in a direct line running east and west across the southern end of the town; the other two were in the same position at the northern end.

Hartford—1 Infestation, 3 Egg-clusters

The southern third of Hartford was scouted by Federal men, and one colony of three egg-clusters was found on a maple tree at 46 Elliot Street, owned by Mr. J. H. Treloar. Three trees were banded and 27 trees sprayed in the spring by a Government crew.

Manchester—4 Infestations, 11 Egg-clusters

Manchester was scouted by a Government crew and four infestations were found. Two of the colonies were in the village of South Manchester, and another about one mile east of this village. The largest colony, however, was found in apple trees a little east of the village known as Hillstown, owned by Mr. Palmer. At the proper time 18 trees were banded and 50 sprayed by a Federal crew.

Newington—2 Infestations, 7 Egg-clusters

The results of scouting in Newington show that two infestations occurred, one of six egg-masses on apple and maple trees owned by Mr. Patrick H. Martin in the village of Clayton, and the other a single egg-mass in an apple tree owned by Mr. M. P. Anderson near the junction of the railroad and the West Hartford line. In addition to roadside scouting, about 40 acres of woodland were scouted in Newington. Thirteen trees were banded and 29 sprayed. The work in Newington was done by Federal men.

New Britain—2 Infestations, 2 Egg-clusters

Two single egg-clusters were found by Federal men in New Britain about one mile apart in the south central part of the town. No banding or spraying was thought necessary at these infestations.

Plainville—1 Infestation, 3 Egg-clusters

In Plainville 15 of the 25 miles of roadway were scouted by a Government crew. One colony of three egg-clusters was found on apple and maple trees owned by the town and located in the village. Ten trees were banded and 25 sprayed by a Government crew.

Rocky Hill—3 Infestations, 13 Egg-clusters

Rocky Hill was scouted by State men and three infestations found. Two had five egg-clusters each; the first was found in apple trees owned by Mr. Charles Wilber on the State road about one and one-half miles north of the Cromwell line. The second was in apple trees owned by Mr. Fred Sope in the central part of the town. Forty-five trees were banded and later in the spring 80 were sprayed by Federal men.

Southington—1 Infestation, 2 Egg-clusters

One colony of two egg-clusters was found in Southington near the town farm by Federal men. No other work was thought necessary.

Suffield—37 Infestations, 110 Egg-clusters

Gipsy moth infestations were found in all parts of this town. There are three large and dangerous ones, the first being one of 17 egg-clusters on willow trees owned by Mr. William Styles on Muddy Brook just north of Suffield village; the second is one of 10 egg-clusters on oak on the east side of Philo Brook near the Massachusetts line, and the third was found in apple trees near Woods Station, owned by Mr. Charles Cannon. Forty-one trees were sprayed in the spraying season by a Government crew.

Simsbury

Simsbury was scouted by Federal scouts and nothing found.

Wethersfield—2 Infestations, 25 Egg-clusters

In scouting Wethersfield this year, two colonies were found, the largest being one of 15 egg-clusters in apple trees owned by Mr. C. McMullen of Jordan Lane. The other was on apple and peach trees owned by Mr. J. Applebaum of Spring Street, and contained 10 egg-clusters. Fifty-five trees were sprayed at these two places by Government men.

West Hartford—3 Infestations, 9 Egg-clusters

Two of the three infestations in West Hartford are single egg-clusters. The third, however, contained seven egg-clusters found on apple trees owned by Mr. C. S. Griswold on the south side of the Hartford and Winsted State road about one mile from the Hartford line. Five trees were banded and 10 sprayed at this infestation by a Government crew.

Windsor—9 Infestations, 55 Egg-clusters

The work in Windsor was all done by Federal men. Of the 55 egg-clusters, 45 were in two colonies, both being in apple trees beside the State road north of the village of Windsor. One containing 33 egg-clusters was on land owned by Mr. Tony Peters, while the other of 12 egg-clusters was on land owned by Mrs. Brooks. The remaining seven infestations were all small. During the spraying season, 40 trees were sprayed.

LITCHFIELD COUNTY

Barkhamsted—1 Infestation, 1 Egg-cluster

About one-fourth of this town was scouted and one egg-cluster found about one mile south of the Hampsted post office on the line road. The work was done by Federal scouts.

Canaan—1 Infestation, 1 Egg-cluster

The single egg-cluster that was found in Canaan was in an orchard owned by Mr. M. C. Dean, about one and one-half miles east of South Canaan post office. The scouting was done by Government scouts, and no spraying was done in this town.

Colebrook—2 Infestations—2 Egg-clusters

The scouting in Colebrook was done in the North Colebrook section of the town. Two single egg-cluster infestations were found, both on apple trees in the northwestern corner of the town. They were on property owned by Mr. Miles Erisson and Mrs. M. Eskolin. The work was done by Government men.

New Hartford—2 Infestations, 11 Egg-clusters

Federal men did the work in New Hartford. Two infestations were found, one a single egg-cluster in an apple orchard in the Pine Meadow district, owned by Mr. F. W. Jones. The other had 10 egg-clusters in an orchard owned by Mr. Leon Sekulski about two miles northwest from the Nepaug post office. Thirty trees were banded in the spring, but no spraying was done.

Norfolk—2 Infestations, 2 Egg-clusters

Two single egg-clusters were found in the extreme northeast corner of the town, one in a basswood tree owned by Mr. F. W. Towers, and the other in an apple tree owned by Miss Mary Hurd. The scouting was done by Federal men, and no spraying or other work was thought necessary.

Plymouth—1 Infestation, 4 Egg-clusters

One colony of four egg-clusters was found in an apple tree owned by Mr. C. O. Jesperren in the village of Hancock. In the spring nine trees were banded and later 96 trees were sprayed. This work was all done by Federal men.

The towns of Cornwall, North Canaan, Salisbury, Thomaston and Watertown, all in Litchfield County, were scouted by Federal men and nothing found.

MIDDLESEX COUNTY

Cromwell

Cromwell was scouted by State men this season and no trace of the gipsy moth was found.

Durham

State men scouted Durham. One female pupa was found, but no further work was done.

Haddam

As in the case of Cromwell, the work was done by State men and nothing found.

Middletown—2 Infestations, 7 Egg-clusters

Two infestations were found by State men in Middletown. One was a single egg-mass; at the other six egg-clusters were found in apple trees owned by Mr. Edward W. Lee, located in the Middlefield Center district. Six trees were banded in the early spring, and 20 trees sprayed at this colony by Federal men.

Portland

Portland was scouted by State men this season, but nothing was found.

NEW HAVEN COUNTY

Waterbury—2 Infestations, 12 Egg-clusters

One colony of nine egg-clusters was found in apple trees owned by Mr. Mikel Jinety of 792 Highland Avenue, and one of three egg-clusters on poplar trees owned by the Chase Company of Grand Street. In the spring five trees were banded and later 200 trees were sprayed, all work being done by Federal men.

Wolcott—2 Infestations, 25 Egg-clusters

The scouting in Wolcott was done by State men. Two colonies were found, the largest being one of 19 egg-clusters in woodland owned by Mr. Peter Ferdano and Mr. Willie E. Pretchard about one mile northwest of the Wolcott post office. The other was in an apple orchard one-half mile east of Wolcott post office, owned by Mr. Arthur M. Cole. Federal men banded 28 trees and sprayed 151 trees at these colonies during the spring and early summer.

Cheshire, Meriden, Middlebury and Naugatuck were the other towns scouted in New Haven County, but no traces of gipsy moth were found.

Statistics of Infestations

Towns.	No. Infestations Found	No. Egg-Clusters Found	No. Colonies Sprayed	No. Trees Banded	No. Larvae Killed	No. Miles Roadway Scouted
Windham County—14 Towns Infested.						
Ashford	78	166	0	0	0	74
Brooklyn	22	396	17	0	103	70.75
Canterbury	5	309	5	0	52	93.50
Chaplin	6	120	5	0	11	46
Eastford	31	466	26	0	127	71
Hampton	5	134	3	0	231	72.33
Killingly	66	1,201	58	0	1,098	121.90
Plainfield	7	166	5	0	17	112
Pomfret	24	507	11	0	226	98.50
Putnam	32	776	26	0	2,406	65
Scotland	7	10	0	0	0	42
Sterling	16	245	14	0	122	65.13
Thompson	157	4,045	89	0	231	145.40
Windham	0	0	0	0	0	2
Woodstock	75	2,067	58	0	1,271	161
Total	531	10,608	317	0	5,895	1,240.51

Towns.	No. Infestations Found	No. Egg-Clusters Found	No. Colonies Sprayed		No. Trees Banded	No. Larvae Killed	No. Miles Roadway Scouted
New London County—12 Towns Infested.							
Colchester	0	0	0		0	0	55
East Lyme	1	1	0		0	0	47
Griswold	13	30	1		0	901	51.63
Groton	7	8	0		0	0	15
Ledyard	2	16	2		0	0	12.75
Montville	5	3†	0		0	0	41
New London	3	4	0		0	0	32
North Stonington	10	126	2		0	6	14.50
Norwich	0	0	0		0	0	5
Preston	4	11	1		0	0	11 & 5 acres
Salem	1	1	0		0	0	32
Stonington	74	127	10		0	55	13
Voluntown	6	33	0		0	46	17
Waterford	5	7	0		0	0	65
Total	131	367†	16		0	1,009	411.88 & 5 acres
Tolland County—7 Towns Infested.							
Columbia	10	14	0		3	0	38
Coventry	14	93	0	43*	54	0	109
Hebron	2	5	0		0	0	37
Mansfield	48	157	0	176	0	0	124
Tolland	19	56	0	44	16	0	67
Union	94	425	24		0	121	72.20
Willington	40	145	0	137	0	0	58
Total	227	895	24	400*	73	121	505.20
Hartford County—21 Towns Infested.							
Avon	0	0	0		0	0	18
Berlin	4	18	2		54	0	86
Bloomfield	3	32	0	125*	15	0	6
Bristol	1	40	0	82	3	0	104
Burlington	1	4	0	32	3	0	36
Canton	0	0	0		0	0	72
East Granby	13	118	0	85	0	0	36
East Hartford	2	11	0	50	5	0	44
East Windsor	2	5	0		0	0	48
Farmington	1	1	0		0	0	12
Glastonbury	6	37	0	195	55	0	101
Granby	5	5	0		0	0	96
Hartford	1	3	0	27	3	0	18
Manchester	4	11	0	50	18	0	92
Newington	2	7	0	29	13	0	16
New Britain	2	2	0		0	0	60
Plainville	1	3	0	25	10	0	15

† Plus 2 pupa cases. * Trees.

Towns.	No. Infestations Found	No. Egg-Clusters Found	No. Colonies Sprayed		No. Trees Banded	No. Larvae Killed	No. Miles Roadway Scouted
Hartford County—Continued.							
Rocky Hill	3	13	0	80	45	0	37
Simsbury	0	0	0		0	0	55
Southington	1	2	0		0	0	95
Suffield	37	110	0	41	0	0	68
West Hartford	3	0	0	10	5	0	35
Wethersfield	2	25	0	55	0	0	30
Windsor	9	55	0	40	0	0	54
Total	103	511	2	926*	229	0	1,234
Litchfield County—6 Towns Infested.							
Barkhamsted	1	1	0		0	0	21
Canaan	1	1	0		0	0	14
Colebrook	2	2	0		0	0	17
Cornwall	0	0	0		0	0	42
New Hartford	2	11	0		30	0	99
Norfolk	2	0	0		0	0	22
North Canaan	0	0	0		0	0	12
Plymouth	1	4	1	96*	9	0	58
Salisbury	0	0	0		0	0	35
Thomaston	0	0	0		0	0	36
Watertown	0	0	0		0	0	45
Total	9	21	1	96*	39	0	401
Middlesex County—2 Towns Infested.							
Cromwell	0	0	0		0	0	47
Durham	1	0†	0		0	0	69.63
Haddam	0	0	0		0	0	105.13
Middlefield	0	0	0		0	0	41
Middletown	2	7	0	20*	6	0	169
Portland	0	0	0		0	0	59.63
Total	3	7†	0	20*	6	0	491.39
New Haven County—2 Towns Infested.							
Cheshire	0	0	0		0	0	106.50
Meriden	0	0	0		0	0	112
Middlebury	0	0	0		0	0	19
Naugatuck	0	0	0		0	0	11
Waterbury	2	12	0	200*	5	0	148
Wolcott	2	25	0	151	28	0	56
Total	4	37	0	351*	33	0	453.50

† Plus 1 female pupa case. * Trees.

SUMMARY OF INFESTATIONS

County	No. Towns Infested	No. Infestations	No. Egg-Clusters Destroyed	No. Infestations Sprayed	Sprayed. No. Trees	No. Trees Banded	No. Larvae Killed	No. Miles Roadway Scouted
Windham	14	531	10,608	317		0	5,895	1,240.51
New London	12	131	367†	16		0	1,009	411.88*
Tolland	7	227	895	24	400	73	121	505.20
Hartford	21	103	511	2	926	229	0	1,234
Litchfield	6	9	21	1	96	39	0	401
Middlesex	2	3	7‡	0	20	6	0	491.39
New Haven	2	4	37	0	351	33	0	453.50
Total	64	1,008	12,446	360	1,793	380	7,025	4,737.48 & 5 acres

† Also 2 pupa cases. ‡ Also 1 female pupa case. * Plus 5 acres.

Towns in the Infested Area Which Were Not Scouted

Several towns in the infested area were not scouted on account of lack of time to do the work with the force at our disposal. For instance, if it were discovered that the next adjoining town was infested, it seemed best to skip a town in an attempt to find the limit of the infestation. Some of these towns not scouted are as follows: Tolland County—Andover, Bolton, Vernon, Ellington, Somers and Stafford; Hartford County—Enfield, Hartland, Marlboro, South Windsor and Windsor Locks; and in New London County—Lebanon, Franklin, Sprague, Lisbon and Bozrah.

Parasites

Years ago the State of Massachusetts, in co-operation with the Federal Bureau of Entomology, imported into this country some of the insect parasites of the gipsy moth in Europe, and which, presumably, have helped to hold it in check there. This work afterward was turned over wholly to the Bureau of Entomology. Later, parasites were obtained from Japan. Rearing, observing, colonizing and recovering these parasites has been kept up to the present day, in the belief that in time the effect in sum total of all these parasites would be felt in reducing the ravages of the gipsy moth in this country. During the war and immediately afterward the unsettled condition of affairs in Europe and other countries made it inadvisable to attempt to collect parasites to be shipped to the United States, but in 1922, appropriations being available, trained men were sent to both Europe and Japan, and additional material was gathered and sent to this country.

From time to time information regarding these parasites has been included in this report. Some of the matter here given was taken from the report of this Station for 1920, page 162, but it

has been revised and brought up to date as far as Connecticut is concerned. We are indebted to Mr. A. F. Burgess for much of this information regarding the planting and recovery of parasites, though our men have co-operated with the Federal authorities in this work in Connecticut.

ATTACKING THE GIPSY MOTH

Calosoma sycophanta Linn.

Though not a parasite, both adults and larvae of this large ground beetle devour the caterpillars of the gipsy moth, and it is therefore quite an important agency for holding that species in check. It was liberated in Stonington in 1914, in Thompson in 1915, and in Killingly in 1917. This species now seems to be fairly well distributed over the State, as it has been collected or observed in Thompson, Putnam, Killingly, Scotland, Plainfield, Groton, Lyme, Clinton, New Haven, Meriden and Darien. Our employees have reported observing these beetles feeding upon gipsy moth larvae in Thompson and Killingly in 1920. A large and beautiful specimen of this beetle was seen by the State Entomologist in his yard in New Haven during the summer of 1922.

Two important and promising egg-parasites have been liberated in large numbers within our territory during the past year. One of them, *Anastatus bifasciatus* Fonsc., was first colonized in the State in 1917, the other, *Schedius kuvanae* How., was first liberated in 1921.

Anastatus bifasciatus Fonsc.

This very minute Hymenopterous egg parasite of the gipsy moth in Europe was first liberated in Connecticut in 1917, when colonies were placed in Thompson, Woodstock, Putnam, Killingly, Pomfret, Eastford, Brooklyn, Hampton, Chaplin, Mansfield and Canterbury. More colonies were planted in Brooklyn in 1918, Canterbury 1919, Eastford 1918 and 1919, Griswold in 1918, Hampton in 1918 and 1919, Killingly in 1918 and 1919, Ledyard in 1919, Mansfield in 1918, Norwich in 1919, Plainfield in 1918 and 1919, Pomfret in 1919, Putnam in 1918 and 1919, Scotland in 1918, Sterling in 1918 and 1919, Thompson in 1919, Voluntown in 1918 and 1919, and Woodstock in 1918.

This insect was recovered from Eastford in 1917, and from Voluntown in 1918.

During 1922 this insect was liberated in each of the following towns, the numerals indicating the number of colonies planted in each town: Brooklyn 22, Canterbury 21, Chaplin 10, Eastford 27, Hampton 9, Killingly 10, Plainfield 15, Pomfret 13, Sterling 16, Stonington 15, Union 47, Woodstock 10; making a total of 215 colonies of 2,000 individuals each, or 430,000 individual parasites.

Schedius kuvanae How.

This little Hymenopterous insect is from Japan and was first liberated in the northeastern or most thickly gipsy moth infested portion of the State in 1921, in numbers of individuals and towns as follows: Thompson 768,000, Putnam 386,465, Woodstock 337,960, Killingly 106,350, total 1,598,775 individuals. Mr. McEvoy, who liberated them, saw them start immediately to work on gipsy moth egg-clusters in the vicinity, 81 being counted on one egg-cluster. Observations in southern Massachusetts show that on an average 40 per cent. of the gipsy moth eggs gathered in five towns were parasitized by this little insect.

In 1922, colonies of this parasite were planted in Connecticut as follows:

Woodstock	91 colonies	(376,000 individuals)
Killingly	59 "	(236,000 ")
Union	73 "	(292,000 ")
Total	223 colonies	(904,000 individuals)

Apanteles fulvipes Hal.

This minute Hymenopterous insect parasitizes gipsy moth caterpillars in both Europe and Asia. No attempt has been made to colonize it in Connecticut until 1922, when 2,500 cocoons were placed in Stonington, and 1,200 cocoons in Griswold.

Apanteles melanoscelus Ratz.

This double-brooded Hymenopterous parasite of both gipsy and brown-tail moth caterpillars from southern Europe, is now firmly established in New England. It also attacks several native insects, and is therefore able to complete its life cycle each year. One colony of 500 cocoons was planted in each of the towns of Thompson, Putnam, Woodstock and Stonington, during 1922.

Monodontomerus aereus Walker.

A minute Hymenopterous parasite of the pupae of both gipsy and brown-tail moths. Not colonized in Connecticut but recovered from Putnam in 1911 and 1915, Hartford and Suffield in 1912.

Blepharipa scutellata Desv.

This Dipterous parasite or two-winged fly from Europe attacks the gipsy moth caterpillars, and although introduced many years ago, it was rather difficult to colonize the species successfully. Apparently it is now well established in this country, and for the first time colonized in Connecticut in 1922. One colony of 1,666 puparia was placed in each of the towns of Coventry and North Stonington. During the season this insect was recovered from Hampton, Canterbury and Plainfield.

Compsilura concinnata Meigen.

This is a medium-sized Dipterous parasite or two-winged fly of the family Tachinidae attacking both the gipsy and brown-tail moths. It was colonized at Putnam in 1912, Hartford in 1913, Mansfield, Plainfield and Stonington in 1914, Stafford, Suffield, Colchester, Norwich and Old Lyme in 1915, and Hampton and Scotland in 1917. It has been recovered from Woodstock in 1915, Stonington in 1916, Putnam, Stafford, Plainfield and North Stonington in 1917, Pomfret, Putnam and Stonington in 1918, Killingly, Plainfield, Pomfret, Putnam, Scotland and Thompson in 1919, and from Plainfield, North Stonington and Putnam in 1920. In 1922 it was recovered from Hampton, Brooklyn and Wolcott.

Sturmia (*Zygobothria*) *nidicola* Townsend.

This is another Tachinid fly of medium size parasitizing the larvae of both gipsy and brown-tail moths, and though never colonized in Connecticut, it was recovered from Canterbury and Waterford in 1917, and from Groton and Stonington in 1918.

ATTACKING THE BROWN-TAIL MOTH

Although the brown-tail moth has disappeared from our territory for the time being, it may return. Without doubt the following parasites have played some part in this disappearance, and are included here to make the record of imported parasites more complete.

Apanteles lacteicolor Vier.

This is a small Hymenopterous parasite of the brown-tail moth larvae. It has been colonized in Connecticut as follows: Putnam in 1912, Suffield, Hartford, Mansfield, Norwich, Stonington, Griswold, Plainfield, Killingly and Hampton in 1913, Manchester, Chester, Colchester and Lebanon in 1915, East Lyme and Canterbury in 1916, Montville and Groton in 1917.

This species has been recovered as follows: Brooklyn 1916, Canterbury 1917, East Hartford 1916, Groton 1918, Hartford 1913 and 1914, Killingly 1916, Lebanon 1915, Pomfret 1913, Putnam 1917, Stafford 1917, Stonington 1915, Suffield 1915, Thompson 1913 and 1916, Waterford 1914, 1916 and 1917, Wethersfield 1916, and Woodstock 1913, 1915 and 1916.

Pteromalus egregius Forst.

A minute Hymenopterous parasite of the brown-tail caterpillars not colonized in Connecticut, but recovered from Hartford in 1913 and 1914, and Putnam in 1915.

Meteorus versicolor Wesm.

This is a minute Hymenopterous parasite of the brown-tail caterpillars, and though no attempt was ever made to colonize the species in Connecticut, probably some cocoons were mixed with those of *Apanteles lacteicolor* and thus it became distributed. It was recovered from Hartford in 1914 and from Brooklyn, Killingly, Thompson and Woodstock in 1916, and from Groton in 1918.

The parasites mentioned on the preceding pages are apparently becoming effective in some portions of the thickly infested areas of Massachusetts, as defoliation was very severe in certain sections in 1921, and was much less so in most of these areas in 1922. It is reasonable to expect that the combined attacks of these different parasites may in time bring about an appreciable diminution of the gipsy moth pest.

THE GIPSY MOTH QUARANTINE*

On account of the recent spread of the gipsy moth in Connecticut, the quarantined area has been extended to include many more towns than were involved in the Federal Quarantine of 1921, or the State quarantine of March 23, 1920, (See Quarantine Order No. 2). The present quarantine was established by the Federal Horticultural Board, effective July 1, 1922, and by the State of Connecticut by Quarantine Order No. 4, effective July 20, 1922, as follows:

*Published as Bulletin of Immediate Information No. 18, August, 1922.

STATE OF CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

QUARANTINE ORDER No. 4

Concerning Gipsy Moths

In order to protect uninfested parts of Connecticut from danger of infestation by the gipsy moth, under authority given in Section 2106 of the General Statutes, the following regulations are hereby established.

1. The following towns are hereby placed under quarantine because of the gipsy moth:

HARTFORD COUNTY:

Avon	Farmington	Plainville
Berlin	Glastonbury	Rocky Hill
Bloomfield	Granby	Simsbury
Bristol	Hartford	Southington
Burlington	Hartland	South Windsor
Canton	Manchester	Suffield
East Granby	Marlborough	West Hartford
East Hartford	New Britain	Wethersfield
East Windsor	Newington	Windsor
Enfield		Windsor Locks

LITCHFIELD COUNTY:

Barkhamsted	New Hartford	Salisbury
Canaan	Norfolk	Thomaston
Colebrook	North Canaan	Torrington
Harwinton	Plymouth	Winchester

MIDDLESEX COUNTY:

Cromwell	East Hampton	Portland
	Middletown	

NEW HAVEN COUNTY:

Waterbury	Wolcott	

NEW LONDON COUNTY:

Bozrah	Ledyard	Preston
Colchester	Lisbon	Salem
East Lyme	Montville	Sprague
Franklin	New London	Stonington
Griswold	North Stonington	Voluntown
Groton	Norwich	Waterford
Lebanon		

TOLLAND COUNTY:

Andover	Ellington	Tolland
Bolton	Hebron	Union
Columbia	Mansfield	Vernon
Coventry	Somers	Willington
	Stafford	

WINDHAM COUNTY:

Ashford	Hampton	Scotland
Brooklyn	Killingly	Sterling
Canterbury	Plainfield	Thompson
Chaplin	Pomfret	Windham
Eastford	Putnam	Woodstock

These same towns have already been quarantined by the Federal Horticultural Board of the United States Department of Agriculture, and it shall be unlawful to remove from this quarantined area any woody nursery stock, lumber, cordwood, telegraph or telephone poles, railroad ties, or other forest plant products, unless the products shall have been inspected and certified by an authorized State or Federal inspector.

2. All Connecticut towns quarantined by Quarantine Order No. 2 (dated March 23, 1920) because of the brown-tail moth, are hereby released.

3. In view of possible future changes in the lines between the infested and non-infested areas of the State, the areas quarantined by the State shall conform to those quarantined by the United States Department of Agriculture; furthermore, the regulations established by the Federal Horticultural Board of the United States Department of Agriculture for inter-state shipments, are hereby adopted for the inspection and certification of similar shipments from the quarantined area to points outside of this area within the State of Connecticut.

4. This order shall take effect from its date.

Dated July 20, 1922.

E. H. JENKINS,
Director, Connecticut Agricultural Experiment Station.

Approved:
EVERETT J. LAKE,
Governor.

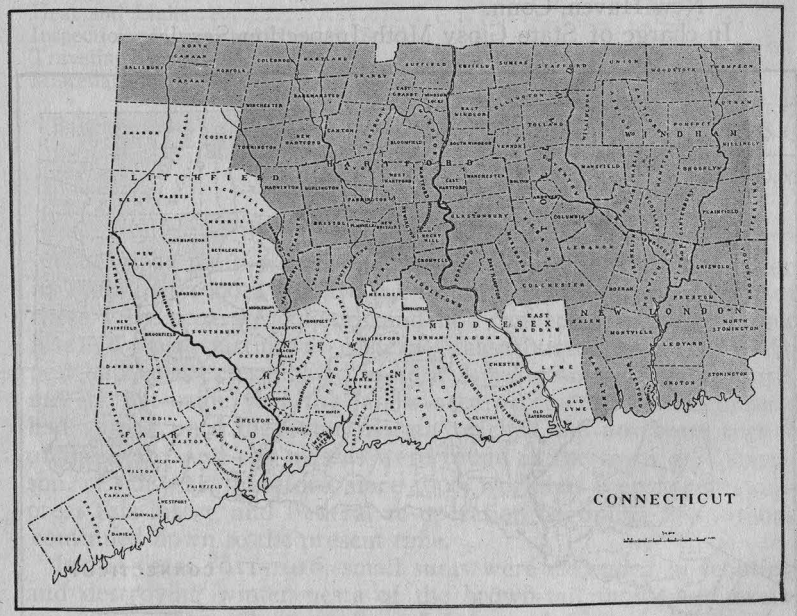

Figure 4. Map of Connecticut showing territory quarantined in 1922 on account of gipsy moth.

Instructions to Nurserymen, Lumbermen, Wood Dealers, Shippers and Transportation Companies

Any shipments of nursery stock, or forest products originating within the quarantined area must not be shipped out of that area into the territory not infested, unless inspected and accompanied by an inspector's certificate. All shipments going into other States must be examined by a Federal Inspector, and the Federal Inspectors have also been authorized to inspect shipments consigned to points within the State: the State inspector can also examine such shipments in case of convenience or if the Federal Inspectors are busy elsewhere.

Transportation companies must not accept nursery stock or forest products consigned to points outside of the infested area unless accompanied by certificate of inspection.

Until an adequate number of Federal inspectors have been assigned to duty in Connecticut, and their districts established, applications for inspection may be made to:

D. M. Rogers, Room 304, 402 Atlantic Ave., Boston, Mass.
In charge of Federal Gipsy Moth Inspection Service.

W. E. Britton, State Entomologist, Conn. Agr. Exp. Station, New Haven, Conn.
In charge of State Gipsy Moth Inspection Service.

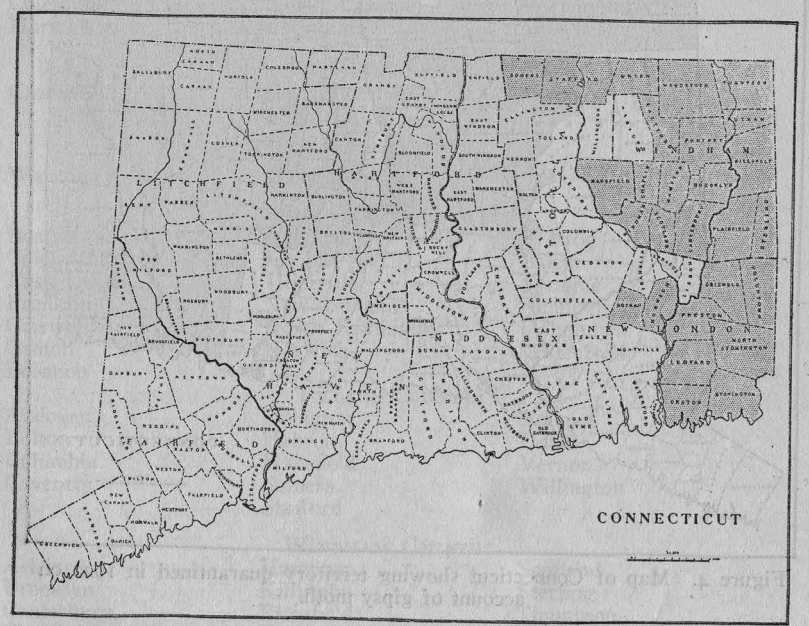

Figure 5. Map of Connecticut showing extent of Federal quarantine in 1921.

Financial Statement

RECEIPTS

Appropriation for biennial period ending June 30, 1923, $60,000.00.

CLASSIFIED EXPENDITURES FOR THE PERIOD ENDING JUNE 30, 1922

Salaries and Wages		$25,105.04
Printing and Illustrations		40.55
Postage		2.47
Stationery		13.05
Telegraph and Telephone		14.75
Insurance (supplies including horse sprayer)		66.40
Spraying Supplies		659.30
Machinery, Tools and Supplies		72.37
Express, Freight and Cartage		5.72
Rental and Storage		340.47
Automobiles: Insurance	$ 630.39	
Supplies and Equipment	337.98	
Repairs	747.04	
Gasoline	1,544.90	
Oil	180.21	
		3,440.52
Heat and Light		76.34
Inspection of Imported Nursery Stock		301.01
Traveling Expenses		159.42
Miscellaneous		4.36
		$30,301.77
Balance		29,698.23
		$60,000.00

Cost of Moth Suppression Work

The gipsy moth was first found in Connecticut at Stonington in 1906. In 1909 a colony was found in Wallingford. Both of these were separate colonies and not connected with the larger infested area starting in eastern Massachusetts. By 1913, the pest had been exterminated in both Stonington and Wallingford, but in that same year the larger area of eastern Massachusetts had spread until the outer margin reached the northeast corner of the State, and egg-masses were found in the town of Thompson. Each year, therefore, since 1906, work has been done to suppress this insect, and Federal co-operation beginning in 1907 has continued down to the present time.

In the years 1911-1916, small sums were expended in scouting and destroying winter nests of the brown-tail moth, and every year since 1909, all nursery stock imported from foreign countries into Connecticut has been inspected because gipsy moth egg-clusters and brown-tail moth nests have often been brought into the United States on such importations.

The cost to the State for all of this work of suppressing the gipsy moth and the brown-tail moth, and for inspecting imported nursery stock is shown for each fiscal year in the following table:

EXPENDED BY STATE OF CONNECTICUT

Year	Amount Expended	Year	Amount Expended
1906	$1,500.00	Brought forward	$31,181.76
1907	4,550.00	1915	8,057.39
1908	2,550.00	1916	13,027.39
1909	1,503.22	1917	7,792.80
1910	4,560.22	1918	22,644.18
1911	4,017.95	1919	17,459.79
1912	2,668.97	1920	33,081.11
1913	5,231.07	1921	35,188.50
1914	4,600.33	1922	29,937.33
	$31,181.76		$198,550.25

Between the beginning of the fiscal year of 1907 and October 31, 1922, the Federal Government has expended on this work in Connecticut, including salaries, temporary labor, traveling expenses, supplies and miscellaneous charges, a total of $276,044.07. The total amount expended by both State and Federal Government on this work in Connecticut to date is as follows:

State Expenditures	$198,550.25
Federal Expenditures	276,044.07
Total	$474,594.32

INCREASED APPROPRIATION NEEDED

On account of the wind-spread mentioned on page 290, which so greatly increased the territory to be covered, a larger appropriation will be absolutely necessary for the next biennial period if the gipsy moth is held in check, and we recommend that $100,000.00 be appropriated for the two years ending June 30, 1925, instead of $60,000.00, the amount appropriated two years ago.

A request for a deficiency appropriation of $20,000.00 was placed in the budget to continue the suppression work to the end of the present fiscal period. It is estimated that a balance of about $14,000.00 will be left from the old appropriation at the time the General Assembly convenes soon after the first of January. We expected this balance to be considerably less, but the increasing difficulty in obtaining trained scouts delayed the progress of the work and consequently the expenditure of a portion of the funds during the fall months. For this reason the deficiency may be considerably less than the amount contained in the budget. Just what will be needed when the Legislature is ready

to take action on deficiencies after the present appropriation is exhausted, is difficult to state, but probably some amount between $10,000.00 and $15,000.00 will be needed.

INFESTATIONS IN OTHER STATES

The gipsy moth first appeared in this country as a pest in Medford, Mass., near Boston, from which point it has spread naturally in all directions, but extending more rapidly and further toward the north than in other directions, due perhaps to climatic conditions, but chiefly to prevailing winds. Of course, its spread toward the east has been limited by the Atlantic Ocean. It has also been accidentally transported and several isolated colonies have been discovered and exterminated, particularly in Connecticut, New York, New Jersey, Pennsylvania and Ohio. The extent of the infestation now in the United States is approximately as follows:

Maine: Infested in the southwestern portion, the infestation extending along the coast into the first tier of towns in Washington County, and not further north than the center of the State. In western Maine it has spread northward into a few towns in the southern part of Oxford and Franklin Counties. The almost exclusive coniferous forests in northern Maine will probably limit the spread of the insect as a destructive pest in this direction. There is danger that it may spread eastward into New Brunswick and Nova Scotia.

New Hampshire: The entire State, except the northernmost part, Coos County, is infested.

Vermont: The insect has spread across southern Vermont to the New York line. Along the Connecticut River, there is an infested strip, four or five towns deep, extending to the northernmost county, Essex County, which has one infested town on its southern border. No gipsy moths have yet been found in the northern and western counties of Orleans, Franklin, Lamoille, Chittenden, Addison and Rutland. Washington County has one infested town and Bennington County has several. Moreover, from a knowledge of the climate and tree growth, there seems to be no reason why the insect may not continue to spread northward through Vermont and into Quebec.

Massachusetts: The entire State is now infested, thickly in the eastern portion, and scatteringly in the Berkshires, where artificial control is very difficult.

Rhode Island: The entire State is now infested.

Connecticut: All of Windham, Tolland and Hartford Counties, and all except the western portion of New London County, the northern part of Litchfield County, and two of the northern-

most towns in each of New Haven and Middlesex Counties are infested. This infestation is all scattered except in Windham County, which has been longest infested, and the northern part of Tolland County adjoining Massachusetts.

New York: A colony was discovered near Mount Kisco and one at Geneva a few years ago, and both exterminated. One on the eastern end of Long Island is nearly exterminated. Several small colonies were started at various points by being sent out on nursery stock from Somerville, N. J., but it is believed that all of these have been exterminated. During the past season the pest has been found in two or three towns adjoining Massachusetts or Vermont.

New Jersey: During the summer of 1920, an infestation of some 800,000 egg-clusters and involving about 100 square miles was found on the Duke estate at Somerville. Vigorous measures were immediately taken by State and Federal authorities, with the result that it has been nearly eradicated. Several shipments of nursery stock carried the pest to other points in New Jersey, but it is believed that these minor infestations have all been exterminated, and that the major colony will soon be exterminated.

Future Outlook

It is perfectly natural to ask about the future prospects of the gipsy moth in Connecticut. Must the State continue to make increasing appropriations to wage what seems to be a losing fight against the gipsy moth? It is a fair question. Yet this pest has been wholly eradicated from two separate infestations in Connecticut, and for ten years the invasion has been stemmed sufficiently so that no stripping of trees or noticeable injury has resulted. Were it not for the occasional wind-spreads, which cannot be prevented or foretold, the spread of the gipsy moth would be very slow in the face of the control measures in effect against it. A marked wind-spread occurred in 1915, a slight one in 1917, a greater one in 1920, but this one in the spring of 1921 is the most severe and carried the larvae the greatest distance, of any on record. With adequate funds, it is not only possible but feasible to eradicate many of these scattered infestations found the past year.

The scouting of all woodland areas is extremely expensive, and must be done several times perhaps to discover all the infestations now present. However, we may fairly expect that some of the infestations may be eradicated, and some of the towns liberated from the quarantined area.

We might take advantage of Sections 2112-2114 of the General Statutes, which provide that the towns be ordered to control

the insect within their borders. Massachusetts has a similar law, which further provides that each property owner expend a certain amount each year, based on the valuation of his property for the control of the insect on that property. If he does not do so, the town will do the work and charge it as taxes upon the property. But trained men are necessary to do this work effectively. The State has a force of such men at present. Few towns or individuals have or could obtain men trained in gipsy moth control. In such cases the work is neither efficient nor effective, and the money is not wisely expended. The moths would probably spread faster than under the present system, exclusive of the wind-spread.

As this insect has now spread to the borders of New York State and New Yorkers are quite alarmed over the prospect, they are seeking the best available data and advice before adopting a plan of campaign. For this purpose a conference was held at Albany, November 16, 1922, called by the New York Commissioner of Farms and Markets. With the exception of Maine, all New England States were represented, as were also New York, New Jersey, and the Canadian and United States Bureaus of Entomology. The following resolution relating to the gipsy moth was adopted:

"*Whereas,* the gipsy moth is one of the most destructive insect pests affecting forest, shade, fruit and park trees; and enormous damage has been caused by this insect in New England; and upwards of twenty millions of dollars have been expended by these states and the Federal government in their efforts at suppression and control; and,

"*Whereas,* the spread of this insect constitutes a serious menace to the forest, shade, fruit and park trees of New York State and the territory south and west thereof; and,

"*Whereas,* it has been demonstrated that in local infestations, as in the case of New Jersey, complete eradication may be possible, and that over wide areas general control measures to reduce damage and injury are practicable; and,

"*Whereas,* owing to topographic features, distribution of different kinds of trees and feeding habits of the insect, it is believed that a control zone should be established from Long Island Sound, in a general northerly course, east of the Hudson River, through New York or New England, or both, for the purpose of permanently preventing the spread of this insect; therefore,

"*Be It Resolved,* that it is the sense of this conference composed of foresters, agriculturists, entomologists and administrative officials, from the New England States, New York and New Jersey and representatives of the United States Department of Agriculture and the Dominion of Canada, held at Albany, N. Y., November 16, 1922,

"*That,* sufficient appropriation should be obtained by the states interested and the Federal government for the purpose of continuing and strengthening present control methods in the infested areas, to eradicate the New Jersey infestation, to do necessary scouting for the discovery and destruction of border infestations, to determine the location of the most practicable place for a control zone, to take necessary steps to make control therein effective, and for the destruction of all infestations in and west of said zone."

Recommendations

In view of existing conditions and our experience in work against this insect, we recommend that this suppression work be continued in Connecticut, and that Connecticut do its full share in co-operation with the other infested States and with the Federal Government in attempting to control and prevent the further spread of this destructive insect pest. To this end we recommend that the appropriation named in the budget ($100,000.00) be granted for the two years ending June 30, 1925, together with such deficiency appropriation as may seem necessary to continue the work with our regular force after the present appropriation is exhausted until July 1, 1923, when the new appropriation becomes available.

MOSQUITO CONTOL WORK

Season of 1922

By S. T. Sealy

Maintenance work for mosquito control on the marshes which have been drained was started April 3, and continued until November 1. During this time the marshes were inspected, patrolled, and all drainage systems kept open. By keeping the ditches in condition to function properly, thereby draining off surface water, salt marsh mosquito breeding was controlled to a great extent.

High tides and the abnormal amount of rainfall during the early part of the season somewhat hindered the work. The excess rain water accumulated in low places at the edge of the marshes which are usually dry. These places made conditions very favorable for mosquito development. Broods of fresh water species developed and got on the wing from a number of such places. Results of collections made during the season showed that a greater proportion of mosquitoes that were so numerous this season were fresh water species.

Several complaints from property owners and summer residents along the shore were investigated. In all investigations it was determined that the heavy mosquito invasions came either from undrained marshes in the near vicinity or from pools caused by rain water accumulating in depressions which are ordinarily dry. Another source that helped keep up the supply was furnished by cans, barrels, buckets, and other receptacles that would hold water long enough for mosquito development.

At the request of the management of Camp Everett, Twin Lakes, Connecticut, an inspection was made August 9, 1922. *Culex pipiens* was found to be breeding in a low, swampy area

extending through the camp grounds. It was suggested than a drainage ditch be dug through this area, which would carry off all surface water into the lake. It would also establish a drain for the many springs in this area. As there have been no further complaints, it is reasonable to suppose that the mosquito pest, in that particular locality, has been eliminated.

A few days before the military camp at East Haven was to be occupied by the State Guardsmen, a request was made by Major C. E. Smith to inspect the camp and determine what could be done to make it more comfortable for the men. An inspection was made July 5, 1922. Several extensive swampy areas were found to be breeding places of *Culex pipiens*. As the time was short and no funds available for drainage work, it was thought best to oil the ponds and streams near the site where tents were to be pitched.

Another inspection was made the day before the camp was to be occupied and no breeding of consequence was found. The oil and labor necessary to apply it were furnished by the military authorities.

New Haven

The marsh north of Middletown Avenue known as the "Quinnipiac Marsh" has given considerable trouble this season. The railroad company is continually increasing its yard limits, and in making foundations for new trackways, dumps carloads of fill on the meadow surface. The enormous weight causes the meadow to sink to such an extent that drainage ditches have been completely closed by the vibration that occurs when heavy trains roll over the tracks. New ditches were cut, but it was impossible to keep them in condition to function properly. In order to control mosquito breeding in this section in the future, it will be necessary to depend entirely on the use of oil until such a time as the marsh is all reclaimed by filling.

Fort Hale marsh has also been a troublesome one this season. The main outlet of the drainage system is not adequate to carry off surface water fast enough to impede mosquito development. Oil had to be used several times during the season.

West Haven

Salt marshes in the town of West Haven with the exception of the area north of Beach Street have not given any serious trouble this season. The Beach Street marsh has been flooded several times, making conditions ideal for mosquito development. The flooding was due to defective tide gates, which have needed repairs for some time past. The matter of repairs has been taken

up with the selectmen and they probably will put the gates in better shape before next season.

East Haven

The ditches on the drained marshes have been cleaned and regraded twice during the season. Mosquitoes on the wing were, however, quite numerous on several occasions. Their breeding places have been traced to the undrained marshes nearby. Another source of supply was from fresh water pools formed by abnormal rainfall.

Branford

Maintenance work has been carried on throughout the season and ditches and outlets were kept free of rubbish. A close watch was kept over the whole drainage system. Inspections of the marshes during the season did not reveal any salt marsh breeding.

Guilford

Marshes have been regularly patrolled and all ditches requiring it have been given the needed attention. The absence of salt marsh mosquitoes this season has been noticeable.

Madison

Scarcity of mosquitoes at the State Park and surrounding territory proved that the drained marshes are almost mosquito proof.

Groton

The marshes at Groton Long Point have been inspected. Ditches were cleaned and all obstructions removed. No breeding occurred on the drained areas.

Stamford

Marshes at Shippan Point have been inspected and all drainage ditches cleaned several times during the season. Heavy rainfall early in the season caused several low areas in this section to fill with water, making conditions ideal for the development of mosquitoes. Oil was used to spray these places, keeping breeding somewhat under control.

As the funds are limited for maintenance and control work, the supply of oil was not adequate to spray all breeding areas. Consequently heavy broods of mosquitoes got on the wing several times during the season.

Fairfield

Marshes in Fairfield have been regularly inspected, patrolled and kept free of mosquito breeding. The Fairfield Improvement Association has renewed its activities and carried on a fresh water mosquito campaign this season. Several breeding places have been permanently eliminated by drainage or filling and others temporarily controlled by the use of fuel oil.

Cost of Maintenance, Season of 1922

Madison	$ 293.75
Guilford	455.50
Branford	445.75
East Haven	38.00
West Haven	261.00
New Haven	515.05
Fairfield	1,245.95
Groton	36.00
Stamford	188.20
	$3,479.20

The total cost of this work for the season, exclusive of supervision, is $3,479.20, of which one-fourth, or $869.80, and the entire cost of supervision are borne by the State. The other three-fourths of the cost of maintenance, or $2,609.40, is collected from the towns by the State Comptroller.

TESTS OF SPRAYS TO CONTROL THE SAN JOSÉ SCALE

A small apple orchard at Mount Carmel, Hamden, was found to be rather badly infested with San José scale. This orchard had been somewhat neglected for a number of years, and judging from the appearance of the trees had not been sprayed. There was considerable dead wood in the tops, and the larger branches and trunks were covered with rough bark and lichens. The present owner, Mr. J. F. Corley, had recently purchased the place and wished to improve the orchard. Messrs. Zappe, Stoddard and Britton visited the orchard on March 8, and advised the owner about the pruning. The orchard was conveniently arranged to divide into six plots for various treatments. Altogether there were fifteen rows with an average of eight trees per row. The owner started to prune the orchard and was about half through with this work when it was time to make the application. Consequently where the B. T. S. (three rows) and the liquid lime-sulphur (four rows) were applied, the trees were not pruned until after the application. All other plots had two rows each.

The rows and plots extended east and west. Though the conditions in this orchard were hardly ideal for such experiments (there being too much rough bark and not enough vigor in the trees) it is difficult in Connecticut to find an orchard where the scale is sufficiently prominent for such tests. Consequently we thought it best to make them.

Mr. Walden cut twigs from each of these plots on April 11, and examined the scales to ascertain the proportions of living and dead individuals. The spraying was done by Messrs. Zappe and Stoddard on April 11, 12 and 13, an Arlington X. L. power outfit being used.

The following materials were used:

Liquid lime-sulphur, one gallon in 10 gallons of water. Four rows.

Sherwin-Williams Dry Lime-Sulphur, one pound in 10 gallons of water. Two rows.

Scalecide, one gallon in 15 gallons of water. Two rows.

Keresol, one gallon in 18 gallons of water. Two rows.

Sulco V. B., one gallon in 25 gallons of water. Two rows.

B. T. S., 12 pounds in 50 gallons of water. Three rows.

Of these commercial preparations a brief statement may be made. Keresol is an oil mixture containing about 70 per cent. of kerosene. Sulco V. B. contains fish oil and a small percentage of phenol. B. T. S. is barium tetrasulphide, a powder which is claimed to give better results than lime-sulphur. Sherwin-Williams dry lime-sulphur is purported to be of the same composition as the commercial liquid lime-sulphur, with the water left out. Scalecide and liquid lime-sulphur are both well-known and need not be explained here.

On June 7, Mr. Walden cut twigs from the sprayed plots and examined the scales to determine the effect of the treatment. The data showing the average results of each treatment is given in the following table:

RESULTS OF TREATMENT

Treatment	Percentage of scales alive before treatment	Percentage of scales alive after treatment	Percentage of scales killed by treatment
Dry lime-sulphur	20.5	5.5	74.9
Scalecide	20.7	1.6	97.2
Keresol	16.2	5.3	68.9
Sulco V. B.	20.8	2.7	84.5
B. T. S.	15.9	4.	72.6
Liquid lime-sulphur	15.1	3.1	77.3

The table shows that there was only a small proportion of the scales living at the time of the applications. On account of the rough bark it is very difficult to reach all of them in a single treatment, however thorough, so in each case some were found to be living when the twigs were examined on June 7. The percentages of kill shown in the right hand column do not vary greatly, but such differences as exist show that Scalecide gave the best control (97.2) followed by Sulco V. B. (84.5). Keresol gave the lowest percentage of kill (68.9) which may possibly be due to too dilute a mixture, though the manufacturer's directions were followed. Of course the lime-sulphur mixtures and the B. T. S. do not have the penetrative power of the oil mixtures, but on young trees having smooth bark would doubtless have made a better showing. It is often necessary to give several treatments before such an orchard can be wholly freed from scale.

These trees afterward made a fairly good growth though it was evident that they needed fertilizing, cultivating and summer spraying to protect the fruit crop.

TESTS OF PARADICHLOROBENZENE AS A REMEDY FOR THE PEACH BORER

By M. P. ZAPPE

On September 10, 1921, a large proportion of the peach trees in the orchard at the Station Farm at Mount Carmel were treated with Paradichlorobenzene to control the peach borer, *Synanthedon exitiosa* Say. This orchard was ten years old at the time of the application and consists of five rows of trees with 30 trees in each row. A few trees have died and have been removed so that the original number were not available for experiment. Four rows were treated, and the fifth row left untreated as a check.

The material was applied according to directions given in Circular 126, New Jersey Agricultural Experiment Station, 1921. The grass and rubbish were first removed from around the trees, the soil leveled, and one ounce of the Paradichlorobenzene was sprinkled in a circular band around the base of each tree trunk about one inch from the bark. This material was then covered with soil free from grass and weeds, making a low mound around the base of the trunk.

The trees were left in this condition over winter, and examined on May 17, 1922, to note the results, which are shown in the following table:

	Number of Trees	Average No. of Living Borers Per Tree	Distribution of Average No. of Living Borers per Tree	
			Above Soil	Below Surface
Treated	108	.62	.42	.20
Untreated	22	1.95		

It will be seen from the figures in the table that the treatment reduced the average number of living borers from nearly two

borers per tree to .62, or a little more than one-half of a borer per tree on the average. Most of the living borers present in the treated trees were above the mound of soil covering the Paradichlorobenzene. Below the surface of the mound, several dead borers were found. Had the soil been mounded higher about the trunks of the trees, it is probable that few borers would have survived. Further tests are now being conducted. The trees showed no indication of injury from the treatment.

CABBAGE ROOT MAGGOT EXPERIMENTS

By M. P. Zappe

The cabbage root maggot, *Phorbia brassicae* Bouche, has caused serious damage to early cabbages nearly every year in the market gardens around New Haven. As several new methods of control have recently been recommended for this insect, it was thought best to test some of them on a small scale at the Station Farm at Mount Carmel in 1922.

Thus 296 plants of Copenhagen Market variety were set in two rows on May 11, 1922. Three treatments were applied each to 75 plants, and 71 were left untreated as checks. The following materials were used: Corrosive sublimate or mercuric chloride; tobacco dust and hydrated lime; and tarred paper disks.

Corrosive Sublimate Treatment

Corrosive sublimate (or mercuric chloride) is a poisonous chemical, partly soluble in water. It was used at the rate of one ounce in ten gallons of water, five gallons being enough to treat 75 plants, or about one-half pint per plant applied just after the plants had been set. This is perhaps more than would ordinarily be needed, but the soil was very dry and needed moisture. The other plants were given an equal quantity of clear water. A second treatment of corrosive sublimate was made about twelve days after the first treatment.

Tobacco Dust and Hydrated Lime

Tobacco dust and hydrated lime were mixed together, using equal parts by weight, and a small quantity placed around the stem of each plant as soon as set. About one and three-fourths pounds of this mixture were applied to the 75 plants. A second application was made twelve days after the first treatment.

Tarred Paper Disks

The usual hexagonal disks of tarred paper, such as may be purchased at seed stores or which may be cut from tarred paper at home, were placed on the plants when set.

Table Showing Results of Treatment

Treatment	No. of Plants Set	No. of Plants Killed by Maggots	Percentage of Injury
Corrosive Sublimate 1 oz. to 10 gals.	75	2	2.6
Tobacco dust, Hydrated lime Equal parts	75	7	9.3
Tarred paper Disks	75	1	1.3
Checks no Treatment	71	11	15.5
	296	21	

Discussion of Results

For some unexplained reason the cabbage maggot was not very abundant, and the resulting damage was considerably less than usual on early-set cabbages at Mount Carmel. Even on the untreated plants, only 15.5 per cent. were killed by maggots. In similar experiments conducted on a much larger scale in the same locality in 1915, nearly one-third of the untreated plants were killed by maggots.

In the present tests, only one plant was killed among the tarred paper disks, two plants treated with corrosive sublimate, and seven plants died where the tobacco dust and lime were applied. Results are shown in the accompanying table.

Thus in these tests the corrosive sublimate treatment and tarred paper disks gave good control with little difference between the two. The former is cheaper and easier to apply. It takes more time to apply the disks to the plants and their cost is greater than that of the corrosive sublimate material, which may be purchased for thirty cents an ounce in small quantities. In larger quantities the cost would be considerably less. An ounce proved enough to treat 150 plants, or to give two applications to the 75 plants in the test. On the other hand, corrosive sublimate is a dangerous poison, and many would prefer to use the tarred paper disks, especially in the home garden.

WORK WITH THE EUROPEAN RED MITE[1] IN 1922

By Philip Garman

The European red mite appeared in Connecticut orchards early in the season, multiplied abundantly and rapidly, and by the middle of June had caused considerable foliage injury. Heavy rains

[1] *Paratetranychus pilosus* Can. and Fanz.

then set in and continued until late in the summer, resulting in only a slight increase of the mites, or in most cases a decided decrease in relative numbers. With these weather conditions it is evident that early treatments should prove of more value than later ones and, as will be seen, they were actually of more benefit.

Eggs began to hatch in 1922 about May 2. A few mites were found mating on May 13 and freshly laid eggs were seen May 15. Eggs laid May 16 and 18 then hatched May 29, but the mites were not followed to maturity at this time. However, eggs hatching July 1 matured by July 8 and the preoviposition period appeared to be of about two days duration. Eggs laid August 6 hatched August 14 and matured August 23. Eggs obtained from another adult August 29 hatched in eight days, while eggs laid September 15 failed to hatch and were apparently in condition to pass the winter. Thus we see that there is a relatively short life cycle, consisting of approximately seventeen days in August, though requiring longer in cold weather. The adults were kept alive in June for three weeks, and one individual laid 34 eggs during this time. It also appears that approximately half the life period is passed as an egg, which in mid summer may remain a week before hatching. Sprays not affecting the egg should therefore be repeated within ten days (allowing eight days for the mites to mature and two days before egg-laying begins), but if more sprays are applied, the third should not necessarily follow within this interval, but could be delayed from two weeks to eighteen days without loss in efficiency.

Spraying operations were undertaken during the summer in three different orchards as follows: (1) the Bradley orchard, owned by Mr. S. T. Bradley at North Branford; (2) the orchard owned by the Plant Brothers at Branford, and (3) that owned by Mr. F. N. Platt at Milford. To all of these gentlemen thanks are due for valuable help and co-operation.

The Bradley orchard consists of Baldwin trees, set in rows, the trees 16 feet apart in each row. This condition provides excellent quarters for mites, and a serious infestation appeared early in June. The orchard received no winter treatment except a few rows through the center which were, however, disregarded, and no special mite treatment applied. It was learned from Mr. Bradley that the whole orchard had been sprayed at the pink bud period with lime-sulphur, lead arsenate and nicotine, and had received one other spray with this combination. Plots were laid out consisting of three rows and 8 to 12 trees deep. The spray outfit consisted of a four-cylinder power rig furnishing a pressure of 300 to 400 pounds. Two leads of hose were used with a spray gun on each.

Each plot received two treatments, one being applied June 2 and the other June 16. The following sprays were used and there was no variation in the two treatments in the composition of the spray: (1) linseed oil emulsion[1] composed of 1 gallon of linseed oil and 1½ pounds of Ivory soap flakes to each 100 gallons of water; (2) Ivory soap flakes, 3 pounds to each 100 gallons of water; (3) Kerospray, 1 gallon to each 100 gallons of water; (4) fish oil soap (sodium) 8½ pounds to 100 gallons; (5) self-boiled lime-sulphur 8-8-50 formula with 1½ pounds of casein lime spreader per 100 gallons; and (6) checks consisting of trees not receiving any treatment, especially for mite control, the only sprays being those applied early in the season by the owner, as mentioned above. Count twigs were collected from trees in the center of the treated blocks after the first spray, but it soon became evident that the value of the sprays (excepting self-boiled lime-sulphur) could be easily judged by inspection, those with fewest mites having decidedly greener foliage.

Examination June 5 showed the block treated with linseed oil to be in somewhat better condition than the rest, but that treated with fish oil soap was not far behind. There was little choice in the remaining treatments except for the Kerospray treatment, where the trees equaled the checks in brownness of foliage. Results of the count are seen in the following table:

RESULTS OF FIELD TESTS WITH SOAPS, LINSEED OIL EMULSION AND SELF-BOILED LIME-SULPHUR

In Bradley Orchard

Insecticide Used.	No. Alive	No. Dead	% Dead	No. of Leaves Examined	No. of Twigs Examined	Date of Treatment	Date of Examination 1922
Linseed Oil 1 gal. Ivory soap 1½ lbs. Water 100 gals.	718	1,524	67.9	80	10	June 2	June 6
Ivory soap 6 lbs. Water 200 gals.	1,743	779	30.8	60	9	June 2	June 6
"Kerospray" 1 gal.-100 gals.	916	381	29.5	50	6	June 2	June 6
Fish oil soap 14 lbs.-200 gals.	691	655	48.6	54	6	June 2	June 7
Self-boiled lime-sulphur (8-8-50) Kayso 2½ lbs.-200 gals.	951	356	27.2	64	8	June 2	June 8
None	1,592	278	14.	65	7	——	June 8

[1] Prepared according to directions in Mass. Agr. Exp. Sta. Bull. 179, pages 175-6, except that flakes were used instead of bars of soap.

Inspections were made June 20, June 30, August 2 and October 8. The same relative value of the treatments was apparent up until the last inspection, those trees treated with fish oil soap and linseed oil emulsion having much better and greener foliage and more of it, as shown on Plate IX, photographed October 8. However, none of the fruit appeared to be in good condition at the end of the season, being largely deformed by aphis and affected with Brooks' fruit spot. Other ingredients are needed to make the spray practical.

The linseed oil and fish oil soap sprays were repeated at Plant's orchard at Branford, the sprays being applied June 26 and July 11. Here the material was applied by power outfit and spray rods. The water used was comparatively hard and the amount of Ivory soap used to emulsify the linseed oil was increased to 2½ pounds of flakes to each 100 gallons after the first application. Fish oil soap was used at the rate of 7 pounds per 100 gallons. The orchard had received a delayed dormant spray with lime-sulphur, a "pink bud", "calyx" and "two weeks" sprays with the usual mixtures. The most heavily infested trees were York Imperials and these were treated with linseed oil emulsion.

While there was no marked improvement in treated trees over checks in this orchard, there appeared some slight improvement in the condition of the foliage, which continued to the end of the season. However, on inspection October 8, little difference could be seen between checks and trees treated with the above mixtures.

The experiments in the orchard of Mr. F. N. Platt at Milford consisted of three treatments, two of which were given in connection with dusting and spraying experiments conducted by Messrs. M. P. Zappe and E. M. Stoddard of this Station. The first consisted of a block of Baldwin and Greening trees, 25 trees in all, 15 of which were Baldwins. These were treated with a combination of borax laundry soap and flour of sulphur. The first application contained four pounds of soap and 10 pounds of sulphur to each 100 gallons, the second seven pounds of soap and 15 pounds of sulphur, and the third six pounds of soap and 10 pounds of sulphur per 100 gallons. Applications were made May 13 (calyx), June 13, and July 19.

The second block, 56 trees, was treated with lime-sulphur and lead arsenate plus nicotine sulphate at the "pink bud", "calyx cup", and "two weeks" periods, these sprays being applied April 27, May 19 and June 13. Two additional applications, June 29 and July 19, were made, but apparently did not increase the efficiency of the control. On the same dates (April 27, May 19, June 13 and 29, and July 19) a third block was dusted with 90-10 sulphur dust containing nearly 4 per cent. nicotine. All sprays were applied with a spray gun, with a single lead of hose and power rig furnishing about 200 pounds pressure; the dusts with a power duster. The entire orchard received no winter or dormant spray.

Inspection of all sprayed trees (both soap and lime-sulphur treatments) in the latter part of June, showed a good many live mites, but the foliage did not turn brown and the fruit appeared to be in good condition at this time. Some of the check Baldwin trees, however, showed considerable browning and defoliation at the end of the season. The block sprayed with lime-sulphur, etc., and that dusted with sulphur and nicotine were adjacent, and the difference in their appearance was very noticeable in the Baldwins. Those sprayed with lime-sulphur, nicotine sulphate and lead arsenate, were green and healthy in appearance, while those dusted with sulphur and nicotine soon turned brown in color, so that a distinct line could be seen between the two blocks. In other words good control was obtained with the sprays and practically none with the dusts. The dusted trees lost considerable foliage towards the end of the summer and appeared in about the same condition as some of the check trees in other parts of the orchard.

As a general summary, then, it may be stated that fish oil soap, laundry soap plus sulphur, linseed oil emulsion and lime-sulphur with lead arsenate and nicotine sulphate gave control in 1922, the more effective being applied before the middle of June. Dust containing nicotine, lead arsenate and sulphur did not control the mite effectively. The mite hatched about May 2 in 1922, and these matured about the middle of this month. In July approximately two generations were observed; and winter eggs were found September 15.

The relative cost of the successful sprays are seen below. It will be noticed that fish oil soap is cheaper than any of the others, and substances could be added for control of fungous diseases without making it too expensive. Linseed oil emulsion is a close second to fish oil soap in this respect, but we do not regard it as a safe practice to add arsenates to either of these sprays, and additional treatments are necessary to control chewing insects. It is not necessary to add nicotine sulphate to fish oil soap, though its addition would doubtless help in controlling aphis. In regard to combinations with linseed oil emulsion, not much is known though it is probable that arsenates, if added, would cause foliage injury.

COST OF SUCCESSFUL SPRAYS, PER 100 GALLONS

Lime-sulphur-nicotine-sulphate-lead arsenate	$3.00 to $5.20
Fish oil soap	.70 to 1.40
Laundry soap plus sulphur	1.72 to 2.32
Linseed oil emulsion	1.50 to 1.80

A few tests were made for control of the mites, the results of which are found in the following table:

RESULTS OF TESTS TO CONTROL MITES

	Insecticide Used	No. Dead	No. Alive	% Dead	Temp. of Atmosphere	Date	Stages Observed
1.	Ivory soap flakes 2 lbs.-50 gals.	67	12	84.8		May 20–22	Mostly adults
2.	Ivory soap 2 lbs.-50 gals. plus Melrosine 1 part-100	71	14	83.5		May 20–22	Mostly adults
3.	Ivory soap flakes 2 lbs.-50 gals.	409	2	99.5	23° C.	May 13–18	Adults and quiescent nymphs
4.	Ivory soap flakes 2 lbs.-50 gals.	406	4	99.0	27–28° C.	May 13–18	Nymphs
5.	Lux 2 lbs.-50 gals.	107	1	99.0	23° C.	May 13–18	Nymphs
6.	Lux, 2 lbs.-50 gals.	164	3	98.1	27–28° C.	May 13–18	Nymphs
7.	Dusted with sulphur	22	59	27.1	23° C.	May 12–18	Nymphs
8.	Dusted with sulphur	101	2	98.0	27–28° C.	May 12–18	Nymphs
9.	Check, no treatment	4	53	9.5	23° C.	May 12–18	Nymphs
10.	Check, no treatment	22	31	41.7	27–28° C.	May 12–18	Nymphs
11.	Check, no treatment	12	70	14.6		May 20–22	Mostly adults
12.	Fish oil soap (potassium) 10 lbs.-50 gals.	12	14	46.1		May 23–25	Adults only
13.	Fish oil soap 5 lbs.-50 gals.	13	41	24.0		May 23–25	Adults only
14.	Check	1	25	3.4		May 23–25	Adults only
15.	Fish oil soap 10 lbs.-50; sulphur 16 lbs.-50 gals.	16	93	14.6	27–28° C.	May 27–31	All stages
16.	Ace Hy 1-400	108	254	29.8		June 31–July 1	All stages
17.	Ace Hy 1-200	40	2	95.2		Aug. 29	All stages
18.	Check	30	287	9.4		Aug. 29	All stages

THE OCCURRENCE OF SEVERAL NEW SPIDER MITES IN CONNECTICUT

By PHILIP GARMAN

Discovery of the European red mite, *Paratetranychus pilosus* (Can. and Fanz.) in Connecticut in 1920, led to the belief that the mite fauna of this State is more cosmopolitan than many groups of insects, a belief which has been verified by the discovery of several new forms of economic importance not hitherto known to occur in Connecticut, some of them not yet reported from the United States. Our attention has been called a number of times to the injury caused by the spruce mite, *P. ununguis* (Jacobi), which on investigation appears to be well distributed over the State. Similarly *Paratetranychus bicolor* Banks, frequenting oaks, chestnut, etc., is well distributed and fairly common. All in all, six species have been found which appear worthy of consideration at this time.

Tenuipalpus lineola (Can. & Fanz.)[1]

This mite has been found feeding upon the under surface of the leaves of elder, *Sambucus canadensis* Linn. It is very inconspicuous and seems to lack the bright color which it has further south. McGregor[2] states that it injures privet in South Carolina, completely defoliating them in some cases. He recommends the use of Schnarrs' Insecticide or lime-sulphur for its control.

Tetranychus populi (C. L. Koch)[1]

This mite infests poplar, being found on the under surface of the leaves. As the species is new to this country, the possibility of its becoming injurious is unknown at present. In England it

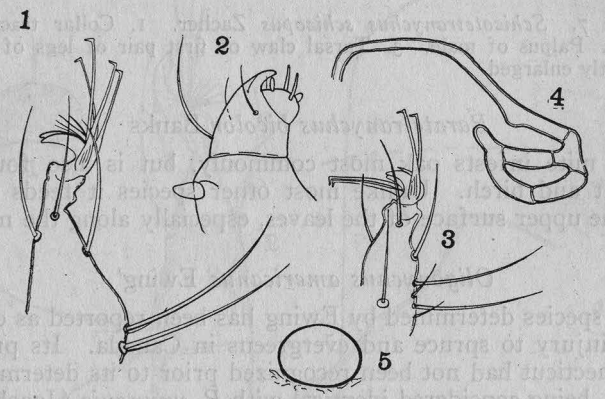

Figure 6. *Tetranychus populi* (C. L. Koch). 1. Tarsal claw of the first pair of legs of female. 2. Palpus of male. 3. Tarsal claw of the first pair of legs of male. 4. Collar tracheae of female. 5. Egg. All greatly enlarged.

is recorded from Lombardy poplar, and is found in Italy on the same host. It is apparently the same as *T. salicicola* Zacher, which infests willows and poplars in Germany. Structural characters of this mite are shown in Fig. 6.

Schizotetranychus schizopus Zacher[1]

This species has been found on various willows in Connecticut, but it is probably not capable of doing serious damage. It was

[1] Identified by Dr. H. E. Ewing.
[2] This species is the same as *T. bioculatus* McGregor.

found in nursery plantings at Wallingford, and also upon native species in the town of Hamden. It is reported from Pennsylvania by Stear (Jour. Ec. Ent. 16:96:1923). Structures are shown in Fig. 7.

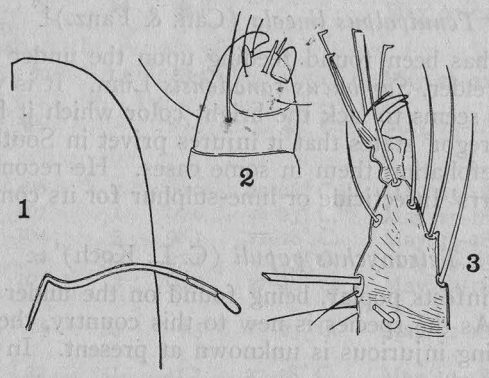

Figure 7. *Schizotetranychus schizopus* Zacher. 1. Collar tracheae of male. 2. Palpus of male. 3. Tarsal claw of first pair of legs of female. All greatly enlarged.

Paratetranychus bicolor Banks

This mite infests oak most commonly, but is also found on chestnut and birch. Unlike most other species it feeds mainly upon the upper surface of the leaves, especially along the mid-rib.

Oligonychus americanus Ewing[1]

This species determined by Ewing has been reported as causing severe injury to spruce and evergreens in Canada. Its presence in Connecticut had not been recognized prior to its determination in 1922, being considered identical with *P. ununguis* (Jacobi). It is apparently able to do considerable damage.

NOTES ON THE LIFE HISTORY OF THE SPRUCE MITE

Paratetranychus ununguis (Jacobi)

By PHILIP GARMAN

This mite has been observed on spruce, red pine seedlings and cedars in Connecticut, and is capable of doing much harm, especially to young trees. The attacks cause the needles to turn brown and drop off. The mites spin a copious web (Plate X, b) within

[1] Identified by Dr. H. E. Ewing.

which they feed, and, like *pilosus,* they multiply most rapidly in spring, the greatest damage being done to young growing needles.

The life history of the mite was studied, and the following notes are offered for what they are worth. The winter is passed in the egg, which is laid on the twigs, usually at the base of the needles. They hatched about April 25 in 1922, and mites infested the trees until fall, winter eggs being deposited about October 1.

The newly hatched larva is very light in color, but soon turns dark green, and successive stages are also dark green to almost black. The adult female has a narrow pale streak on the mid-dorsum and a pale collar. The structure of the tarsi, etc., are illustrated in Fig. 8. The egg has a central stalk and faint radiating ridges above, and when first laid it is clear, light brown, but darkens with age. The incubation period varies from five days at 80-90° F., to 13 days at 62° F., averaging about 11 days

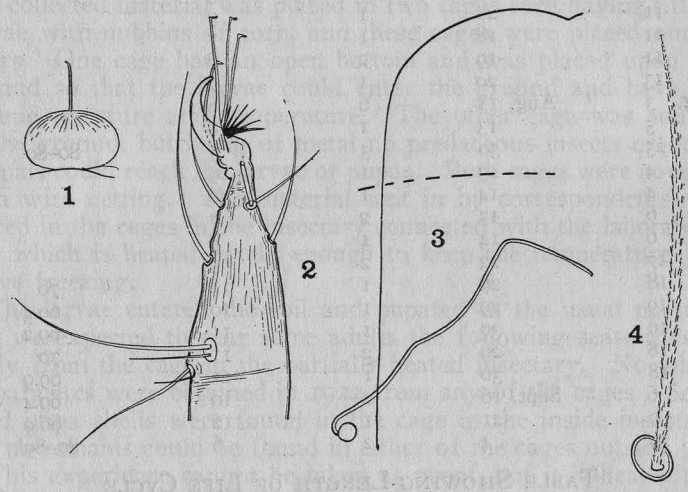

Figure 8. The spruce mite, *Paratetranychus ununguis* Jacobi. 1. Egg. 2. Tarsal claw and appendages of the first pair of legs of female. 3. Collar tracheae of female. 4. Dorsal seta of female. All greatly enlarged.

at 70°. The remainder of the life period (larva to adult) requires about five days at 80-90° or 13 days at 62.7°. At 69° the period lasted nine days. There is a preoviposition period of from one to four days. A total period (from egg to adult) of 11 to 23 days was obtained, the shortest period under natural conditions being 14 days. There are apparently three molts in both sexes, each molt being preceded by a quiescent period of one to three days. Adult females were kept alive from six to eight days in confinement, but probably live much longer under natural conditions.

The mites were reared in small tubes fastened on the needles as shown on Plate X, a, one end of the tube being plugged with cotton, the other fastened on the twig with a cotton plug soaked in beeswax. These tubes furnished suitable conditions for the development of the mites and continuous generations were obtained in some of them.

The tables below give the life history data in tabular form:

TABLE SHOWING LENGTH OF THE EGG STAGE AT NEW HAVEN IN 1922

Eggs Obtained	Eggs Hatched	Number Observed	Length of Period, Days	Mean Temperature Degrees Fahrenheit
May 19	June 1	3	13	62.5
June 21	29	2	8	
21	30	2	9	
23	30	1	7	
July 17	July 24	1	7	
11	15	1	5	
11	20	1	9	
11	18	1	7	
11	19	2	8	
13	20	1	7	
Aug. 3	Aug. 11	6	8	
5	13	1	8	
25	30	3	5	80–89[1]
4	13	1	9	
4	14	1	10	
6	13	2	7	
6	14	1	8	
17	22	2	5	
18	29	1	11	70
19	29	1	10	69.4
19	30	1	11	69.2
18	29	2	11	70
18	30	1	11	69.9
Sept. 6	Sept. 16	2	10	69.4
9	21	1	12	66.0
Aug. 29	4	2	6	80–89[1]

TABLE SHOWING LENGTH OF LIFE CYCLE

Eggs Obtained	Eggs Hatched	Adults Obtained		Eggs Obtained From Adults	Total Period, Days	Mean Temperature Degrees Fahrenheit
June 23		July 10		July 14	21	68.1
23	June 30	5			12	67.5
21	30	8		10	19	68.1
Aug. 3	Aug. 11	Aug. 19	(Male)		16	71.3
3	11	18		20	17	71.4
4	13	17			13	70.5
19	29	Sept. 7		Sept. 0	21	60.2
19	29	7		9	21	69.2
19	29	7	(Male)		19	69.7
18	29	8		10	23	68.9
29	Sept. 4	8		9	11	80–90
	15	28	(Male)		13	62.7

[1] Reared in an incubator.

DOES THE CORN EAR WORM LIVE OVER WINTER IN CONNECTICUT?

Chloridea obsoletă Fabr.

The corn ear worm which was so very abundant in Connecticut in 1921 (see Report of this Station for 1921, page 165) was present in small numbers in 1922, but was reported or sent to the Station from only a few places. Mr. Zappe found it in Hamden and New Haven, and County Agent B. G. Southwick reported it as being "rather numerous in Hartford County, though not so bad as last year." Mr. L. J. Robertson, Manchester, informed the writer that his corn was quite badly infested by it in 1922, and that he did not see it at all in 1921.

In the fall of 1921, much material of this insect was sent to the Station, and an additional quantity was gathered by Mr. Zappe at the Station Farm, and from his own garden. On October 24, this collected material was placed in two cages each having fifteen larvae with nubbins of corn, and these cages were placed out of doors. One cage had an open bottom and was placed upon the ground so that the larvae could enter the ground and have the ground moisture and temperature. The other cage was sunken in the ground, but being of metal no predaceous insects or other animals could reach the larvae or pupae. Both cages were covered with wire netting. The material sent in by correspondents was placed in the cages in the insectary connected with the laboratory, and which is heated barely enough to keep the temperature just above freezing.

The larvae entered the soil and pupated in the usual manner, and we expected to rear some adults the following season, especially from the cage in the partially heated insectary. No adults or parasites were obtained in 1922 from any of the cages. Some dead pupa shells were found in the cage in the inside insectary, but no remains could be found in either of the cages outside.

This experience cannot be taken as proof, but it indicates that this insect may not be able to survive the winters in this latitude. We hope to make further tests on this point. As was mentioned in the Report of this Station for 1921, some entomologists believe that our invasions of the corn ear worm late in the fall, especially in the northern states and Canada, may be due to a flight of moths from the southern states. There is also a possibility that they may be due to infested sweet corn shipped north in mid-summer.

Several times the writer has seen southern grown sweet corn on sale in markets before the local crop is grown, and the southern product often is infested with these larvae, one or more of which are eating the soft kernels at the tip of the ear.

Though the results of the tests here reported are only negative, they support the theory that the species does not survive our northern winters, but further work is necessary to settle the matter.

NOTES ON THE EGG STAGE OF THE EUONYMUS SCALE

In preparing the article on the Euonymus scale published in the Report of this Station for 1921, page 185, the question arose regarding the stage in which this insect passes the winter. Houser[1] states that "the winter is passed in the egg stage, securely protected by the rigid scale of the mother insect. From these over-wintering eggs young emerge in late May or in June, and two broods at least develop during the summer."

On September 15, 1921, specimens received at the Station showed on examination that the eggs had not been formed. On October 27, Dr. Garman collected material and examined it in the laboratory. There were living females under the shells, but no eggs. I collected more material and placed in the insectary on November 22. Dr. Garman examined specimens on this date and found no eggs.

Some of our species of *Chionaspis* form eggs under the shells early in the fall, at least as early as the middle of September, and pass the winter in the egg stage, the eggs hatching the last few days of May. Therefore we were interested to learn the truth in regard to this point in the life history of the Euonymus scale. Other problems demanded our attention most of the time, but Mr. Walden examined the scales from time to time during the winter without finding eggs. I quote from his notes as follows: "On May 5, eggs had formed in the bodies of some of the scales. They were slightly lighter, but of the same color as the bodies of the females. The shell was thin and frail and the contents of a watery nature. On May 11, there were from three to seven eggs under a number of the shells, and the tip of the abdomen in these scales was somewhat contracted, but all still contained eggs. On May 18, some of the eggs had hatched. Under many of the shells, there were at the same time, eggs within the female, eggs which had been ejected, and others which had hatched.

Description of Egg: Length, .2 mm., width, .08 mm., cylindrical with ends rounded, the surface smooth and shining, and the color a dark amber."

Thus these observations confirm those made at Washington, D. C., by the late Dr. C. V. Riley[2] called to my attention by Mr.

[1]Bulletin 332, Ohio Agricultural Experiment Station, page 293, 1918.
[2] Proceedings Entomological Society of Washington, iii, 66, 1893.

Harold Morrison to the effect that the Euonymus scale winters as a partially mature female, and that the eggs begin to be formed during May. Dr. Riley makes no mention of the color of the eggs, but states that the females continue to produce eggs over quite a long period.

We may therefore regard it as settled that this insect in Connecticut at least forms eggs in May, and passes the winter as partially grown females. We were unable to follow the species through the season to learn whether it is single-brooded or double-brooded in Connecticut.

AN ASIATIC BEETLE IN CONNECTICUT

Anomala orientalis Waterhouse

On July 16 and 29, 1920, and July 26, 1921, Messrs. Zappe and Walden collected a few beetles in Westville, New Haven, on the grounds formerly occupied by the Elm City Nursery Company, but now covered with new dwelling houses. These beetles were recognized as belonging to the genus *Anomala*, but were distinct from the species represented in the collection, and from any that we had seen. Specimens were sent to Mr. Charles Schaeffer of Brooklyn, who, at that time, was engaged in making a study of the American species of *Anomala*. Mr. Schaeffer was unable to identify the species, but considered it a possible introduction, and finally sent it with other Coleoptera to Mr. Arrow of the British Museum for identification. On May 17, 1922, I received from Mr. Schaeffer a letter containing the following: "He identified it as *A. orientalis* Wat., a Japanese species, he tells me, which is reported as a destructive pest on sugar cane in the Hawaiian Islands. If it should get a good foothold here it may prove as injurious as *Popillia japonica* (the Japanese beetle) in New Jersey, also an introduced Japanese species." This beetle is shown on Plate XIV, b.

A few days later, I sent this information, together with reports on other insect pests, to the Federal Bureau of Entomology for the Insect Pest Survey, and the Insect Pest Survey Bulletin of June 1, 1922, contained the following note: "One of the most interesting developments of the month has been the determination of a beetle, collected in a Connecticut nursery during the past two years, as *Anomala orientalis* Waterh., the *Anomala* which occasioned so much concern in Hawaii about 10 years ago. The insect is a native of Japan, and was probably introduced into Hawaii before 1908 in soil on the roots of imported plants from Japan. In 1908, Dr. Lyon, then working with the Hawaiian Sugar Planters' Association, observed large numbers of these

larvae at the base of cane plants, but mistook them for the Japanese beetle of Hawaii (*Adoretus tenuimaculatus* Waterh.). In 1912, Dr. A. T. Speare, in studying the fungous diseases of insects affecting sugar cane in Hawaii, collected a number of these larvae and turned them over to Mr. F. Muir, who recognized them as a species new to the islands. In June of that year, Mr. Muir visited the infested fields and collected adults. The pest, though infesting but a small area, was extremely destructive, and the Hawaiian Sugar Planters' Association detailed a specialist to proceed to the Orient and obtain parasites for the control of this pest. This work was so successful that one of the parasites (*Scolia manilae* Ashm.) was established between the years of 1914 and 1916, and by 1919 it had so thoroughly controlled this pest that from an area where, in 1917, 3,500 *Anomala* grubs were collected only four grubs were found, by most diligent search. The parasite has extended its range beyond the area infested by the *Anomala,* and is now infesting the Japanese beetle of Hawaii. That the *Anomala* is established in Connecticut seems evident, as specimens have been collected in the same nursery two successive years."

I corresponded further regarding the matter with Mr. J. A. Hyslop, Editor of the Insect Pest Survey Bulletin, and placed all the facts before the Federal Horticultural Board. Mr. Zappe visited the spot two or three times during July and August, 1922, and made a careful search for more adults. None could be found.

The precise locality where these beetles were collected was a part of a nursery, but the land had been sold recently for building purposes, and new houses now occupy every available site. The nursery stock was all removed, and the excavations and grading necessitated the handling over of all the surface soil, so that it is quite probable that the infestation may have been entirely eradicated. Nevertheless, a careful watch will be kept, and if further signs of this insect appear, attempts will be made to eradicate it.

NICOTINE DUST AS A CONTROL FOR THE TURNIP APHID

By B. H. Walden

On August 21 a field of yellow Rutabaga or Swedish turnips at the Station Farm was found infested with the turnip aphid, *Aphis pseudobrassicae* Davis. The leaves on a few scattering plants throughout the field were turning yellow from injury, and a large proportion of the other plants had colonies of aphids on the under side of the leaves. The indications were that the crop would be severely injured if no treatment were applied to control the aphids.

The turnips were planted in rather close rows and the tops covered about three-fourths of the surface of the ground. It was evident that it would not be practicable to spray the field, and it was decided to use a nicotine dust and apply it with a hand duster.

The application was made on the evening of August 21, using a sulphur-nicotine dust containing five per cent. of nicotine sulphate, equivalent to two per cent. of nicotine.

It was found that by placing the discharge pipe of the duster near the ground it was possible to cover thoroughly the underside of the leaves with the dust.

An examination of the field two days later showed that the aphids were practically all killed where the dust was thoroughly applied. On the far side of the field where the dusting was finished as it began to grow dark, some of the aphids were not killed. This side of the field was dusted again on August 26. A satisfactory crop of turnips, which, without any treatment, would probably have been a failure was produced on the field. No record was kept of the cost of the treatment.

According to Campbell*, one man with a bellows type of hand duster can cover about two acres of truck crops per day, and from 30 to 50 pounds of dust is required, depending upon the size of the plants to be treated. With nicotine dust at twenty cents per pound and labor at three dollars fifty cents per day, the cost of treating an acre would be from seven dollars seventy-five cents to eleven dollars seventy-five cents.

THE RHODODENDRON BORER

Sesia rhododendri Beutenmuller.

During the last two years damage to rhododendron plantings from a borer has been reported from New Haven, South Manchester and Greenwich. In most cases *Rhododendron maximum* was the species attacked or damaged more seriously than others, but in a number of instances hybrid rhododendrons were injured. The damage is caused by a larva tunneling in the sap wood and inner bark, usually on the larger stems and especially at a crotch. This injury cuts away a portion of the cambium and causes a partial or complete girdling of the twig or branch. The burrow of each larva is more or less irregular in shape. It is often on the upper side of a branch, or on the inside of a crotch, but usually is just below the crotch. Sometimes, however, several larvae tun-

* Nicotine Dust for Control of Crop Insects, Farmers' Bulletin 1282.

nel in the same stem and girdle it. The injury is usually, though not always, apparent from the outside of a planting, on account of the leaves scorching or turning brown at the edges and often the branch breaks off. An injured stem is shown on Plate XV.

Mr. Zappe was the first member of the Department to inspect an injured plantation. This was on St. Ronan Street in New Haven, and the examination was made on March 25, 1922. He found the borers numerous in the stems just below the point where the main stems branch, and considerable injury had already been done to the planting. He collected some material from which the adults emerged on the 16, 20 and 26 of May.

On March 31, we received some rhododendron stems with white larvae in tunnels in the sap wood from Mr. C. C. Gallinat, gardener for the F. W. Cheney Estate at South Manchester. Mr. Gallinat wrote that these insects had destroyed a good many whole plants, and that there were also many bushes with borers in them. Mr. Zappe and the Entomologist visited the grounds on April 26, and found the borers in many plants of *Rhododendron maximum*, and also in a few hybrid rhododendron plants. There were many dead tops and broken branches. From material collected on this trip, adults emerged on June 6.

On April 29, the Entomologist visted Keney Park, Hartford, and in company with Mr. George H. Hollister, Superintendent, examined a portion of the extensive plantings of *Rhododendron maximum* there. This evergreen shrub is planted there in large masses, and a majority of the stems showed injury from the attacks of the rhododendron borer. From many of the infested stems, the bark had been torn off in shreds, apparently by birds, and some of the larvae had been eaten. According to Dr. Felt[2] the downy woodpecker feeds upon the larvae, often inflicting deep wounds, which may cause more injury than the attacks of the insect.

On May 10, Messrs. Garman, Zappe and Britton, in company with Mr. F. A. Bartlett of Stamford, visited the grounds of Mrs. Williams near Edgwood Inn, Greenwich. Large masses of rhododendrons had been injured by the borers, and the gardener had cut them out, covered the wounds with grafting wax and wrapped the stems with newspapers. In fact he had done this work so thoroughly that it was difficult to find a borer in any of the stems. On the same day, May 10, Mr. Zappe noticed the characteristic injury on rhododendrons growing near the sidewalk on the grounds of Miss Anna B. Jennings in Fairfield, but he did not enter the premises to ascertain the extent of the infestation.

In June 1920 we received from the Elm City Nursery Company

[2] See references to literature at the end of this paper.

of New Haven, a section of *Rhododendron* stem, from which the adult moth emerged on June 23.

The insect responsible for this injury is one of the clear-wing moths, *Sesia rhododendri* Beutenmuller, presumably a native of the United States, as it was originally described from Pennsylvania in 1909.[1]

Life History

The complete life history has not been worked out in Connecticut, but the account given by Dr. Felt[2], from Mr. Engelhardt's notes, indicates that the eggs are laid singly on small twigs, though many of them may occur in close proximity to the trunks and branches of large plants. On hatching, the larva at first attacks the inner bark, tunneling through the cambium layer into the sap wood, where it forms irregular galleries from one to two inches in length. The larva becomes about half-grown by the latter part of August, and many reach full size by the end of October. Each larva remains in its gallery in a dormant condition throughout the winter, and in early spring prepares a place to pupate by burrowing outward from the hibernating chamber through the outer bark, leaving only a thin circular layer at the opening for the easy emergence of the adult. Pupation takes place in May in the lower gallery in a loose cocoon made of silk and small bits of wood, the pupal stage requiring about fifteen days. In 1922 our specimens emerged as adults from May 16 to June 6.

According to Mr. Englehardt's observations, young plants and small twigs are often girdled and soon wilt and die. Larger stems are more resistant, but as the insect prefers to work in and around the wounds caused by previous attacks, the injury is cumulative and finally kills the stem or plant. Dr. Felt states[2] that plants are rarely injured within one foot of the ground, but occasionally we find stems with borers working near the base. According to the observations of Mr. Engelhardt, mountain laurel and azalea are also attacked only when grown with rhododendrons.

Natural Enemies

According to Dr. Felt[2], one Hymenopterous parasite, apparently a species of *Macrocentrus,* has been reared from the infested branches. The downy woodpecker also destroys many of the larvae, and evidence of the work of woodpeckers was present in the infested rhododendron plantings in Keney Park, Hartford, examined by the writer on April 29, 1922.

Descriptions.

Egg: Length .45-.53 mm; thickness .29-.32 mm; white, oblong, somewhat flattened on two opposite sides. Finely and indistinctly reticulated and closely resembles the egg of the peach borer. Shown in figure 9, e.

Larva: Length about 10 mm; thickness about 2 mm; body yellowish-white, semi-transparent, cervical shield and caudal segment slightly darker, transparent, the latter bearing brownish hairs. Head and legs reddish-brown, mandibles a darker brown. Each body segment bears a number of rather short, stout brownish hairs. Shown on plate XV, a, and in Figure 9, a.

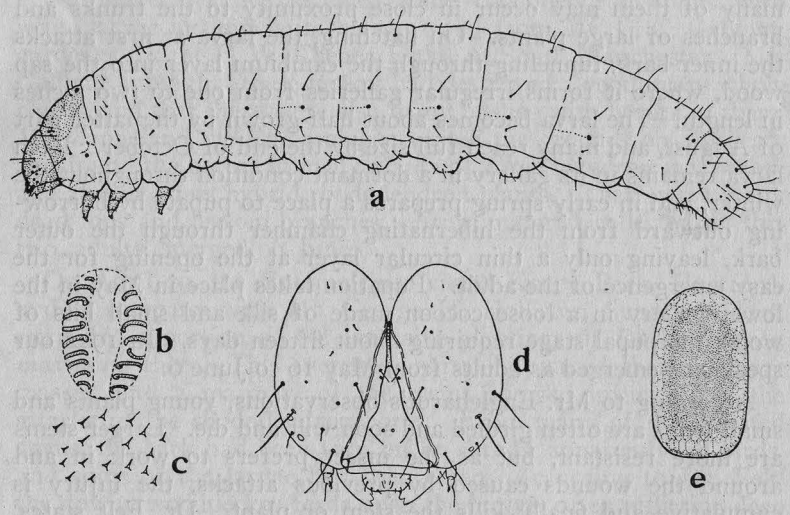

Figure 9. The rhododendron borer, *Sesia rhododendri* Beutenmuller. a. Larva, about thirteen times enlarged. b. Hooks of prolegs, greatly enlarged. c. Microscopic appearance of cuticle. d. Front view of head, greatly enlarged. e. Egg, about fifty times enlarged.

Adult: The following is the original description by Mr. Beutenmuller:

"Male: Head black with metallic blue black reflection, and a few white scales on each side of the face. Palpi yellow beneath, black above. Collar metallic black above, white at the sides and beneath. Antennae purple. Thorax wholly purplish or bluish metallic black. Abdomen metallic black, with a narrow yellow transverse band on the posterior edges of the second, fourth and fifth segments, and a yellow line on each side from the base to the first yellow band. Anal tuft large black, narrowly edged with yellow at the sides and yellow along the middle beneath. Thorax beneath black, with a yellow patch on each side. Abdomen beneath black, with the yellow bands on the fourth and fifth segments very broad or almost covering the segments. Legs: Anterior coxae white, slightly marked with yellow, femora purplish or bluish, yellow on the inner sides. Middle and hind tibiae metallic purple, with the spurs and tufts pale yellow. Tarsi pale yellow, scaled with black above. Wings transparent, narrowly bordered with purple along the costa inner margin and broadly margined with the same color along the outer margin. Borders with a few yellow scales. Transverse mark purple, as are also the veins. Hind wings transparent, narrowly bordered with a black, which appears brassy in certain lights. Underside of fore wings with the borders golden yellow, with the veins and transverse mark like above. Expanse 10-15 mm.

Female: Very similar to the male in color and markings, but the transverse bands on the abdomen are broader and cover segments beneath. Sometimes these bands are whitish at the middle beneath."

The adult is shown on Plate XV, b.

Control

The problem of control is a somewhat difficult one in large plantings. In small plantings it may be possible to examine every stem and to cut out the borers, but even this is quite a task. The wounds caused by the borers and in cutting them out should be protected from further attack and also from decay. Covering them with grafting wax, as was done in Greenwich is probably a satisfactory treatment, though perhaps coating the wounds with melted paraffin would be simpler and easier, applying it with a brush. All dead or badly infested stems and branches should be removed and burned during the fall, winter or early spring. Mr. Engelhardt[2] suggests scraping the injured portions, then applying thick tar paint, one coat "in the fall as a repellent to woodpeckers, and another in the spring preferably in late April or early May to prevent the emergence of the moths."

Literature

[1] Beutenmuller, William, Entomological News, Vol. XX, page 82, 1909.
[2] Felt, E. P., 29th Report of the State Entomologist of New York for 1913, page 19, 1915.
[3] Weiss, H. B., New Jersey Department of Agriculture, Circular 26, page 37, 1919.

THE MAPLE BORER

Glycobius (Plagionotus) speciosus Say

The sugar maple, a native tree planted extensively for shade and for ornament, is attacked by a number of insect enemies, the chief of which is the maple borer. Other species of maple do not seem to be attacked by this insect, but the sugar maple, whether it be planted as a street tree, a shade tree on the lawn, or growing wild in the pasture, woodland or along the roadside, is attacked and severely injured, particularly in the northeastern states. Certain trees once injured seem to be attacked each season year after

year until they finally succumb and are removed. Though this insect attacks and injures vigorous trees, those trees which are weakened from other injuries, or from growing in unfavorable situations seem to be more susceptible to attack.

Character of Injury

Trees attacked by the maple borer often show one or more dead branches, which will in time, break off unless removed. One of the commonest symptoms is to see certain branches on which the leaves turn red or yellow in late summer while the remaining foliage is still green. This indicates that the branch has been injured and is ripening its foliage prematurely. The most probable cause of injury is the maple borer, and the location of the burrows is indicated by ridges on the bark, and sometimes by sawdust thrown out of the openings. Old scars are usually quite prominent on the trunk and at the base of the larger branches, often seriously disfiguring and distorting the tree. The borer does

Figure 10. The maple borer, *Glycobius speciosus* Say, much reduced.

not usually tunnel in the twigs or branches in the upper portion of the tree; its attack seems to be confined to the trunk and base of the larger branches. The gallery is usually in the form of a spiral going upward and working around the trunk or branch. Sometimes it cuts squarely around as shown on Plate XII, b. The gallery is cut partly in the sapwood and partly in the bark, usually severing the cambium layer and partially girdling the tree. When nearly full grown the borer cuts a burrow half an inch in diameter. Consequently, when two or more borers are at work at the same time on a trunk or branch, it is often entirely girdled, and that portion above dies and breaks off. I have observed several cases where this has happened. Frequently a dead area is formed around each burrow, and it is a favorite point of attack for various borers of secondary importance, such as the maple sesian,

Synanthedon (*Sesia*) *acerni* and the pigeon horntail, *Tremex columba*. There are certain trees which show scars indicating that they have been subject to repeated attacks over a period of years. Also there are certain localities where nearly all of the sugar maple trees are attacked. For instance, on the hill along Prospect Street in New Haven, hardly a sugar maple has escaped, and many have been destroyed and removed. Plate XI shows some of these trees. Most of them now remaining are prominently scarred and deformed by the attacks of this insect. The writer visited Lanesboro, Mass., in August, 1922, and nearly all the village trees, which are sugar maples, were in unthrifty condition because of this insect. Though occasionally burrows are found as high as twenty-five or thirty feet from the ground, the attacks are usually not higher than fifteen feet.

Life History and Habits

The adult beetles mostly emerge during the first half of July in Connecticut, and may be found resting and crawling on the trunks of the host trees. Of course, some appear earlier and others later, but most of them emerge soon after July 1. In 1922, specimens were received from Ridgefield on June 22, from East Plymouth on June 27, and from Torrington on July 6. The Torrington correspondent stated that she had killed 35 of these beetles on her trees that season. Of 32 specimens now in the Station collection, 16 were taken between the first and fifteenth of July, five the latter part of June, six the last half of July, one August 15, and one September 14. June 22 is, therefore, the earliest date, and September 14 the latest. The beetles mate and the females lay eggs in July or early August, probably in the crevices of the bark of the trunk and at the base of the larger branches. These eggs soon hatch and the small grubs begin to tunnel in the bark and sapwood, making at first very small burrows. The point of entrance can usually be detected because of a discoloration on the bark caused in part by the exuding sap and in part by the excrement and sawdust thrown out of the minute burrow. Small particles often hang from the opening.

According to Dr. Felt, the grub passes the first winter in a shallow excavation in the sapwood, renewing its activity with increased vigor in the spring. Two years are supposed to be required for the development of this insect from the egg to the adult stage. The grub increases in size with age, and the tunnel becomes correspondingly larger as the grub advances, and of course, the sawdust becomes more conspicuous. On the approach of the second winter the grub works its way upward into the solid wood about four inches below the surface and then extending a few inches parallel with it. At the end of this deep

burrow, the grub passes the winter and also pupates, and from it the adult beetle works its way out through a hole nearly circular, but somewhat flattened, about three-eighths by five-eighths of an inch in size. The beetles prefer trees in the open and like to rest on the bark in the sunlight.

Description.

The adult is one of our most beautiful long-horned beetles, about an inch in length and three-eighths of an inch in breadth. It is black in color with bright yellow markings as shown on Plate XII, a. One conspicuous character is the W-shaped mark at the base of the wing-covers. The antennae are black, thorax black with lateral transverse yellow bands, and the wing-covers black with apex and several transverse and zigzag bands of yellow. Legs and under surface mostly yellow.

The larva is about two inches long when fully grown, cylindrical with a round head and without feet. The head and body are whitish, with mouth-parts brown.

Control Measures

All trees and branches killed by this borer as well as those nearly dead from its attacks should be removed, preferably before June, as some of the borers will then be destroyed before the adults emerge. Choice shade trees may be kept in a greater degree of freedom from borers if examined, carefully and thoroughly at least twice each year and the borers killed. These examinations should be made not too late in fall nor too early in spring. A good time is in September, before the grubs go into winter quarters, and again in May after they have resumed activity. Burrows may be located by the sawdust thrown out and sometimes by the sap, and by judicious cutting in the bark, it is possible to find the grub without seriously injuring the tree. Too much cutting might cause as much damage as the borer. Where there is a long burrow, it is not necessary to cut it open the whole length, but small cuts can be made through the ridge, here and there, until the borer is found. It is often possible to run a wire into the burrow and kill the grub without cutting until the grub is exposed. Some writers advise injecting carbon disulphide into the tunnel to kill the borer. This is effective if the tunnel is gas tight, and the opening should be closed with grafting wax, paraffin or a bit of moist soap. But on account of the uncertainty, most authorities do not trust the carbon disulphide method, but recommend cutting out or the use of the wire.

Wherever serious wounds are made in cutting, the cut surfaces should be covered with melted paraffin applied with a brush. All

dead areas where wood has been killed by the borers should be covered with paint. Most tree surgeons use coal tar paint, but good white lead and linseed oil, with just enough lamp black and burnt umber added to match the color of the outer bark makes a good tree paint. It is unsafe to use pine tar, or to add such ingredients as turpentine or dryer to the white lead paint.

It has been suggested that a deterrent wash be applied to the trunks and base of branches of trees so that the beetles will not oviposit there. Dr. Felt suggests carbolic soap, but possibly a lime-sulphur wash or a strong nicotine arsenate of lead mixture may answer the purpose. So far as I know the value of these applications has not been demonstrated.

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THE MAPLE SESIAN

Synanthedon (*Sesia*) *acerni* Clemens.

This is one of the minor pests of maple trees, and it seldom attacks a tree which is perfectly healthy. Wherever there is a wound, such as may be caused by a collision, borers, fire injury, or a stub left in pruning, this insect is apt to breed in the weakened tissues adjacent to the injury. It thus attacks both hard and soft maples. In front of the writer's residence in New Haven, are rows of silver maples planted as street trees between the curbs and the sidewalks. In 1919, a residence on an adjoining lot was moved into the next block, and pulley blocks were fastened to these trees near the base. This work was done the last few days of May and though the trunks of these trees were wrapped with burlap and blocks of wood placed under the ropes, in one case the bark was loosened around one side of the trunk near the base for half the circumference. Had it been noticed at the time proper treatment might have been given, but when first seen the bark was already dry and loose. This was removed, the wood

painted over and grafting wax applied on the exposed cambium around the wound. In 1921, the writer noticed that borers were at work in the bark just above the wound, and a few exit holes appeared that season. In 1922 there were many more of these holes (see Plate XIII, a) and on June 23, the writer found one of the adults just emerging from a burrow. The moth is shown on Plate XIII, b.

Dr. Felt[2] states that "trees wounded from any cause find great difficulty in the comparatively simple process of covering exposed wood with bark, after being attacked by this insect. Thus relatively insignificant wounds result in scars constantly increasing in size and finally in a badly disfigured, gnarled maple. These creatures, when abundant, may nearly girdle a tree." The distribution of this insect has been given by Mr. Beutenmuller as Canada, New England and Middle States, westward to Nebraska.

Life History and Habits

The eggs are laid on roughened areas on the bark in the vicinity of wounds in May or June. The newly hatched borers soon begin to tunnel in the bark and sapwood, reaching a length of about half an inch at the end of the season, when they suspend operations and pass the winter in the tunnels, which are nearly filled with frass. In the spring the caterpillar resumes feeding and completes its growth, eating its way to the surface, except for a thin layer, then retires into the tunnel and pupates in a loose silken cocoon. The pupa later works its way partly out of the tunnel; its skin splits open and the adult emerges, leaving the old pupa case protruding from the hole.

There is only one generation each season.

Description

The moths have been described by Beutenmuller as follows:

"Male: Head, collar, and palpi orange, orbits white. Antennae brown black. Thorax above and below yellow. Abdomen blue black more or less scaled with pale yellow, underside wholly yellow. Anal tuft bright orange. Legs pale yellow, tibiae with a black band at the end. Fore wings narrow, elongate, with narrow purplish borders more or less covered with pale yellow scales, outer part of wings pale yellow between the veins, with indications of a broken band. Discal mark large and deep black. Underside same as above. Hind wings transparent with the very narrow border and fringes purplish brown, sometimes yellow at the apex; underside similar to the upper, but with the costa marked with yellow.

"Female: Similar to the male. The margins of all the wings are darker in color and the hind wings want the yellow at the apex.

"Expanse: Male and female, 22-25 mm."

Natural Enemies

According to Felt[2] and Houser[4] woodpeckers constitute the most important natural check of this insect.

Control

Protect all trees as far as possible from mechanical injuries, as this insect works chiefly around wounds. The larvae work near the surface and on small trees may easily be dug out and destroyed. If the wounds are properly dressed and the cut surfaces coated with tree paint or carbolic acid emulsion about the middle of May, it will have a tendency to prevent egg laying by the females. Particularly should this emulsion be applied on the areas where these borers were at work the preceding year.

Literature

[1] Beutenmuller, William. Monograph of the Sesidae, Memoirs of the American Museum of Natural History, Vol. I., Part VI., page 294, 1901.

[2] Felt, E. P. Insects Affecting Park and Woodland Trees, Vol. I., page 56, 1905.

[3] Forbes, S. A. Twenty-sixth Report on the Noxious and Beneficial Insects of Illinois, page 35, 1911.

[4] Houser, J. S. Destructive Insects Affecting Ohio Shade and Forest Trees, Bulletin No. 332, Ohio Agricultural Experiment Station, page 322, 1918.

THE SPRUCE GALL APHID

Chermes abietis Linn.

One of the most serious pests of the spruce in Connecticut is the spruce gall aphid, and apparently this insect has increased in abundance during the past few years. The distinguishing characteristics of an infested tree are the green cone-shaped galls at the base of the new growth shown on Plate XX, a, and in extreme cases nearly every new shoot bears one of these galls at its base. Usually the shoot dies, and it is a common sight to see the dead twigs on spruce trees, each twig having a cone-shaped gall at the base. Continued attack seriously devitalizes the trees, and many large spruce trees have died in Connecticut during the last ten years. It would be perhaps an exaggeration to attribute their death solely to the attacks of this insect, but I believe it has contributed in a large degree. Wherever a tree becomes weakened, certain bark beetles begin to tunnel under the bark, and the tree is soon killed. Though several species of spruce are attacked by this insect, my observations indicate that the Norway spruce, *Picea excelsa,* is more susceptible to attack and more seriously

injured than any others Other spruces from which this insect has been taken are: the white spruce, *Picea alba*, black spruce, *Picea nigra*, blue spruce, *Picea pungens*, and the hemlock, *Tsuga canadensis*. Another species of gall aphid, *Chermes cooleyi* Gillette ocurs in Connecticut and makes larger galls on the blue spruce, *Picea pungens*, as shown on Plate XX, b.

This insect occurs throughout Europe, England and the northern part of the United States, from the Atlantic to the Pacific. Apparently it is more destructive in the New England States than elsewhere, though in the States of New York, Pennsylvania and New Jersey, it is reported as doing considerable damage.

From the notes of the nursery inspectors each year in Connecticut, I gather that this is one of the most prevalent of all nursery pests, and perhaps the most prevalent of all insects attacking conifers in Connecticut.

Life History and Habits

The life history was worked out many years ago by Professor R. A. Cooley and published by Professor Charles H. Fernald.[4] From this paper the chief facts are taken.

There are two annual generations of this insect which differ greatly in form, one being known as the winter generation and the other as the summer generation. The young females pass the winter on the twigs, especially around the buds, and in spring molt and complete their growth and secrete a woolly coating of wax filaments. They lay their eggs early in May, then die, though the woolly mass remains on the tree for a long time. The eggs hatch in about a week, and the young crawl to the tips where the new growth is just beginning to form, and there settle in the cracks at the base of the leaves, where the bud scales have already been deformed by the female, and are distinctly swollen at the base. The nymphs probably have some further influence on the formation of the gall, which as it develops, grows over the small insects and the cavities close except for a curved or semi-circular incision or opening surrounded by a pinkish or grayish pubescence. These nymphs live inside the gall until they reach maturity early in August, when the galls turn yellow, the cavities open, and the galls later become brown and die. The nymphs crawl out one at a time, molt and crawl over the leaves. They are now provided with wings and are the adult insects of the summer generation. In about two days each female attaches herself to a leaf, usually near the tip, and inserts her mouth parts. She does not move afterwards, but deposits a cluster of eggs, then dies, and her dead body protects the eggs which she has laid. Each egg is attached to the leaf by a slender stalk about as long as the egg itself, which is ellipsoidal in shape, about one-sixteenth of

an inch long and about half as thick. It is light yellow when first laid, but turns darker just before hatching.

These eggs hatch in about two weeks, and the nymphs scatter over the leaves and twigs, some crawling into the crevices at the axils of the leaves and buds. According to Cooley, only those nymphs which find protection at the base of the buds survive the winter, and most of them die.

Control Measures

On small trees the galls may easily be clipped off in June and burned. This treatment has already been practiced in one Connecticut nursery where many conifers are grown, and resulted in very few galls being found at the time of the annual inspection in August.

Spraying in April with a contact spray to kill the over-wintering females is one of the best control methods. Fernald[4] found that kerosene emulsion was not effective, but does not give the formula or rate of dilution. He states that whale oil soap, one pound in two gallons of water, proved so effective that no insects had since been found upon the trees.

For several years at the Elm City Nursery in New Haven, the spruce trees have been sprayed in April with miscible oil, one part in twenty parts of water The same treatment has also been applied late in the fall, and both have been effective in controlling the spruce gall aphid. There has never been any injury to the trees except once, and this probably was due to not mixing the contents of the original package thoroughly before diluting with water.

Literature

[1] Britton, W. E., Report Conn. Agr. Exp. Station for 1906, page 302.
[2] ———— *Ibid,* for 1916, page 139 (records *Chermes cooleyi* in Connecticut.)
[3] Felt, E. P., Insects Affecting Park and Woodland Trees, Vol. I, page 189, 1905.
[4] Fernald, C. H., and Cooley, R. A., Thirty-fourth Report Mass. Agr. College, page ...., 1898. (Gives life history studies made by R. A. Cooley).

THE BRONZE BIRCH BORER

Agrilus anxius Gory.

Many cut-leaf white birches in Connecticut have died during the past few years as a result of the attack of the bronze birch borer. Other trees without cut leaves have also been killed, but in most cases they represent the same species of tree, known as the European white birch, *Betula alba*. One such tree on the

Station grounds (see branch on Plate XIV, d) was killed by this beetle and removed in 1922. Native birches are not wholly immune from attacks, but seem to be much less susceptible than the European species. Mr. F. A. Bartlett of Stamford informs me that in one locality at least the native black birch, *Betula lenta,* has been seriously attacked and many trees killed by this insect. I have not observed injury to any of our native birches though the gray birch, *Betula populifolia*, is very common, and both the black birch and the paper or canoe birch, *Betula papyrifera* were growing in the vicinity of trees killed by this borer. According to Dr. Felt, this beetle attacks the black, yellow and cut-leaf white birches, and Dr. Lintner observed it on poplars, and Professor Davis has recorded it from willow.

Character of Injury

The first symptom generally noticed is that the foliage becomes thin in the upper portion of the top, and later the top-most branches die. Sometimes the following season the lower branches will have leaves all through the season, but often they will die in midsummer, and turn brown, but hang upon the tree. If examined carefully, ridges or swellings may be noted on branches half an inch to an inch in diameter, before anything wrong can be detected with the foliage. Sometimes there are oval swellings on the branches, but often there are distinct ridges, some spiral and some transverse, over the galleries. Later there will be many semicircular exit holes where the adults have emerged. There are also numerous rust-colored spots or patches on the bark where the burrows are near the surface.

If the bark is removed, we can see numerous irregular winding galleries, which often cross each other and which, in a badly infested branch entirely undermine the bark. The result of this attack is to girdle the branches, and death follows.

Life History and Habits

There is one annual generation and the larvae live through the winter in cells just under the bark, pupating early in May. The beetles emerge late in May or early in June and probably lay eggs either in June or July, in the crevices in the bark. The minute larva at first tunnels next to the bark, but as it increases in size goes deeper into the wood. The larvae reach maturity in October and form their hibernating cells. The beetles fly about and feed somewhat upon the foliage of willow, poplar and probably birch. Collected specimens in the Station collection bear the following dates and localities: Granby, 21 May, 1917; Farmington, 6 June, 1921. At the Station the beetles emerged from the dead wood on May 31, 1922, and during the next few days.

It has been observed that woodpeckers feed upon the grubs, and a small four-winged Chalcid fly, *Phasgonophora sulcata* Westw., has been reared from the galleries in New York State. Two specimens of this insect emerged from our material on July 3, and were determined by Mr. S. A. Rohwer.

Description

The adult beetle belongs to the family Buprestidae and is from one-third to one-half inch in length, about three-thirty-seconds of an inch in breadth and is olive brown or bronzy-green in color. It is shown on Plate XIV, c.

The larva or borer is one of the so-called flat-headed borers, and is about three-fourths of an inch in length, slender, with a flattened prothorax commonly called head. It is whitish with dark mouth parts.

Control Measures

All dead and infested trees and branches should be cut out and burned before May 15 in order to prevent the escape of the beetles. Only prompt community effort will check the devastations of this insect, and the destruction of individual trees here and there will not serve the purpose.

Literature

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CONTROL OF ANT INVASIONS*

During the present season an unusual number of inquiries have come to 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.

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* Published as Bulletin of Immediate Information No. 17, July, 1922.

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 angleworms, 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 indicate how best to control them.

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,

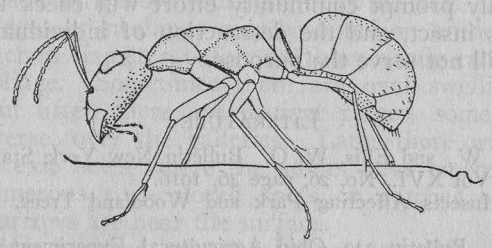

Figure 11. A common ant, *Formica fusca* var. *subsericea* Say, much enlarged.

occasionally found in Connecticut, may nest in houses. The large black ant or carpenter 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.

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 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,[1] and recent studies by Mr. H. B. Peirson[2] 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.

Ants 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 the 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 kerosene emulsion, or 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

[1] *Formica exsectoides* Forel.

[2] Mound Building Ants in Forest Plantations, Journal of Forestry, Vol. 20, page 325, April, 1922.

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 and may be purchased from druggists.

Ants in Households

Most of the ant invasions in dwelling houses come from the colonies established in the garden or soil outside, and a destruction of these colonies will bring relief. The ants enter the house to obtain food and usually visit the kitchen and the pantry, where they gather crumbs of bread, cake, meat and particles of sugar to carry away to their young. These ants usually enter the house or cellar at a certain place and all of the individuals travel along this path or runway. A free use of naphthalene flakes scattered on the shelves, floors, corners and particularly along the runways and at the point of entrance will usually drive away most species within a few hours. Another common method to reduce their numbers is to saturate a coarse sponge with sweetened water and after permitting the ants to crawl into it, immerse the sponge in hot water and set the trap again.

Rarely there are cases where the ants nest in houses like the Argentine ant[1] which is now present in the Gulf States, and the little red house ant or Pharaoh's ant[2] 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 following formula was recommended by the U. S. Bureau of Entomology in Farmers' Bulletin No. 740, and has proved satisfactory against Pharaoh's ant in a dwelling house in Hartford:[3]

Poisoned Bait for Ants

Sugar	1 pound
Arsenate of Soda	125 grains
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

[1] *Iridomyrmex humilis* Mayr.
[2] *Monomorium pharaonis* Linn.
[3] Report of the Connecticut Agricultural Experiment Station for 1917, page 314.

said to attract the ants. When cool, use with bits of sponge in small shallow dishes, and place two or three dishes in each room. The object of this 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. This poison should be kept away from young children and domestic animals.

Ants Tunneling in Wood

Black Ants

The large black ants commonly known as carpenter ants[1] 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

[1] *Camponotus herculeanus pennsylvanicus* DeGeer.
[2] *Reculitermes flavipes* Kollar.
[3] Report of the Connecticut Agricultural Experiment Station for 1909, page 373.
[4] *Ibid.*, 1915, page 187.

eaten by them. Trees and herbaceous plants in the field and greenhouse are occasionally attacked and injured. In 1914,[1] 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,[2] a colony of these 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 greehouse 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.[3] 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.

[1] *Ibid*, 1914, page 196.
[2] *Ibid.*, 1921, page 199.
[3] *Reculitermes flavipes* Kollar.

Summary of Control Measures

Kill ants in their nests by fumigating with carbon disulphide. Drive them out of houses by scattering naphthalene flakes on shelves and floors, particularly along the runways; trap them in sponges moistened with sweetened water. If these measures are not successful, use the poisoned bait described on page 364.

On trees and plants destroy the aphids or other insects which attract ants.

THE EUROPEAN CORN BORER

Pyrausta nubilalis Hubn.

This destructive pest has not yet been found in Connecticut, but may appear at any time. In fact the town of Douglass, Massachusetts, has just been found infested and placed under Federal quarantine, and this town joins Thompson, Connecticut. There has been a marked westward spread of this insect during 1922. The present infested area in North America is as follows:

Maine: All of York County, and the town of Sebago in Cumberland County: 28 towns.

New Hampshire: All of Rockingham, Strafford, Merrimack, Hillsborough and Belknap Counties; the towns of Holderness, Ashland, Plymouth, Bridgewater, Bristol, Hebron, Groton, Alexandria and Orange in *Grafton County;* Moultonborough, Tuftonboro, Wolfeboro, Ossipee, Effingham, Wakefield and Brookfield in *Carroll County*: total, 133 towns.

Massachusetts: All of Essex, Middlesex, Suffolk, Norfolk, Plymouth, Bristol and Barnstable Counties; the towns of Ashburnham, Gardner, Westminster, Fitchburg, Lunenburg, Leominster, Lancaster, Harvard, Hubbardston, Princeton, Sterling, Clinton, Berlin, Bolton, Rutland, Holden, West Boylston, Boylston, Northborough, Worcester, Shrewsbury, Westboro, Southborough, Millbury, Grafton, Upton, Sutton, Northbridge Milford, Hopedale, Douglas, Uxbridge, Mendon and Blackstone in *Worcester County*: total, 211 towns.

Rhode Island: All of Newport and Bristol Counties; and Cumberland, Lincoln, Woonsocket, Pawtucket, Providence, North Providence and East Providence in *Providence County*: total, 15 towns.

New York: In New York there are two separate infestations:

Eastern New York: All of Albany, Schenectady, Montgomery and Saratoga Counties; all of Fulton County except Stratford and Oppenheim, and all of Rensselaer County except Schodak,

Nassau, East Greenbush, Berlin and Stephentown; the towns of Hebron, Fort Edward, Greenwich, Easton, Jackson, Cambridge and White Creek in *Washington County;* Greenville, New Baltimore and Coxsackie in *Greene County;* Wright, Schoharie, Middleburg, Fulton, Cobleskill, Carlisle and Esperance in *Schoharie County;* Cherry Valley in *Otsego County;* Wells, Lake Pleasant, Benson and Hope in *Hamilton County;* total, 88 towns.

Western New York: All of Niagara and Erie Counties; all of Wyoming County except Covington, Castile, Seneca Falls and Pike; all of Chautauqua County except Busti, Kiantone, Carroll and Poland; the towns of Alabama, Pembroke, Batavia, Stafford and Darien in *Genessee County;* Perrysburg, Dayton, Persia, Otto, East Otto, Ashford, Yorkshire, Freedom, Machias, Leon, New Albion, Mansfield, Ellicottville, Franklinville, Napoli, Little Valley and Salamanca in *Cattaraugus County;* total of 93 towns. Total for New York, 181 towns.

Pennsylvania: All of Erie County, except Union and Concord; the town of Beaver in *Crawford County*: total, 21 towns.

Ohio: All of Lake County; the towns of Conneaut, Monroe, Pierpont, Kingsville, Sheffield, Denmark, Ashtabula, Plymouth, Jefferson, Saybrook, Austinburg, Geneva and Harpersville in *Ashtabula County;* Chester, Chardon and Thompson in *Geauga County;* Dover, Rockport, West Park, Middleburg, Cleveland, Euclid, Independence, Newburg, Warrensville and Mayfield in *Cuyahoga County;* Brownhelm, Black River, Amherst, Sheffield, Elyria, Avon and Avon Lake in *Lorain County;* Margaretta, Portland, Perkins, Huron, Berlin and Vermillion in *Erie County;* Allen, Clay, Benton, Carroll, Danbury, Erie, Bay, Portage, Middle Bass Island, North Bass Island, South Bass Island and Catawba Island in *Ottawa County;* Townsend in *Sandusky County;* Ross and Lake in *Wood County;* Washington, Toledo, Oregon and Jerusalem in *Lucas County;* total, 67 towns.

Michigan: The towns of Exeter, Berlin, Frenchtown, Monroe, Ida, LaSalle, Whiteford, Bedford and Erie in *Monroe County;* Greenfield, Hamtramck, Gratiot, Grosse Pointe, Springwells, Detroit, Ecorse, Monguagon, Brownstown and Huron in *Wayne County;* total, 19 towns

Ontario, Canada: The following Counties are entirely infested: Essex, Elgin, Middlesex, Oxford, Perth, Norfolk, Brant, Waterloo, Haldimand and Welland; all of *Kent County* except Raleigh, Romney and East Tilbury; all of *Lambton County* except Moore; all of *Huron County* except Ashfield, East and West Wawanosh and Howick; all of *Lincoln County* except Grimsby and Cristor, Culross in *Bruce County;* Guelph in *Wellington County;* East and West Flamboro and Ancaster in *Wentworth County;*

Trefalgar in *Halton County;* Chinquacousy in *Peel County;* Scarboro and York in *York County;* Pickering, East and West Whitby in *Ontario County;* Clarne in *Durham County* and Brighton in *Northumberland County;* total, 139 towns.

MISCELLANEOUS INSECT NOTES

Chinch Bugs Injuring Lawn: On September 22, 1922, a sample of soil and grass was received from Hartford, where the grass had been killed in spots. Examination showed the presence of many chinch bugs, *Blissus leucopterus* Say, which were probably responsible for the killing of the grass. A similar infestation occurred on a lawn in Bristol in September 1914. An application of kerosene emulsion, nicotine solution, or even strong soap suds would probably kill these bugs without injuring the grass.

The Sour Gum Leaf-Miner: This insect attacks the sour gum, pepperidge, or tupelo, *Nyssa sylvatica,* and is called the sour gum leaf-miner or case-bearer. The adult is a small moth *Antispila nyssaefoliella* Clem., and its larva is a miner in the leaves. Certain trees in Orange were brown in September because of this attack and hardly a leaf escaped. In 1893 this insect was very abundant, and injured the sour gum trees on Long Island. No remedy is known.

The Blue Elm Beetle: On September 11, Mr. G. A. Cromie, Superintendent of Trees, New Haven, brought to the Station some small dark blue beetles which were found feeding upon elm trees in West Haven. This is *Altica ulmi* Woods, a species described in 1918 and formerly confused with the strawberry flea beetle, *A. ignita Ill.* We have received this insect on elm from Salisbury in 1902, from Stonington in 1907 and from Old Saybrook in 1908. It does not seem to do much damage, but in case it becomes abundant, the proper treatment is to spray with arsenate of lead.

Scolytid Beetles in Pine Twigs: On October 7 and 17, 1921, Mr. H. W. Hicock, Assistant Forester of this Station, brought to the office some white pine twigs from Canaan, in which small beetles were tunneling lengthwise. This caused the tips of the branches to turn brown, and in some cases there were as many as one hundred brown tips on a tree. The beetles responsible for this injury were sent to Dr. J. M. Swaine of the Entomological Branch, Ottawa, Canada, who identified them as *Pityophthorus ramiperda* Swaine, a species described from Canada which "kills twigs by excavating tunnels in the pith as well as in the bark."

Leaf-Miner in Cultivated Sorrel: While attending a field meeting of the Connecticut Vegetable Growers Association at

Windsor, Conn., June 24, 1922, the writer collected a number of leaves of cultivated sorrel, containing larvae of a leaf-miner. At this time the crop had been nearly all harvested, but there were still many plants left in the fields. These plants were badly infested, often two or three leaves on a plant showing the characteristic work of this leaf-miner. Some of this material was collected and placed in breeding cages. On July 15, adults began to emerge, and proved to be *Pegomyia calyptrata* Zett., a fly, closely related to the spinach leaf-miner. The identification was made by Mr. Charles W. Johnson. M. P. ZAPPE.

Beetles Boring in the Timbers of an Old House: On June 23, some specimens of beetles were received from Durham, which were boring in the sills and floor timbers of an old house. The beetles proved to be *Hadrobregmus carinatus* Say, of the family Anobiidae, formerly placed in the Ptinidae and closely related to the Bostrichidae. They are brown in color and about three-sixteenths of an inch long, much larger than the powder post beetles of the genus *Lyctus*. They also make larger holes in the timbers. As no member of the staff visited the place, we do not know whether the beetles burrowed entirely through the timbers or whether they worked only in the sapwood, as is the case generally with the powder post beetles.

A Rare and Curious Horn Worm: On July 14, two horn worms or sphinx larvae on grape leaves were handed to Mr. Walden. They were about two inches in length, brown, with caudal horn and a black spot just back of the head. At first we were unable to identify these larvae, which were unfamiliar to all members of the staff. After much searching, from published descriptions we were finally able to identify the species as *Dilophonota ello* Linn. The larva is shown on Plate XIV, a. During a period of more than twenty years' work in collecting and rearing insects, we never saw this larva before, and our collection contains no adults. These larvae were placed in a cage in the insectary, but they refused to eat any kind of food given them and finally died, apparently of a bacterial wilt. They are said to feed upon *Euphorbia,* but though plants representing several species of this genus were placed in the cage, they refused to eat.

Galls on European Willows: While inspecting a shipment of Manetti rose stocks at Cromwell, imported from Oudenbosch, Holland, the writer noticed some oblong swellings on the willow shoots which were used in tying together the bundles of Manetti stock. On cutting into these galls, they were found to contain small white larvae. Specimens of the galls were collected and sent to Dr. E. P. Felt, State Entomologist, Albany, New York. They were identified by his assistant, Mr. D. B. Young, who stated that: "they are undoubtedly the galls of *Rhabdophaga salicis*

Schrank." This insect has evidently become well established in this country, and there are records of its causing injury to willows in New York State as far back as 1898.* All the tying willows were cut from the bundles of Manetti stock and burned in the furnaces of the greenhouse heating plant, thus eliminating any chance of re-establishing this insect in Connecticut.

M. P. ZAPPE.

The Cottony Cushion Scale in a Connecticut Greenhouse: On January 6, 1921, a curious fluted scale insect on *Acacia* was received from Mr. Nathaniel Slocombe of Farmington. Further study by the staff of this Department leads us to conclude that this is the well-known cottony cushion scale, *Icerya purchasi* Maskell, an Australian species which, in some way, became introduced into California, and for a time in the eighties seriously threatened the citrus fruit industry of California. It was not until an entomologist was sent to Australia and collected and brought back specimens of a little lady beetle, *Novius cardinalis* Muls., that the insect began to disappear. This lady beetle feeds upon the young scales, and it soon became so abundant as to overcome the pest, which has never assumed prominent proportions in California since. Of course, this scale might be shipped anywhere on tropical plants, which in Connecticut are grown under glass, as in former years this class of stock was brought into the country without inspection.

Maggots Appearing in Factory: On April 24, a number of fat, dirty, white maggots or Dipterous larvae were brought to the Station from a factory of the C. & K. Mfg. Co., in New Haven. This firm manufacturers powder puffs and novelties on Daggett Street, but on the next floor of the same building a firm uses cheese in the manufacture of crackers or biscuits. These maggots, in considerable numbers, dropped from the ceiling in the rooms of the C. & K. Mfg. Co., and one of the proprietors brought them to the Station for identification and to learn something about their life history and habits. They were placed in breeding cages, and on May 16, several adults emerged, which were identified by Mr. Charles W. Johnson as *Cynomyia cadaverina* Desvoidy. It was learned that the firm on the floor above, being troubled with rats, had used rat poison, and possibly some rats had died between the floor and ceiling or in the partitions. These maggots, therefore, may have bred in dead rats or in some accumulation of cheese or other waste food materials, and on reaching larval maturity, as is their habit, worked downward in search of a proper place to transform. They usually pupate in the ground.

* Twenty-ninth Report of New York State Entomologist, page 96, 1915.

A Borer in Rose Stems: On August 5, specimens were received from the Rowayton Greenhouses, Traendly & Schenck, proprietors, of rose stems with larvae tunneling lengthwise in the flower stems. Several of these larvae were alive and were placed in breeding cages, but the adults have not yet emerged. Dr. Garman was able to identify the larvae from Mr. Middleton's published descriptions and figures[1], as *Adirus trimaculatus* (Say), a native species of the family Cephidae, closely related to the sawflies. Dr. Garman and Mr. Walden visited the greenhouses on August 9. Hardly any infested stems could be found, as most of them had been cut out and destroyed. The larvae are cylindrical, pinkish-white and a little less than an inch in length. Usually they are borers in blackberry stems, but occasionally attack rose. In the Rowayton case, the greenhouse had been rebuilt and for several weeks during the summer there was no glass on the roof. The Station collection contains two adult specimens of *Adirus trimaculatus,* one collected in Hamden, 15 June 1918, by M. P. Zappe, and the other in Orange, 2 June 1920, by W. E. Britton. The adult is a black four-winged fly with body slender and nearly half an inch in length, and with smoky wings.

Rose Midge in Connecticut: On November 1, some rose tips were received from Mr. John McCarroll, gardener on the Truesdale place, Indian Field Road, Greenwich. The tips had crushed larvae in them which Dr. Garman recognized as the rose midge, *Dasyneura rhodophaga* Coq. Dr. Garman and Mr. Zappe visited the place during the afternoon of that same day, and found that in a small greenhouse the buds and young leaves of the rose plants had been attacked by this insect. But as the gardener had picked off and destroyed many infested buds and leaves, the insect was not very abundant. This insect has caused considerable damage in some of the large greenhouses around Baltimore, Chicago, Ohio and in Canada, but this is the first definite record that we have of this insect occurring in Connecticut, though no doubt it has been present in rose houses for some time, and not called to our attention. According to Mr. Sasscer[2], one of the most effective means of control is that worked out by Professor E. N. Cory of the Maryland Station, and consists in covering the surface of the soil in the rose beds with a layer from one-fourth to one-half inch deep with tobacco dust, and to fumigate the house nightly by burning tobacco stems, or one of the nicotine preparations.

Cutworms Injuring Strawberries: On April 19, a strawberry grower near New Haven brought to the laboratory some cutworms and strawberry plants injured by them. The leaves were

[1] Proceedings Entomological Society of Washington, Vol. XIX, page 174, 1917.
[2] Bulletin No. 778, U. S. Department of Agriculture, 1919.

badly eaten, and many of the stems had been cut off close to the crown. The larvae were apparently full-grown, and the indications were that most of the damage had been done. It was suggested to the grower, however, that he try a poisoned bran mash against the larvae. The specimens were placed in the insectary and the larvae soon pupated. Adults emerged on May 21 and proved to be *Noctua c-nigrum Linn.* This is called the spotted cutworm, a well-known injurious species, attacking many different crops. The larva is about one and one-half inches long when full-grown, of a grayish-brown color with two rows of triangular dark spots, which increase in size towards the rear end. An injured strawberry plant with a larva is shown on Plate XVI.

B. H. WALDEN.

Larvae Feeding Upon Pansies: In the spring of 1922, pansies growing in a cold frame in the writer's garden were injured by having both leaves and flowers eaten. Some flowers had the petals nearly all devoured, and others were only notched: the leaves were also eaten, both forms of injury being shown on Plate XVII. At first it was supposed to be the work of slugs, but on searching, some small Lepidopterous larvae resembling small cutworms were found in the soil around the plants. These were gathered by hand each day for several days, but the injury did not cease, and finally the plants were thoroughly sprayed with arsenate of lead. After this there was little or no further injury. Larvae were collected on May 8 and placed in cages in the insectary. In due time they became full-grown and pupated in the soil. On September 23, the adult emerged and proved to be a Noctuid moth, *Feltia venerabilis* Walker. This species is usually classed as one of the cutworms, though these larvae did not cut off the stems of the plants, but devoured the leaves and blossoms. Gibson[1] reports *F. venerabilis* as destroying plants in vegetable gardens in Canada, and in 1914 it was found injuring oats.

A New House Fly in Connecticut: During the late summer and fall of 1922, large flies were noticed as being rather common in the laboratory buildings at the Station, as well as in the residences of members of the staff. Little attention was paid to them except to kill them, as they were supposed to be some common and well-known species. On November 14, 1922, a letter was received from Mr. Charles W. Johnson, Curator of the Museum of the Boston Society of Natural History, stating that a large, blue-black fly, three or four times the size of the common house fly, a European species, had made its appearance in the vicinity of

[1] Bulletin No. 10, Entomological Branch, Canadian Department of Agriculture, page 31, 1915.

Boston. It was first taken in Connecticut by Dr. W. M. Wheeler and Mr. K. F. Chamberlain. From the abundance of this fly south and west of Boston, Mr. Johnson inferred that this fly was introduced further south, and asked whether we had observed it in New Haven. Specimens were collected and sent him, and a reply received November 24 stated that this fly is the European *Muscina pascuorum* Meigen. He regarded it as remarkable that an introduced species should gain such great headway before being discovered. Mr. Johnson read a paper on the subject before the entomological meetings in Boston, December 26, 1922.

The Hemlock Web Worm: On April 26, when the writer and Mr. Zappe visited South Manchester to examine rhododendron plantings infested by the rhododendron borer, small larvae and slight webs were noticed on some hemlock trees on the grounds. Some of the leaves were eaten off and fastened together by silk threads, thus making a loose case (see Plate XVIII) in which the larva lives and feeds on the leaves from the inside of the case. These severed leaves turned brown, and as the cases were abundant, the dead patches were rather conspicuous on the trees. Some of the larvae were bright green, and others were brown, but all seemed structurally alike and about one-fourth of an inch in length. These tiny larvae would drop downward on their silk threads when disturbed. The work of this insect was also noticed by the writer in Keney Park, Hartford, on April 29. Material was placed in the insectary and adult moths emerged on May 25 and 31. The insect is a small moth, *Gelechia abietisella* Pack., of the family Tineidae, and must lay its eggs on the leaves during June. It is thought to be single brooded and that the caterpillars become nearly full-grown by winter, and pass the winter in their cases and become again active in the spring.

On May 23, 26 and 31, several Hymenopterous parasites emerged. These were sent to the U. S. National Museum and identified as belonging to the genera *Copidosoma* (3 specimens), *Apanteles* (2 specimens), *Eubadizon* (1 specimen) and *Bassus* (1 specimen).

The moth has a wing expanse of three-eighths of an inch, whitish with ends of wings and fringe light brown, and with darker transverse bands on the costal margin of the fore wings.

Rose Chafers in Vineyard: On June 10, I visited the 80-acre vineyard of Mr. P. M. D'Esopo in Marlborough. The owner reported severe injury in 1921 from the rose chafer, *Macrodactylus subspinosus* Fabr., and feared that the partial loss of his crop might follow the attacks of these beetles in 1922. At the time of my visit, the adults had just begun to appear on the vines, but were not very abundant. The owner expected that they would be present in full force a few days later, and was spraying the

vines with arsenate of lead to prevent injury. While present, I mixed up a barrel of self-boiled lime-sulphur, and the men applied it to certain rows on one side of the vineyard. I also applied two gallons of "Derrisine" with a hand pump to a few vines near the buildings. Mr. Walden and I visited the vineyard on June 15. There were only a few rose chafers on the vines sprayed with self-boiled lime-sulphur, and though not extremely abundant anywhere, they were present in greater numbers on vines sprayed with lead arsenate. It seemed to us that the rose chafers were nowhere sufficiently abundant to cause material damage to the crop, and they had not greatly increased in numbers since my former visit on July 10. The "Derrisine" had a strong and characteristic odor when first applied, but this had all disappeared by June 15, and there were then a few chafers on the vines. Apparently the self-boiled lime-sulphur acts as a repellent against the rose chafer and has proved quite successful in New Jersey.

Cutworms Attacking Raspberries and Asparagus: While examining raspberry plants in a field in East Haven on May 8, it was noticed that the lower leaves, especially those of the new canes, had numerous holes apparently eaten by some insect. The foliage was examined hastily and no insects were found that would cause the injury. The plants were examined again on May 16, when it was found that the injury had increased. The soil around the base of some of the plants was dug away, and a number of cutworms about an inch long were found a short distance below the surface. A number of the larvae were collected to rear, and adults emerged from this material on June 28, belonging to two species, *Paragrotis messoria* Harr., and *Paragrotis tessellatus* Harr. The larvae of both of these species are climbing cutworms, and are well-known pests, having a large variety of food plants. Similar injury was observed on red and black cap raspberries in North Branford and Montowese, At Montowese, in an asparagus field near the raspberries, many of the new stalks were crooked and badly distorted, making them unfit for market. It was found that nearly all of the crooked stalks had been eaten on the inner side. A cutworm was found in the soil at the base of the stalks showing fresh injury. While no adults were reared from these larvae, it is quite probable that it was one of the species attacking raspberries. A number of asparagus stalks showed injury from frost or cold weather, but the tips of these were somewhat shriveled and had a whitened or blasted appearance readily distinguished from those injured by the cutworms. The injuries caused by these cutworms and the adult of *Paragrotis messoria* Harr, are shown on Plate XIX.

B. H. WALDEN.

Cabbage Worms Controlled by Sulphur-Lead Arsenate Dust: The imported cabbage worm, *Pontia rapae* Linn., was sufficiently abundant to have caused serious injury to an experimental block of cabbage at the Station Farm the past season. An application of dust prepared by mixing ten pounds of dry lead arsenate with ninety pounds of dusting sulphur was applied August 21 with hand dusters. The heads were about one-third to one-half grown.

An examination of the plants a few days later showed that the treatment was very effective in killing the imported cabbage worm. The cabbage looper, *Autographa brassicae* Riley, was also present in small numbers, and those that had gone far into the heads were not affected by the treatment. When the looper is present, in order to be effective the treatment should be applied before the worms have entered the head.

It is difficult to coat the smooth foliage of the cabbage thoroughly with a spray. It is necessary to use a spreader, such as casein and lime, with a lead arsenate spray. While no comparison was made between the dust and a spray, the indications were that dust gave as good results as could be expected.

Probably hydrated lime could be used as a carrier for the lead arsenate in place of the sulphur, so that the dust mixture would cost no more than the spray with a spreader. The dust can be applied more cheaply than a spray.

B. H. WALDEN.

Springtails Injuring Vegetable Seedlings: On May 29, the New Haven County Farm Bureau advised this Department that the gardener on an estate in Pine Orchard was having trouble with a small "black bug" which was destroying his vegetable seedlings, and requested that the matter be investigated. The place was visited on the same day, and it was found that springtails were causing the injury. Specimens were collected and sent to Professor J. W. Folsom, Urbana, Illinois, who identified the species as *Sminthurus hortensis* Fitch.

The garden had been on the same ground for a number of years, and liberal amounts of stable manure had been used. The gardener stated that the insects were very abundant at the time the first seedlings came up, and had since been gradually disappearing. The first plantings of carrots, beets, swiss chard, spinach and onions were practically destroyed soon after the leaves appeared. These vegetables had been replanted, and from one-third to two-thirds of these plants had been destroyed. The second planting of onions was not as severely injured as the other vegetables. This was the first year that the gardener had been on the place, but he was informed that this trouble had been experienced for several seasons.

While but few of the springtails were observed on May 29, six rows of spinach were thoroughly dusted with sulphur-nicotine dust. The spinach was examined on June 1. No springtails were found on the dusted plants, and only an occasional one was found on the ground under these plants, but it was found that the insects had also nearly all disappeared from the untreated rows. It will be necessary to make tests earlier in the season when the springtails are more abundant in order to get any conclusive data regarding control measures.

B. H. WALDEN.

Clothes Moths: On December 9, 1921, specimens of small, white Lepidopterous larvae were brought to this office by an agent of a casket manufacturing concern in New Haven. The casket manufacturers had sold some caskets to an undertaker in 1919. Two of these caskets were covered on the outside with a gray woolen material and were lined with silk on the inside. About one year after they were purchased, holes were eaten through the gray cloth covering and the undertaker requested the manufacturers to recover one of these caskets which was done. When the manufacturer again received a request to recover another casket, he felt reluctant to go to this expense, unless it could be shown that the caskets were infested with "bugs" when the undertaker bought them. To settle this controversy, this office was called on for information as to what the insects were and where they were coming from. As it was difficult to determine these points from an examination of the larvae, the writer visited the undertaker's establishment to see the casket and the surroundings.

The casket was quite badly infested with small, white larvae, from some of which adults were reared. It proved to be one of the clothes moths, *Tinea pellionella* Linn. A few of the larvae were feeding on the woolen cloth on the outside of the casket, but most of them were on the inside, where the outside covering lapped over the edge. This lapped material was covered with silk on the inside, making a dark place for the larvae to work. The wood of which the casket was built had been tunneled by wood-boring insects and wherever these tunnels opened on the outside of the casket, the clothes moth larvae had eaten the cloth away, leaving a round hole. Apparently the larvae had crawled into these holes in the wood to pupate and before emerging as adults, had eaten through the cloth for exit. This led the undertaker to believe that the insects were coming from the wood and had been in the caskets since he purchased them.

The undertaker's rooms adjoined those of a tailoring establishment and also a hat shop. In these shops it is the habit to keep the scraps of felt and wool cloth in the back rooms, and

this material was undoubtedly infested with clothes moths. The undertaker said that in the fall he had noticed large numbers of small moths flying about. Probably it was these moths which started the infestation in the caskets.

A short time later another large infestation of clothes moths was seen in a warehouse which supplied retail stores with athletic and sporting goods, hardware, etc. Here the infestation had apparently started, or at least the greatest number of larvae were found in felt weather strips. Many moths had emerged from these strips and many larvae were still present in them. The weather strips were a complete loss and were all burned immediately. Other material subject to infestation, such as sweaters, jerseys, camel's hair brushes, trout-flies, etc., was in danger of being attacked and was exposed so that the adult moths could get at it. It was suggested to the man in charge of the warehouse that when all the moths had disappeared, this material could be placed in the ovens of the wood kiln drying plant and subjected to very high temperature to kill any eggs or larvae that might be left in it.

M. P. ZAPPE.

NOTE REGARDING AUTHORSHIP.

For bibliographical purposes, all notes and articles in this Report (Bulletin 247) should be credited to W. E. Britton, except where otherwise indicated.

ILLUSTRATIONS.

The illustrations in this Report (Bulletin 247) are from the following sources: Text figures are all from drawings as follows: Figs. 4 and 5, Map drawn by A. E. Moss, shaded by Stoddard Engraving Co.; Figs. 6, 7, 8, 9 and 11 from original drawings by Dr. Philip Garman; Fig. 10, from Spray Calendar, drawn by Mrs. E. L. Beutenmuller; Plates V, VI, VII, VIII and XII, b, from photographs by W. E. Britton; Plates IX and X, from photographs by Dr. Philip Garman; Plate XII, a, from photograph by H. A. Doty; Plate XIII, b, photographed from a colored plate published by Dr. E. P. Felt; all others from photographs by B. H. Walden.

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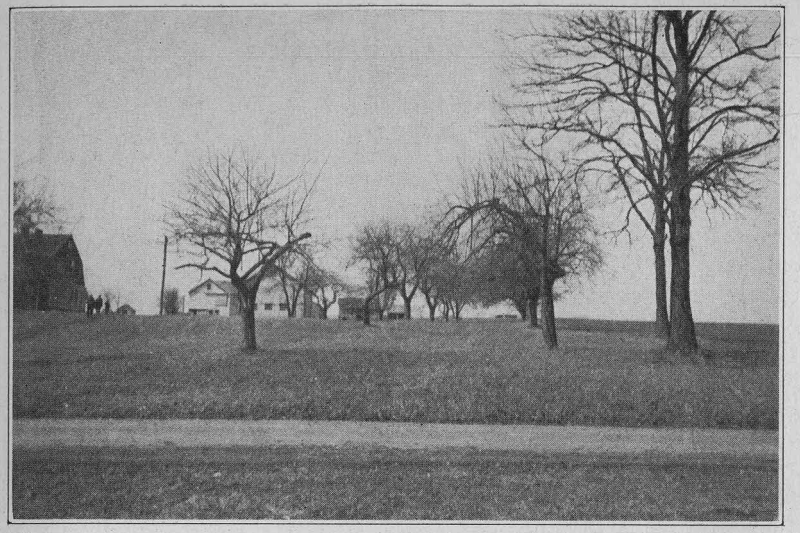
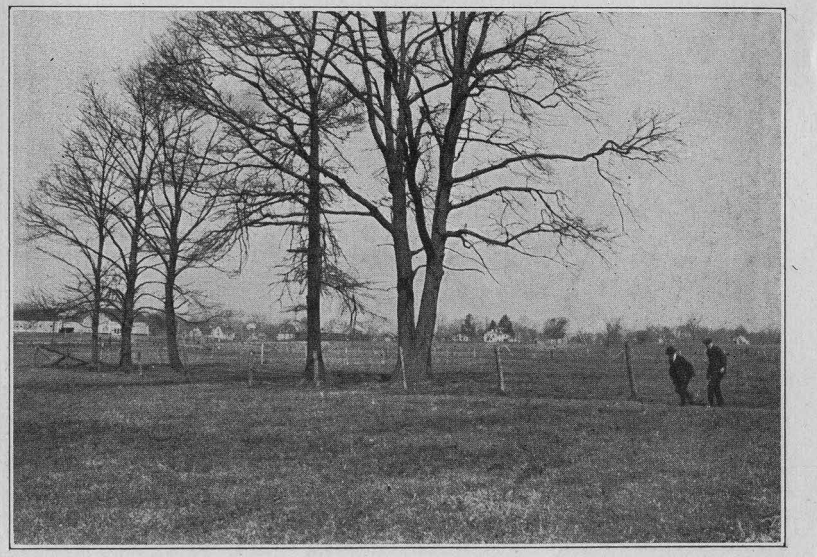
PLATE V.



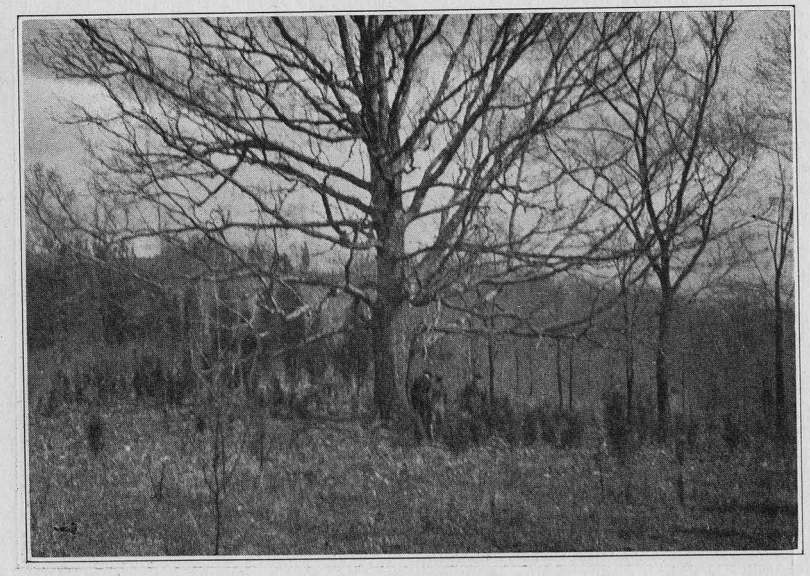
a. Infestation on place of C. D. Mexcur, Bloomfield, north of village, April 6, 1922.



b. Infestation in Bloomfield, east of village, April 6, 1922.

PLATE VI.

a. Infestation in birches in Berlin, just east of Shuttle Meadow Country Club, April 20, 1922.

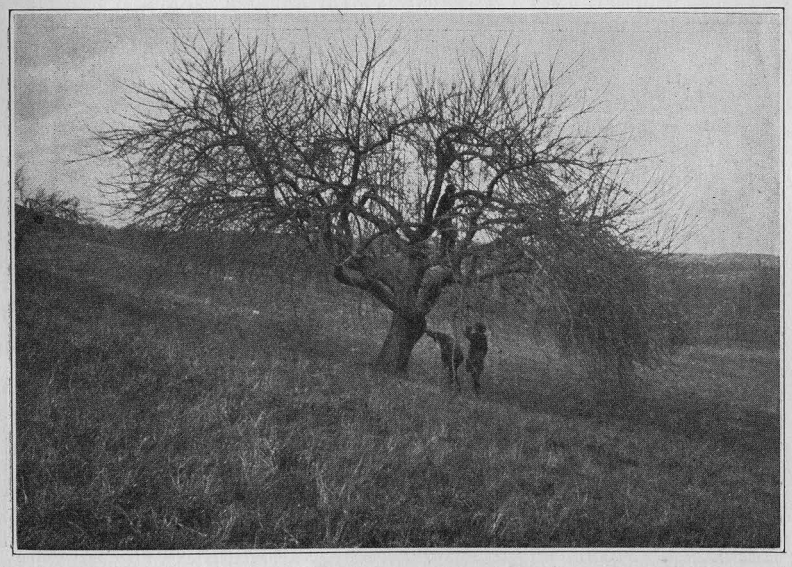


b. Infestation on white oak, Berlin, southwest of Shuttle Meadow Country Club, April 20, 1922.

GIPSY MOTH WORK

PLATE VII.

a. First infestation found in Glastonbury: on apple trees northeast of village, March 17, 1922.



b. Infestation on large apple tree in open field, Berlin: east of state road to Meriden, April 20, 1922.

GIPSY MOTH WORK

PLATE VIII.

a. Infestation in apple orchard, Wolcott, northeast of village, April, 20, 1922.

b. The only infestation found in Southington was on this apple tree in a yard adjacent to the town farm, April 20, 1922.

GIPSY MOTH WORK

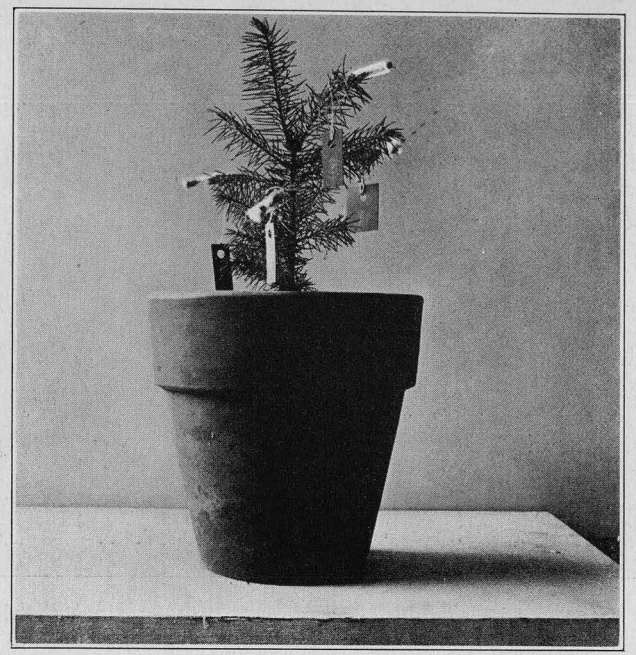
PLATE IX.

a. View in orchard of Smith T. Bradley, North Branford, showing untreated trees partially defoliated by mites

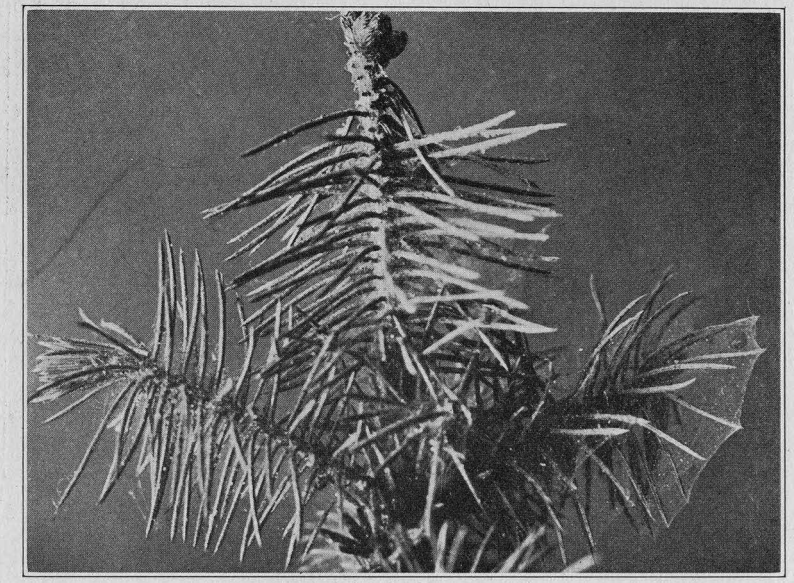
b. View in same orchard showing trees which were sprayed with linseed oil emulsion.

EUROPEAN RED MITE

PLATE X.



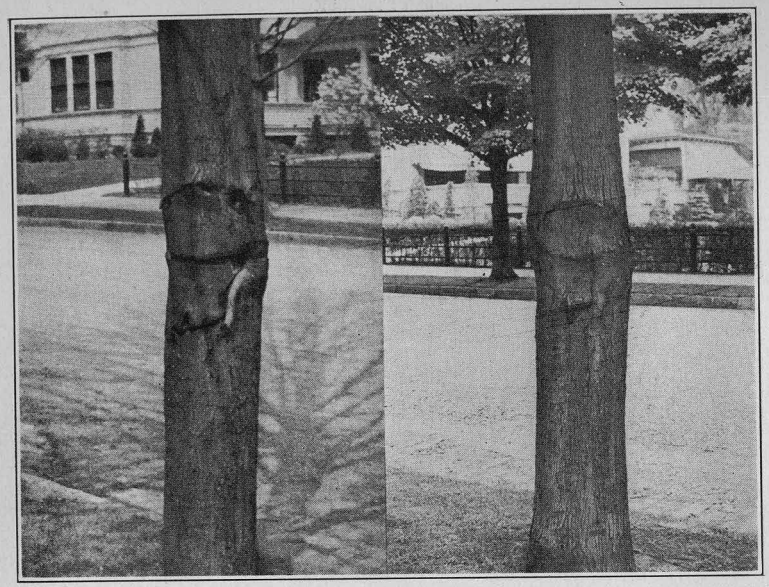
a. Small spruce tree in pot showing method of confining mites for study.



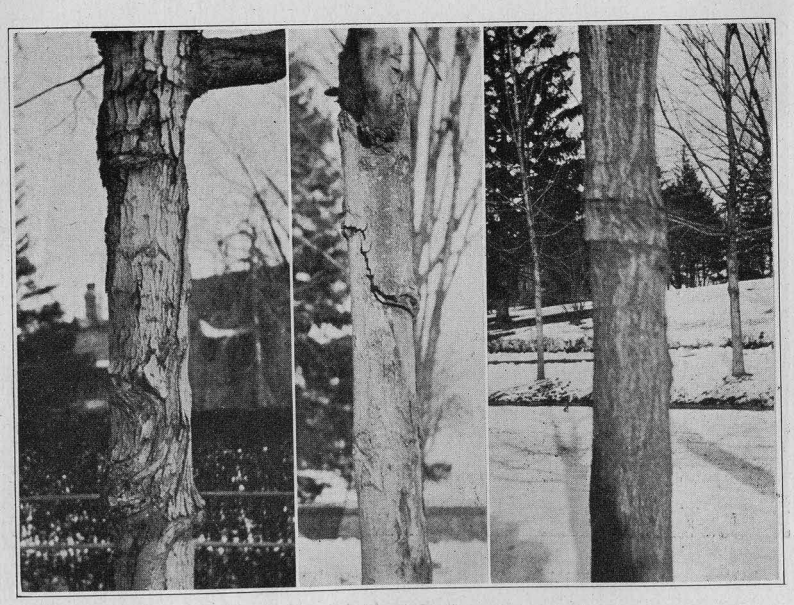
b. Web formed by mites on spruce twigs.

SPRUCE MITE

PLATE XI.



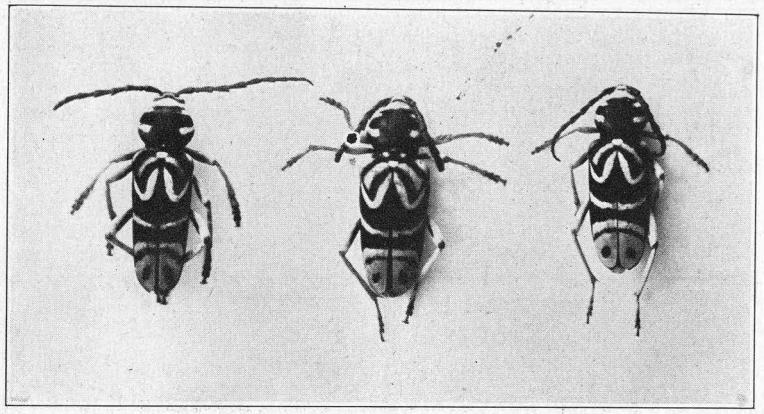
a. Left, scar on young maple tree; right, view of same tree four years later.



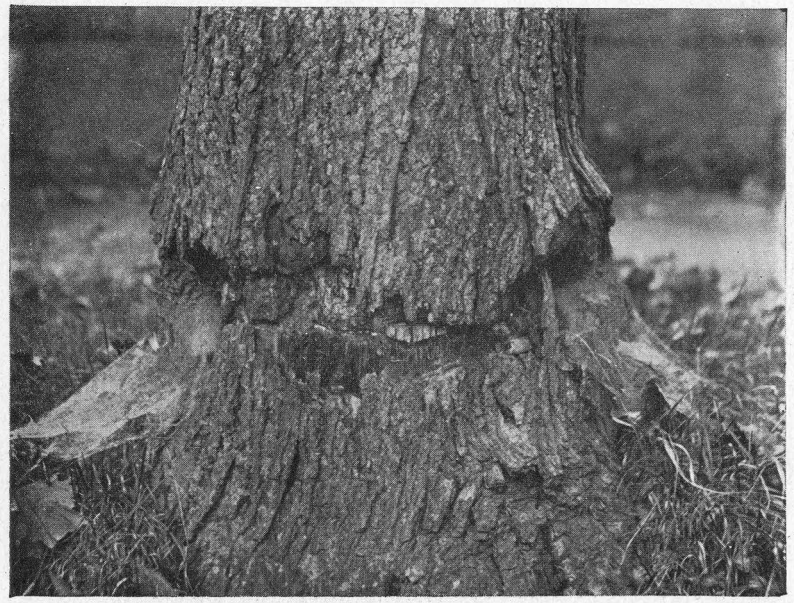
b. Three young maple trees in New Haven, showing scars caused by maple borer.

MAPLE BORER

PLATE XII.



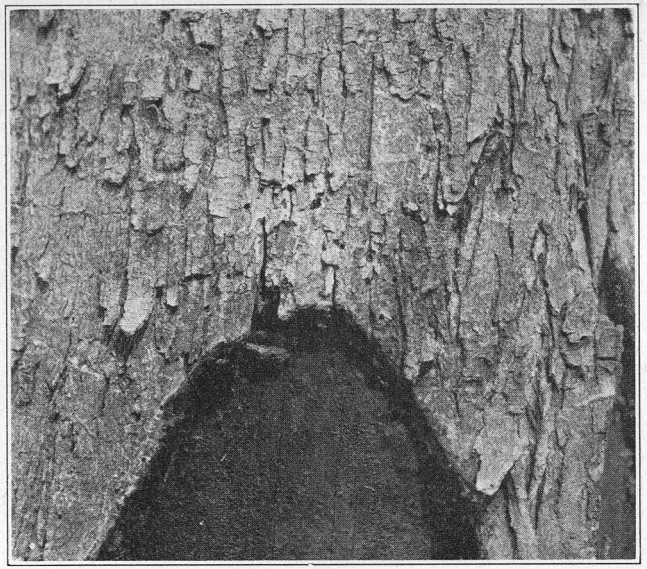
a. Adult maple borers, natural size



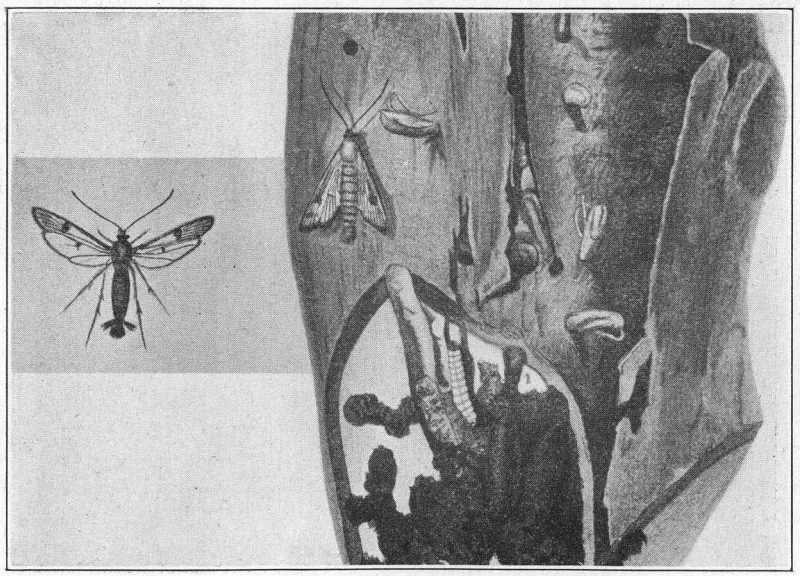
b. Tree partly girdled at base by maple borer.

MAPLE BORER

PLATE XIII.



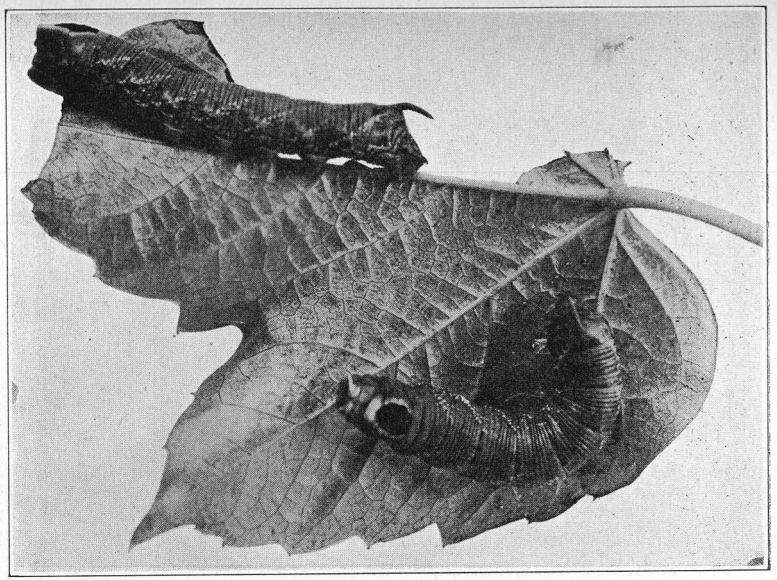
a. Small exit holes of adults on injured silver maple.



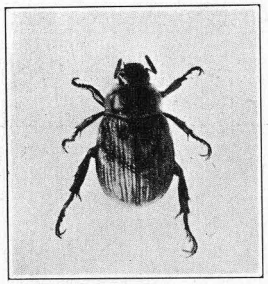
b. Adult and work of maple sesian. (After Felt).

MAPLE SESIAN

PLATE XIV.

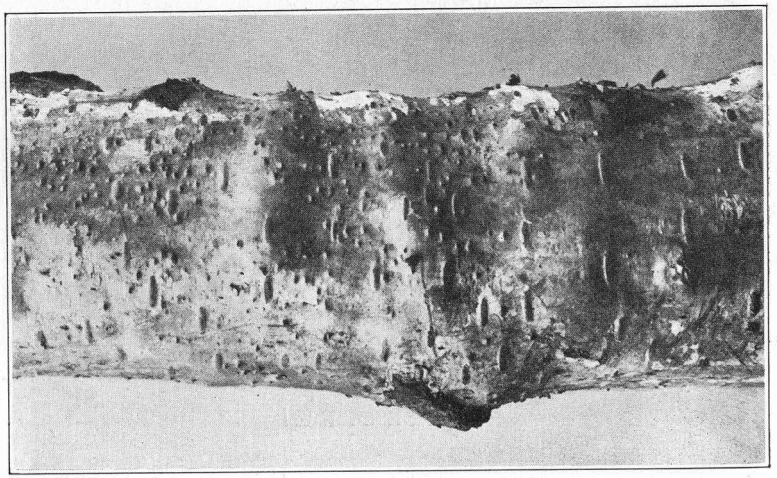


a. Curious hornworms, *Dilophonota ello* Linn. Natural size.



b. Asiatic beetle, twice enlarged.

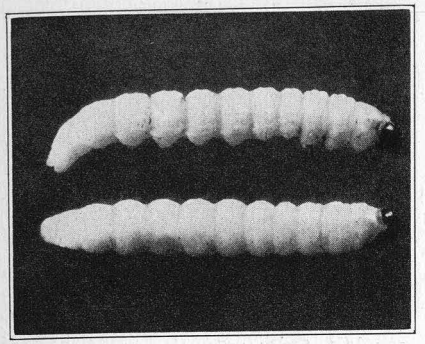
c. Bronze birch borer, twice enlarged.



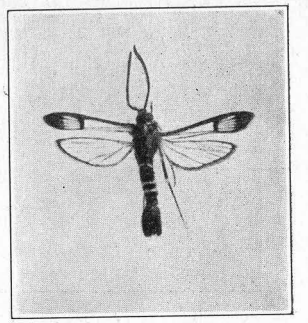
d. Ridges on birch, caused by bronze birch borer.

HORN WORMS, ASIATIC BEETLE AND BRONZE BIRCH BORER

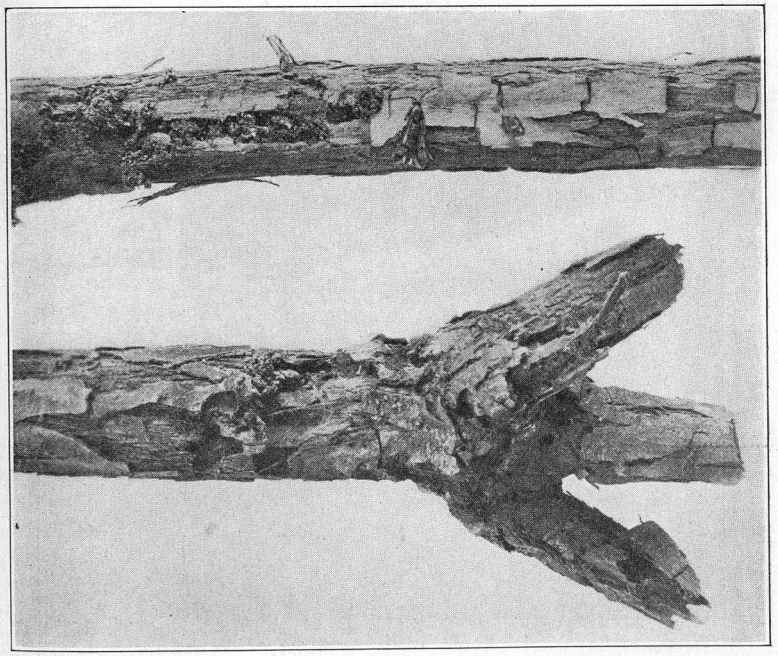
PLATE XV.



a. Larvae, four times enlarged.



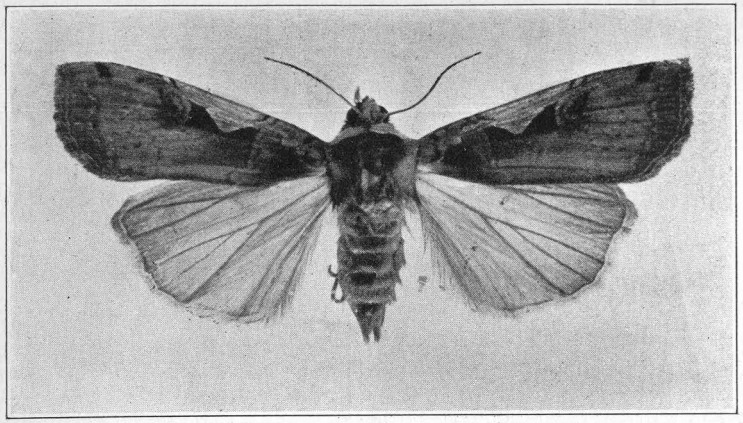
b. Adult, twice enlarged.



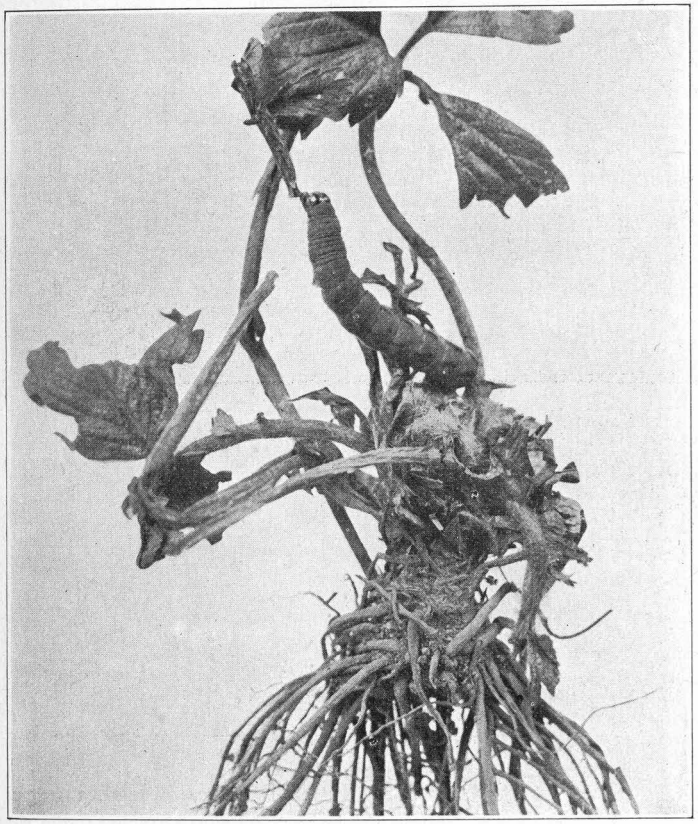
c. Appearance of infested stems showing adult. Natural size.

RHODODENDRON BORER

PLATE XVI.



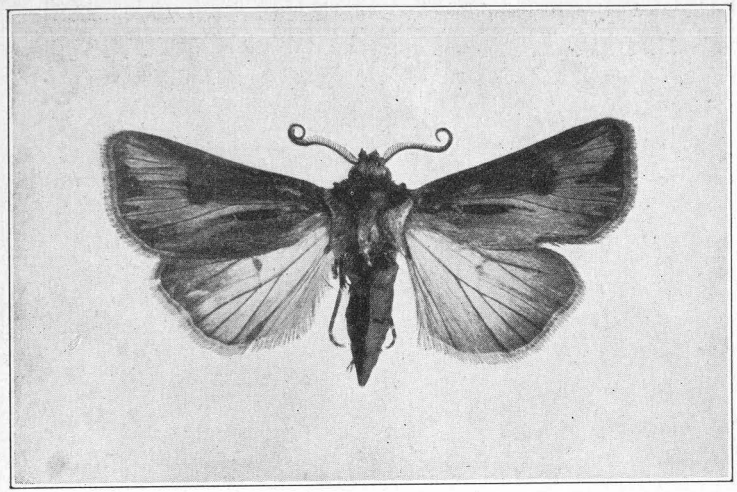
a. *Noctua c-nigrum* Linn. adult, twice natural size.



b. Larva, feeding on strawberry, natural size.

CUTWORMS INJURING STRAWBERRIES

PLATE XVII.



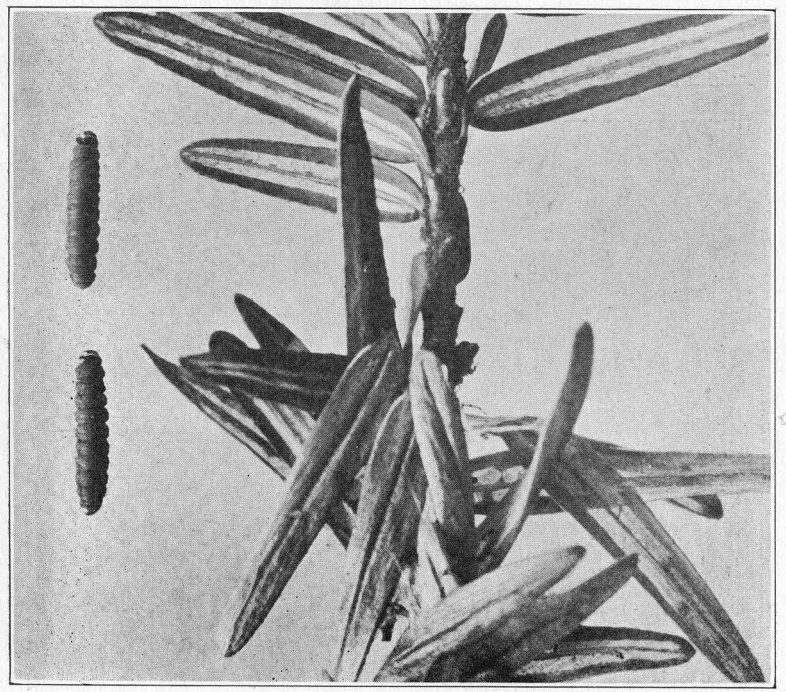
a. *Feltia venerabilis* Walker, adult, twice natural size.

b. Pansy blossom and leaves eaten by larvae, natural size.

NOCTUID LARVAE INJURING PANSIES

PLATE XVIII.

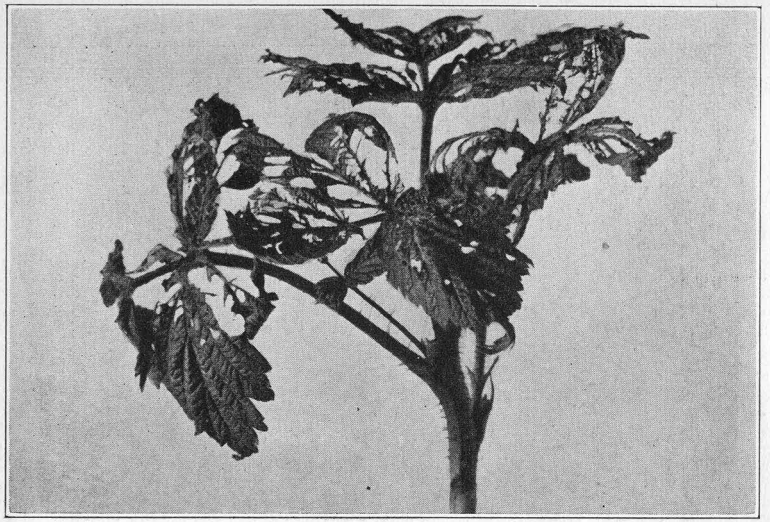
a. Appearance of infested twigs, natural size.



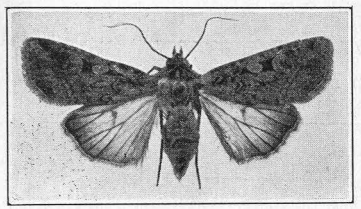
b. Webbed leaves and larvae, four times enlarged.

HEMLOCK WEB WORM

PLATE XIX.



a. Raspberry shoot eaten by larvae, natural size.

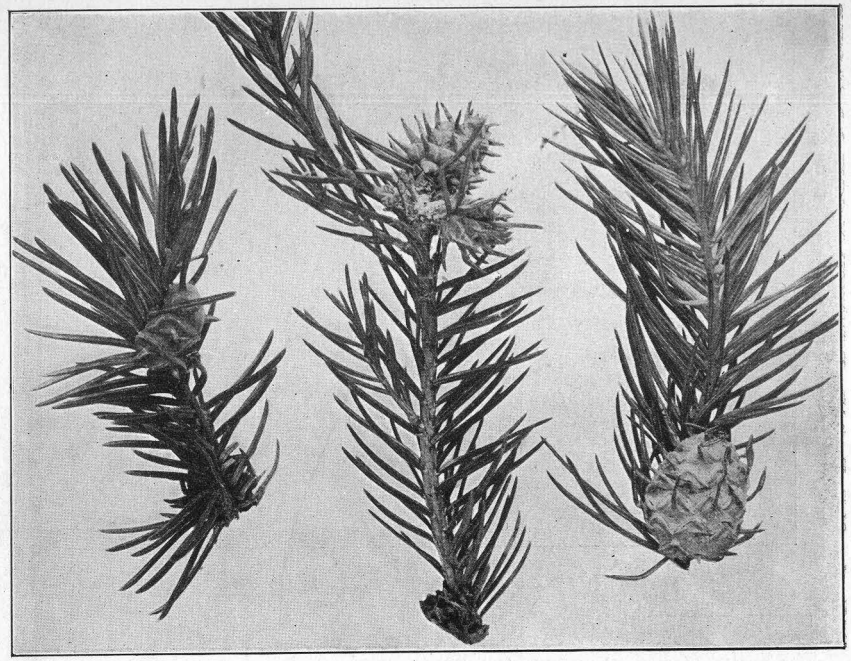


b. *Paragrotis messoria* Harr.
Adult, natural size.

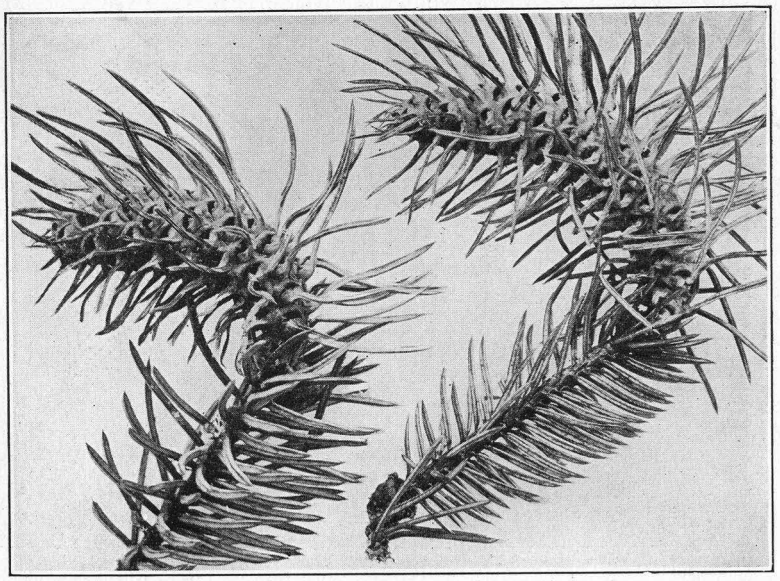
c. Asparagus shoots eaten by larvae, natural size.

CUTWORMS INJURING RASPBERRY AND ASPARAGUS.

PLATE XX.



a. Galls of *Chermes abietis* Linn., on Norway spruce, natural size.



b. Galls of *Chermes cooleyi* Gillette, on blue spruce, natural size.

SPRUCE GALL APHIDS

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 248 MARCH, 1923

BEING THE

Twenty-Seventh Report

ON

Food Products

AND

Fifteenth Report on Drug Products

Part II

By E. M. BAILEY.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

March, 1923

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CONTENTS

FOODS, ETC.

DRUGS, ETC.

The Twenty-seventh Report on Food Products and the Fifteenth Report on Drug Products, 1922

Part II

By E. M. Bailey.

Twenty-five hundred and forty-six samples of foods and drugs have been examined in the past year, largely for the immediate purpose of food and drug control, as required by the Dairy and Food Commissioner.

Aside from the routine work of inspection, however, a special investigation of commercial vitamine preparations has been made, first to devise a plan for evaluating their potency and second, to show comparatively their powers to promote growth in experimental animals. A full account of this investigation has been published in Bulletin 240, which constitutes Part I of this report. Collaborative and other studies of methods of analysis have been made in which various members of the laboratory staff have participated.

Credit for the analytical work herein reported is due entirely to Messrs. Andrew, Shepard, Nolan, Fisher and Merwin. Mrs. Storrs has contributed largely to the work of compilation and preparation of results for publication.

I. FOODS.

CARBONATED BEVERAGES.

The use of saccharin in this class of products has greatly diminished since the passage, two years ago, of a law regulating the manufacture and bottling of non-alcoholic beverages, which makes the use of saccharin illegal. Of one hundred and twelve samples of bottled soda examined during the past year only six were found to contain this artificial sweetener. In 1920, 40.5 per cent. of the samples examined contained saccharin; in 1921 the percentage thus adulterated was 18.7; in the past year the proportion is 5.4 per cent.

Of the total number of samples examined, one hundred and four were submitted by the Dairy and Food Commissioner, five were collected by the Station agent and three were submitted by individuals.

Saccharin was found in the following samples:

D. C. No.	Brand.	City or Town.	Manufacturer or Dealer.
22121	Strawberry Soda	*New Britain*	Boston Bottling Works.
23100	Lemon Soda	*New Haven*	Samuel Weiner.
23112	Lemon Soda	*New Haven*	Oresto Balzano & Sons.
19890	Cream Soda	*Norwich*	Washington Club Bottling Works.
19891	Strawberry Soda	*Norwich*	Washington Club Bottling Works.
20049	Strawberry Soda	*Thomaston*	August Koegel.

CEREAL PRODUCTS.

Breakfast Foods.

19907. *Zep,* made by the Battle Creek Food Co., Battle Creek, Mich. This is a breakfast food said to be rich in food iron, food lime and vitamine.

20097. *Trufood,* made by the Farney Trufood Co., Morris Plains, N. J.

Analyses:

	19907	20097
Moisture	5.00%	5.65%
Ash	2.85	1.38
Protein (N x 6.25)	14.00	11.50
Fiber	1.34	1.80
Nitrogen-free extract	74.60	77.13
Fat	2.21[1]	2.54
Iron (Fe)	0.008[2]	

[1] Method as described in Conn. Exp. Sta. Bull. 200, p. 133.
[2] Iron was determined colorimetrically. Conn. Exp. Sta. Bull. 227, p. 254.

Wheat bran contains about the same amount of iron as we have found in Zep.

Corn Meal.

Three samples of corn meal were collected by the Station agent. They were **15686**, *Quaker,* yellow and **15703**, *Quaker,* white both made by the Quaker Oats Co., Chicago; also **15687**, yellow, made by the Great Atlantic and Pacific Tea Co.

All samples were normal in taste and odor, and neither moisture nor acidity was excessive. Acidity numbers (cc N alkali per kilo of meal), were 19.8, 21.8 and 23.2 respectively and percentages of moisture 10.26, 10.30 and 9.93 were found. Acidity was determined by the Schindler method[1] by which figures above 30 are regarded as indicating meal unfit for consumption. The standard[2] for corn meal does not allow more than 14 per cent. of moisture.

CIDER.

Two samples of cider, submitted to the Dairy and Food Commissioner, not officially taken by his inspectors, were examined for alcohol. D. C. No. **19897** contained 2.40 per cent. and D. C. No. **22487** contained 0.90 per cent. alcohol by volume.

One sample, **19174**, was submitted by G. E. Norton of Bristol. It contained 0.57 per cent. alcohol, and was preserved with benzoate of soda.

CLAMS.

Eighteen samples of canned clams were examined, all collected by the Station agent.

Analyses are given in Table I.

The total solids in the drained meats varied from 20.8 per cent. to 23.1 per cent. in round clams, and from 21.8 per cent. to 24.1 per cent. in long clams. Long clams showed more protein and fat, and distinctly less carbohydrate (as glycogen), than round clams. The averages for carbohydrate contents of drained meats and of liquor in round clams were 1.81 per cent. and 3.37 per cent. respectively; the corresponding figures for long clams were 0.61 per cent. and 1.13 per cent., or about one-third as much in each case. Salt, as indicated by the chlorine content, was not very different in the two types of products.

The net weight of clams found was 90 per cent. or more of the weight declared (where statements of contents were made), except in one case where 5 ounces were declared and 4 ounces were found. In one case, **19840**, the net contents was indistinctly marked. The combined weight of meats and liquor equaled or exceeded 10 ounces in all cases. Clam meats packed in water of less salt content than their own liquor will yield some of their solids, notably salt, to the surrounding medium.

DIABETIC AND SPECIAL FOODS.

Under this group twenty samples have been examined for dietitians or others interested.

19519. *Casein flour,* submitted by Dr. J. R. Williams, Rochester, N. Y.

[1] Leach. *Food Inspection and Analysis,* p. 338.
[2] Circ. 136, U. S. Dept. Agr., Office of the Secretary.

TABLE I. ANALYSES OF CANNED CLAMS.

Station No.	Brand	Contents				Water	
		Declared		Found			
		Clams	Liq'r	Clams	Liq'r	Clams	Liq'r
	ROUND CLAMS.	Oz.	Oz.	Oz.	Oz.	%	%
19883	E. S. Burnham Packing Co., New York. *Tarpan Bay*	11.0		4.7	6.3	78.40	91.76
19824	J. H. Doxsee & Sons, New York *Doxsee's Little Neck*	5.0	5.0	4.7	6.8	79.03	91.61
19888	J. H. Doxsee & Sons, New York *Doxsee's Little Neck*	5.0	5.0	4.6	6.3	79.19	92.12
19836	J. H. Doxsee & Sons, New York. *Neptune*	5.0	5.0	4.9	6.3	76.94	88.20
19852	R. C. Williams & Co., New York. *Royal Scarlet*	5.0	.	4.6	6.7	77.98	92.42
	LONG CLAMS.						
19860	Farnsworth Packing Co., Brooklin, Me. *Blue Hill*	5.0	..	4.8	6.2	76.39	95.09
19882	L. E. Gardner & Co., Cutler, Me. *Atlantic*	5.0	..	4.7	6.7	76.38	95.34
19855	Hinkley, Stevens & Co., West Jonesport, Me. *Our Brand*	5.0	..	4.8	6.5	75.92	94.12
19847	Arthur L. Johnson Co., Boston. *Crusoe*	5.0	..	5.2	5.9	76.23	94.86
19877	A. L. Johnson Co., Boston. *Down East*	5.0	..	4.5	6.5	76.71	95.11
19844	H. S. Kane, Brooklin and Adison, Me. *Pleasant River*	5.0	..	4.8	5.7	77.71	96.22
19840	Andrew Kerr Co., Boston. *Kerr's Choice*	[1]	..	3.9	6.9	76.12	94.72
19835	Francis H. Leggett & Co., New York. *Premier*	5.0	..	4.9	6.4	77.83	94.20
19832	Palmer, McElwain & Cole, Inc., Boston. *Seamade*	5.0	..	4.0	6.7	77.70	95.82
19843	Portland Packing Co., Portland, Me. *Star*	5.0	6.0	5.1	4.9	77.92	92.43
19845	Thorndike & Hix, Rockland, Me. *Gold Coin*	5.0	4.0	5.6	5.1	78.00	95.03
19837	William Underwood Co., Boston.	10.0		4.2	6.0	76.56	93.54
19853	Joseph Wyman & Sons, Millbridge, Me. *Hunter*	5.0	..	4.6	5.9	78.24	95.26

[1] Declaration illegible.

CANNED CLAMS.

Ash		Protein (N x 6.25)		Fat		Carbohydr. (as glycogen)		Undetermined		Chlorine		Station No.
Clams	Liq'r	Clams	Liq'r	Clams	Liq'r	Clams	Liq'r	Clams	Liq'r	Clams	Liq'r	
%	%	%	%	%	%	%	%	%	%	%	%	
2.30	2.30	16.33	2.77	0.75	0.03	1.26	2.31	0.96	0.73	0.82	1.03	19883
2.17	1.76	15.19	2.38	0.91	0.04	2.03	3.62	0.67	0.59	0.64	0.76	19824
2.15	1.81	15.60	2.78	0.79	0.03	1.46	2.79	0.81	0.47	0.67	0.82	19888
2.22	1.77	15.31	3.25	1.35	0.07	3.20	5.88	0.98	0.83	0.60	0.74	19836
2.38	2.88	16.38	2.88	0.90	0.15	1.14	2.24	1.22	0.50	0.59	0.79	19852
3.26	2.58	17.06	2.31	2.03	0.02	0.55	1.02	0.71	0.02	0.70	1.27	19860
2.35	1.77	18.49	2.49	1.87	0.04	0.35	0.49	0.56	0.13	0.50	0.85	19882
2.19	1.65	18.95	3.31	1.99	0.03	0.55	1.13	0.40	0.24	0.38	0.68	19855
2.57	1.73	17.89	2.55	1.50	0.02	0.43	0.77	1.38	0.07	0.46	0.74	19847
2.25	1.76	17.28	1.91	1.76	0.03	0.64	1.13	1.26	0.06	0.44	0.78	19877
1.93	1.45	17.88	1.60	1.32	0.02	0.41	0.61	0.75	0.10	0.34	0.67	19844
2.98	1.91	17.92	2.16	1.59	0.07	0.59	1.22	0.80	0.09	0.51	0.88	19840
2.53	2.07	15.75	2.13	2.22	0.07	0.71	1.31	0.96	0.22	0.62	1.01	19835
1.89	1.05	16.56	1.75	1.69	0.04	0.77	1.40	1.59	0.06	0.18	0.46	19832
2.51	2.11	16.17	3.56	1.60	0.03	0.85	1.81	0.85	0.17	0.60	0.92	19843
2.56	2.28	16.75	1.89	1.33	0.03	0.50	0.79	0.86	0.02	0.65	0.94	19845
1.67	1.25	17.75	3.13	2.09	0.05	0.95	1.97	0.98	0.06	0.20	0.42	19837
2.59	1.54	16.42	2.16	1.42	0.09	0.58	1.10	0.75	0.15	0.45	0.73	19853

Diaprotein No. 2, made by the John Norton Co., Columbus, Ohio, was examined for the Council on Pharmacy and Chemistry, American Medical Association.

Analyses are as follows:

	19519 %	Diaprotein, No. 2. %
Moisture	7.44	11.23
Ash	3.49	6.75
Nitrogen	8.89	12.43
Protein (N x 6.38)	56.72	79.30
Lactose	7.52	0.88
Fat	19.76	1.55

19323. *Washed Gluten flour,* The Health Food Co., N. Y. This flour contained: Moisture 7.10 per cent.; nitrogen 14.05 per cent.; protein (factor 5.7), 80.09 per cent.; soluble carbohydrate (calculated as dextrose), 0.55 per cent.; starch, 2.81 per cent.

18806. *Strawberry extract;* **18807** *Raspberry extract;* **18808** *Pineapple extract;* **18809** *Peach extract;* **18810** *Onion extract.* These were submitted by R. J. Brazil, Rockville, and were examined for sugar only. On short hydrolysis with acid (10 minutes), the samples gave amounts of reducing sugar (calculated as invert sugar), of 0.5, 0.8, 6.5, 11.0 and 3.5 grams per 100 cc. in the order named.

18170. *Sugar Free Milk,* made by D. Whiting & Sons, Boston.

19135 and **19520.** *Whey mixtures,* submitted by Dr. A. S. Brockett, Bristol.

Analyses were made as follows:

	18170 %	19135 %	19520 %
Solids, calculated (determined 16.29)	16.49	....	....
Ash	0.76	....	....
Protein (N x 6.38)	6.25	0.98	1.60
Lactose	0.55	....	....
Fat	8.56	2.60	2.20
Gelatin	0.37	....	....

The question was raised by a manufacturer of diabetic food products as to the possible loss of fat in foods during the baking process. The following series of trials was made using the same recipe in all cases, except that the shortening material was varied to include (1) butter, (2) lard, (3) cottonseed oil, and (4) corn oil.

The recipe was as follows:

½ cup shortening	2 teaspoons baking powder
1 cup sugar	2½ cups flour
2 eggs	½ teaspoon vanilla
1 tablespoon milk	½ teaspoon nutmeg.

One-half of the dough was taken for analysis and the remainder baked. Analyses of both portions on the moisture-free basis are given in Table II.

TABLE II. PROXIMATE COMPOSITION OF DOUGH BEFORE AND AFTER BAKING (MOISTURE-FREE BASIS).

	Trial I Butter		Trial II Lard		Trial III Cottonseed Oil		Trial IV Corn Oil	
	Unbaked %	Baked %	Unbaked %	Baked %	Unbaked %	Baked %	Unbaked %	Baked %
Ash	2.67	2.60	1.65	1.80	1.94	1.95	1.65	1.70
Nitrogen	1.13	1.17	1.11	1.15	1.08	1.10	1.16	1.15
Protein	7.09	7.32	6.93	7.17	6.78	6.85	7.27	7.21
Fiber	0.28	0.23	0.36	0.29	0.22	0.28	0.24	0.23
Carbohydrate	74.67	74.62	74.44	74.14	74.43	74.06	76.47	76.41
Fat	15.29	15.23	16.62	16.60	16.63	16.86	14.37	14.45

The results show no significant differences in composition between the doughs and the corresponding baked products. The variation in fat which was thought to have occurred was undoubtedly due to the unequal moisture content in the products compared and partly, also, to the greater difficulty in extracting the fat from baked materials.

18601. *Commercial Inulin.* A sample of commercial inulin was examined in comparison with inulin prepared in the laboratory from dahlia tubers.

The commercial sample contained: Moisture 9.53 per cent.; nitrogen 0.16 per cent.; ash 2.58 per cent.; insoluble in water trace; direct reducing sugar calculated as levulose 0.79 per cent.; monosaccharide present (Barfoed's test). Specific rotation at 20° C., corrected for moisture, ash and protein, —32.9°.

According to Browne[1] the specific rotation at 20° of inulin is —36.0° to —40.0°; of pseudoinulin —32.2 and for closely related compounds lower values.

The specific rotation of the inulin prepared in this laboratory from dahlia tubers was —36.5 corrected.

[1] Handbook of Sugar Analysis, p. 614.

EGGS.

Twenty-two samples of eggs were submitted by the Dairy and Food Commissioner for examination. These were, in most cases, Western or New York State eggs, retailed as *fresh* or *fresh western*. A few were guaranteed to be fresh Connecticut eggs. Of the Western or New York State eggs there were fifteen samples comprising a total of 48 eggs of which, on examination, 3 were classified as fresh, 45 as not fresh; 47 were edible and 1 was non-edible. There were five samples of guaranteed fresh or fresh Connecticut eggs comprising a total of 18. Of these 16 were classified as fresh, 2 not fresh; 17 were edible and 1 was non-edible. Two samples labeled as recandled and repacked were not sold as fresh eggs.

The characteristics of a fresh egg have been defined by various authorities from which the following may be cited.[1]

CHARACTERISTICS OF A FRESH EGG.

Before the candle.	Out of shell.
Air space: Not enlarged; less than three-fourths inch in diameter.	*White:* Firm and thick; opalescent; reflects the light.
White: Firm and clear.	*Yolk:* Spherical and firm; chick spot small with no sign of hatching. Color is uniform for the entire yolk, but varies in color from light yellow to deep orange, and is occasionally olive green.
Yolk: Dimly seen through the white as a shadowy object indistinct in outline. The chick spot is not visible.	*Distinguishing characteristics:* General firm condition of white and yolk. White, opalescent.
Distinguishing characteristics: No shrinkage and general firm conditions of white and yolk. Edible.	

The characteristics of a fresh egg have been further defined in more general terms as follows:[2]

"Its white is capable of whipping well; in cooking it can be satisfactorily poached or soft boiled, it has not absorbed foreign disagreeable odors, its embryo shall not have developed appreciably. The yolk should be fairly stiff and well rounded, the white should not be watery and the chalaza should be well defined."

Opposed to eggs of this quality are those which are recognized as stale or shrunken, yet edible, the characteristics of which have been defined as follows:[3]

[1] U. S. Dept. Agr., Bull. 565, p. 13 (1918).
[2] Penn. Dept. Agr., Bureau of Foods, 17, p. 44 (1919).
[3] U. S. Dept. Agr., Bull. 565, p. 13 (1918).

CHARACTERISTICS OF AN EGG WHICH IS NOT FRESH.

Before the Candle.	Out of Shell.
Air space: Enlarged; the lower wall may be movable in outline.	*White:* Thin, no opalescence, does not reflect the light as much as does a fresh egg.
White: Thin and clear.	*Yolk:* Flattened, and occasionally may have light, mottled areas.
Yolk: Definite in outline; sometimes weak, and may occasionally have dark mottled areas.	*Distinguishing characteristics:* Thin white and flattened yolk.
Distinguishing characteristics: Enlarged air cell and increased contrast between white and yolk as compared with a fresh egg. Edible.	

Other types of eggs which are not fresh, but still edible, are hatch-spot eggs, weak eggs and eggs with movable air space. The numerous types of inedible eggs need not be enumerated here.

Laws regulating the distribution and sale of eggs aim to insure that the consumer obtains good, edible eggs always, and fresh eggs if the extra price of such is paid. If, however, the consumer's understanding of a fresh egg be one that is but two or three days old then he seldom gets what he expects. If he accepts fresh eggs to be those possessing the characteristics here defined for fresh eggs he obtains such eggs much more frequently. Whatever his idea of fresh may be, it can be positively stated that the elapsed time since an egg was laid is not the determining factor in establishing its freshness; the conditions of holding are all-important. As to how old an egg may be and still retain the characteristics of a fresh egg it is pertinent to quote the following[1]:

"An egg laid in March or April and kept under proper conditions will retain the characteristics which distinguish a fresh egg for from three to four weeks. In warmer weather this time would necessarily have to be reduced, and an egg laid in very hot weather and possibly allowed to remain in the nest for twenty-four hours or more, has lost these characteristics to such an extent that it is not as good as an April egg kept for a month under favorable conditions, and it should not be offered for sale nor be permitted to be sold as and for a fresh egg.

"Nor can an egg which is allowed to remain exposed to ordinary atmospheric conditions in a retail store for several days or a week in warm weather be expected to retain the characteristics which are expected of a fresh egg."

Thus it would appear that when eggs are sold under the description fresh, they should conform to the characteristics of fresh eggs and our examinations have been made upon this hypothesis.

For many of the abuses which occur in connection with the sale of so-called fresh eggs the consumer himself is largely responsible

[1] Penn. Dept. Agr., Bureau of Foods, 17, p. 44 (1919).

by reason of this prejudice against cold storage eggs. No matter what the season of the year may be he insists that the eggs he buys shall be fresh, and the retailer finds it necessary to incorporate the word *fresh* somewhere in the legend under which he offers eggs for sale in order to sell them at all. If he goes further and increases the price a few cents per dozen his sales are further facilitated, because the average purchaser is very suspicious of cheap eggs. We do not defend this practice on the part of the retailer, but the consumer's share in the responsibility for it is obvious.

In the last ten years great progress has been made in methods of production, handling, transportation and storage through the efforts of federal and state authorities in egg producing centers which furnish the bulk of eggs which are placed in cold storage. The object of all this study which has been given to the egg problem is to insure that good, edible eggs shall be obtained in the season of shortage. It is chiefly his traditional prejudice against this cold storage product which prevents the consumer from availing himself of the full benefit of these improved conditions.

ESKIMO PIE.

This relatively new confection consists of a small brick of ice cream coated with chocolate. The chocolate coating may or may not be reinforced with cocoa butter.

Three samples, all from New Haven manufacturers, collected by the Station agent were examined.

TABLE III. ANALYSES OF ESKIMO PIE.

Sta. No.	Manufacturer	Weight		Fat		Ash
		of Ice Cream	of Coating	in Ice Cream	in Coating	
		Oz.	Oz.	%	%	%
18073	Harris-Hart Co.	1.0	0.7	8.8	45.0	...
18072	New Haven Dairy Co.....	0.8	0.5	12.8	35.0	1.53
18071	Semon Ice Cream Co. ...	1.0	0.7	10.0	36.5	0.95

FATS AND OILS.

OLIVE OIL.

Forty-five samples of olive oil were examined, one of which was taken by the Station agent and the remainder by the Dairy and Food Commissioner. Thirty-three were passed, nine were found to be short weight, and three were adulterated with cottonseed oil.

The brands deficient in volume and adulterated are listed in Table IV.

TABLE IV. OLIVE OIL SAMPLES MISBRANDED OR ADULTERATED.

D. C. No.	Brand	Contents		Remarks
		Declared	Found	
		Ozs.	Ozs.	
21530	*A. & P.* Pure Olive Oil...	16.0	15.2	Short weight
20817	*A. & P.* Pure Olive Oil...	8.0	7.3	Short weight
21512	*Emeri Brand* Olive Oil....	16.0	15.2	Short weight
21544	*Kleckner's* Pure Olive Oil.	8.0	6.8	Short weight
21526	*Kleckner's* Pure Olive Oil.	8.0	7.5	Short weight
11378T	*Kleckner's* Pure Olive Oil.	8.0	6.8	Short weight
21473	*Nectar Cream.* Castel & Fils, Nice	8.0	7.1	Short weight
21531	*Nectar Cream.* Castel & Fils, Nice	8.0	7.4	Short weight
11377T	*Nectar Cream.* Castel & & Fils, Nice	8.0	7.6	Short weight
19831	*P. P. Brand,* Pure Virgin Olive Oil	...	...	Contained cottonseed oil
19844	*P. P. Brand,* Pure Virgin Olive Oil	...	...	Contained cottonseed oil
19845	*P. P. Brand,* Pure Virgin Olive Oil	...	...	Contained cottonseed oil

A second sample of Emeri Brand was passed. The weight was declared to be 16 ozs. and 15.9 ozs. were found.

COTTONSEED OIL.

One sample, **19875,** *Wesson oil,* was examined and passed.

BUTTER.

Two samples of butter were submitted by F. L. Davis, County Agent, Putnam. One sample, **19118,** contained 16.5 per cent. water and 79.2 per cent. of milk fat; the moisture was excessive and the fat deficient. The other sample, **19119,** contained 9.8 per cent. water and 86.3 per cent. fat.

FLAVORING EXTRACTS.

LEMON EXTRACT.

Lemon extract is the flavoring extract prepared from oil of lemon, or from lemon peel, or both, and contains not less than five per cent. (5%) by volume of oil of lemon.[1]

Seventeen samples were collected by the Station agent, of which sixteen were passed and one found to be below standard, contain-

[1] Circ. 136, U. S. Dept. Agr., Office of the Secretary.

ing but 4.3 per cent. of oil of lemon. The deficient sample was made by Chas. H. Baldwin & Son, West Stockbridge, Mass.

Analyses are given in Table V.

TABLE V. ANALYSES OF LEMON EXTRACT.

Station No.	Manufacturer and Brand	Lemon Oil %	Refraction of Oil at 25° C. (Butyro-refractm'r)
18348	Acker, Merrall & Condit Co., New York	6.30	70.0
18412	Armour & Co. *Veribest*	10.40	73.0
18305	Baker Extract Co., Springfield. *Baker's*	5.10	70.0
18419	Chas. H. Baldwin & Son, West Stockbridge, Mass. *Baldwin's*	4.30	73.8
18378	Direct Importing Co., Boston, Mass. *Benefit*	5.10	72.6
18358	Garrett & Co., Brooklyn, N. Y. *Virginia Dare*	9.70[1]	70.0
18403	Globe Grocery Stores, New York. *Pocono*	5.40	73.4
18295	Great Atlantic & Pacific Tea Co., Jersey City, N. J. *Red Front*	5.20	70.0
18323	Howland's, Bridgeport. *Howco*	5.30	70.0
18398	Loomis & Wilson Co., Hartford. *Phoenix*	5.00	72.7
18341	McCormick & Co., Baltimore, Md. *Bee*	7.40	72.0
18376	The Mohican Co., New York. *Mohican*	4.90	71.9
18430	C. F. Sauer Co., Richmond. *Sauer's*	5.80	72.1
18318	Temple Garden Co., Boston, Mass. *Temple Garden*	5.50	70.0
18354	James VanDyke Co., New York. *Ambassador*	5.30	70.0
15708	Williams & Carleton, Hartford. *Charter Oak*	6.50	70.0
18379	Williams & Carleton, Hartford. *Williams' Pure*	7.60	72.6

[1] Labeled double strength.

TERPENELESS EXTRACT OF LEMON.

Three samples of terpeneless extract of lemon were also collected by the Station agent, all of which were properly labeled. They contain no oil of lemon, but should contain 0.2 per cent. of citral derived from oil of lemon.

VANILLA EXTRACT.

Vanilla extract is the flavoring extract prepared from the vanilla bean, with or without sugar or glycerine, and contains, in one hundred cubic centimeters, the soluble matters from not less than ten grams of the vanilla bean[1].

Such an extract was found to contain from 0.07 to 0.22 per cent.

[1] Circ. 136, U. S. Dept. Agr., Office of the Secretary.

TABLE VI. ANALYSES OF VANILLA EXTRACT AND VANILLA SUBSTITUTE.

Station No.	Manufacturer and Brand	Net Contents		Vanillin	Coumarin
		Declared	Found		
		Ozs.	Ozs.	%	%
18347	Acker, Merrall & Condit Co., New York	2.0	2.0	0.21	...
18611	Armour & Co., Chicago, Ill. *Veribest*	1.0	1.0	0.25	...
18296	Great Atlantic & Pacific Tea Co., Jersey City, N. J. *Red Front*	2.0	1.9	0.21	...
18396	Baker Extract Co., Springfield, Mass.	1.0	1.0	0.17	...
18338	Andrew Davey, Inc., New York. *Atlas*	2.0	2.1	0.18	...
18328	Hallock - Denton, Newark, N. J.	2.0	2.0	0.18	...
18324	Howland's, Bridgeport. *Howco*	1.5	1.6	0.20	...
18357	Garrett & Co., Brooklyn, N. Y. *Virginia Dare*	1.25	1.3	0.31[1]	...
18402	Jones Bros. Tea Co., New York. *Pocono*	2.0	2.2	0.18	...
18316	Hartford Extract Co., Hartford. *Stuart*	1.5	1.6	0.66	0.06
18361	McCormick & Co., Baltimore, Md.	0.75	0.74	0.22	...
18321	The Mohican Co., New York	2.0	2.1	0.22	...
18340	Morrow & Co., New York. *Morrow's*	...	0.74	0.24	...
18319	The Newton Tea & Spice Co., Cincinnati, Ohio. *Red Seal*	2.0	1.9	0.18	...
15710	C. F. Sauer Co., Richmond, Va.	1.5	1.7	0.26	...
18422	St. John & Co., Inc., New York	1.5	1.5	0.58	0.08
18418	Schlotterbeck & Foss Co., Portland. Me. *Foss*	2.0	2.0	0.16	...
18355	James Van Dyke Co., New York. *Ambassador*	1.0	1.1	0.20	...
15704	Williams & Carleton Co., Hartford	2.0	1.9	0.24	...
18420	Chas. H. Baldwin & Sons, West Stockbridge, Mass. *Baldwin's*	2.0	1.9	0.09	...

[1] Labeled 150% strength.

of vanillin according to old data[1] obtained in this laboratory upon extracts prepared according to the formula given in the U. S. Pharmacopoeia (1890). More recent figures[2] obtained upon extracts made by the same formula show a range from 0.11 to 0.31 per cent.

Eighteen samples were collected by the Station agent. Seventeen were passed; one bore no statement of net contents. Vanillin content ranged from 0.09 to 0.26 per cent., excluding one sample labeled 50 per cent. over strength. Analyses are given in Table VI.

Vanilla Substitutes.

Two samples labeled Vanilla Substitute were examined, which contained vanallin and coumarin. These contained high percentages, 0.57 to 0.67 per cent. of vanillin, probably synthetic, together with 0.08 and 0.06 per cent. respectively of coumarin.

FLOUR.

Bread and Pastry Flours.

Fifteen samples of flour, representing bread and pastry flours and flours for general family use, were collected by the Station agent and have been analyzed. Moisture was determined by drying in an electric oven at 105°C. and, for comparison, many of the samples were also dried at the temperature of boiling water in an atmosphere of hydrogen. The figures obtained by drying at 105°C. were generally higher than those obtained by drying in hydrogen at 100°C. The comparison was made in eight cases and the differences, referred to the temperature of 105°C., ranged from —0.06 to +0.25 per cent. All differences were + except the one just mentioned, and one other which was ±0. The average difference was +0.11 per cent.

Similarly, a comparison was made in the fat content as determined by the official sixteen-hour continuous extraction, and by the method recommended for baked products.[3] The differences, referred to the modified method, ranged from +0.18 to +0.38 per cent.; the average was +0.25 per cent. based on eleven samples in which the comparison was made.

Ash was determined by slow ignition over night in an electric furnace. The results varied within the narrow limits of 0.36 to 0.48 per cent.

Analyses are given in Table VII.

[1] Conn. Exp. Station Report 1901, p. 150.
[2] Leach, *Food Inspection and Analysis*, p. 915.
[3] Conn. Exp. Sta. Bull. 200, p. 133 (1917).

Table VII. Analyses of Flour.

No.	Manufacturer	Moisture	Ash	Protein (N x 5.7)	Fat		Acidity (as lactic acid)
					Official	Modified	
		%	%	%	%	%	%
20181	Austin, Nichols & Co. *Palo*	11.69	0.45	9.69	...	1.41	...
19901	Austin, Nichols & Co. *Snow Flake*	11.85	0.43	9.01	1.09	1.30	0.13
20182	Duluth-Superior Mill. Co. *Imperial*	11.72	0.46	11.97	...	1.67	...
19902	Eagle Roller Mill. Co. *Daniel Webster*	11.65	0.45	10.89	1.14	1.43	0.06
19906	Farwell & Rhines, Inc. *Pansy* (pastry flour)	12.43	0.48	8.27	1.18	1.37	0.13
20178	Jas. Frazee Mill. Co. *Cremo* (winter patent)	13.48	0.37	7.58	0.98	1.29	0.09
19903	Great Atlantic & Pacific Tea Co. *A. & P. Family Flour*	11.33	0.45	11.06	1.03	1.28	0.07
19905	Hecker-Jones-Jewell Mill. Co. *Superlative*	11.18	0.43	10.43	1.19	1.44	0.10
19909	Iglehart Bros. *Swans Down* (cake flour)	11.78	0.36	7.03	0.85	1.03	0.09
20179	Niagara Falls Mill. Co. *Bridal Veil*	12.58	0.38	10.94	1.01	1.39	0.10
19900	Pillsbury Flour Mills Co. *Best XXXX*	11.78	0.42	10.83	1.29	1.48	0.08
20184	Poter-Wrightington, Inc. (cake and pastry flour)	13.63	0.39	8.78	...	1.19	...
20183	Russell-Miller Mill. Co. *Occident*	13.20	0.43	11.39	...	1.67	...
20180	Van Vechten Mill. Co. *Van Vex*	13.09	0.47	8.55	1.16	1.46	0.13
19904	Washburn-Crosby Co. *Gold Medal*	11.83	0.43	10.43	1.05	1.28	0.08

TABLE VIII. ANALYSES OF SELF-RAISING FLOUR.

No.	Manufacturer	Moisture	Ash	Protein (N x 6.25)	Fat		Carbon Dioxide			Salt, (NaCl)
					Official	Modified	Avail.	Residual	Total	
		%	%	%	%	%	%	%	%	%
19821	The D. & C. Co., Inc. *D. & C.* (Mixture of wheat flours)	11.75	1.48	10.31	0.67	0.97	0.30	none	0.30	1.20
20185	France Mill Co. *Gold Medal.* (Wheat and corn flours)	11.39	6.45	13.38	...	3.27	0.35	none	0.35	...
19897	The Great Atlantic & Pacific Tea Co. *A. & P.* (Flour with powdered skim milk)	10.53	4.61	13.88	2.65	2.81	0.15	0.15	0.30	1.80
19846	Hecker Cereal Co. *Cream* (Wheat flour)	11.44	3.09	10.00	0.75	1.03	0.43	0.15	0.58	0.90
19842	Hecker Cereal Co. *Grandma's* (Wheat, corn and rice flours)	10.83	3.91	8.75	1.18	1.37	0.12	0.08	0.20	1.49
19916	Jersey Cereal Food Co. *Jersey* (Whole wheat and corn flours)	10.23	6.01	10.50	1.01	1.05	0.18	0.36	0.54	2.26
19908	Pillsbury's Flour Mills Co. (Wheat, corn, rice and rye flours)	10.68	3.85	9.38	1.13	1.18	0.20	none	0.20	1.49
19874	The Quaker Oats Co. *Quaker*	11.72	4.35	10.13	0.58	0.83	none	none	none	1.74
19818	Reliable Flour Co. (Wheat flour)	11.48	2.43	10.00	0.76	1.02	0.59	none	0.59	0.76

SELF-RAISING FLOUR MIXTURES.

Nine samples of pancake and other flour mixtures were examined, all collected by the Station agent.

Moisture and fat were determined by two methods in each case, as already noted in the discussion of flour, and the differences observed were of about the same order of magnitude as was noted for flour. No carbon dioxide was found in **19874**. Salt content ranged from about 0.8 to 2.3 per cent. calculated as sodium chloride from chlorine.

The analyses are given in Table VIII.

Five samples said to be entire wheat flour submitted by individuals require no particular comment.

ICE CREAM.

In connection with an inspection of ice cream during the past year complete analyses[1] of a number of typical samples were made. These were given in Table IX.

The milk solids, taken as the sum of the percentages of protein, fat, ash and lactose, are in reasonably close agreement with the estimated milk solids taken as the difference between the percentages of total solids and sucrose. The values by the first named plan, vary from 18.3 to 28.1 per cent. and the average of the ten analyses is 22.4 per cent. It is recognized that fat derived from chocolate is included in the milk solids and that nitrogen derived from gelatin is evaluated as milk protein.

Three hundred and thirty-two samples were submitted by the Dairy and Food Commissioner. The classification of these by towns, together with the range in fat content and the average per cent. of fat, is given in Table X.

Samples found to be below the State standard of 8 per cent. for plain ice cream and 6 per cent. for fruit and nut ice cream are given in Table XI.

Classification of samples on the basis of fat content (Table XII), shows that from 50 to 60 per cent. of the samples examined in the last four years were within the range of 8 to 12 per cent. fat. There was also a substantial percentage above 12 per cent. However, as we have stated in previous reports the true average fat content of ice cream produced in the State cannot be deduced from these tables since they cannot take into account the gross production of creams of the several divisions. Products testing above 12 per cent. are not made by the larger manufacturers.

[1] Lactose and sucrose were determined by methods as described in *Methods of Analysis A. O. A. C.*, p. 231.

TABLE IX. ANALYSES OF ICE CREAM.

Sample No.	Flavor	Protein (N x 6.38)	Fat	Ash	Lactose	Sucrose	Milk Solids: Total Solids (determined)	Milk Solids: Protein+Fat+Ash+Lactose	Milk Solids: Total Solids—Sucrose	Refraction of Fat at 25° C. (butyro-refractometer)
		%	%	%	%	%	%	%	%	
23757	Vanilla	4.33	11.00	0.78	5.05	14.76	36.06	21.16	21.30	49.2
23758	Vanilla	4.38	10.00	0.85	5.36	13.29	35.18	20.59	21.89	49.5
23761	Vanilla	3.00	15.40	0.52	3.38	12.36	34.12	22.30	21.76	49.3
23829	Coffee	5.17	11.20	1.03	6.46	12.08	37.13	23.86	25.05	52.3
23833	Vanilla	2.45	13.60	0.54	3.66	14.43	34.44	20.25	20.01	51.5
23836	Vanilla	3.17	13.60	0.63	3.48	19.86	38.85	20.88	18.99	50.7
23839	Vanilla	2.14	22.80	0.42	2.76	17.93	45.11	28.12	27.18	51.7
23840	Vanilla	3.72	10.80	0.58	3.19	16.73	38.85	18.29	17.12	51.0
23841	Chocolate	5.54	11.00	1.10	6.22	14.10	38.68	23.86	24.58	51.5
23844	Strawberry	4.58	12.40	1.03	6.58	14.55	38.50	24.59	23.95	51.8

TABLE X. INSPECTION OF ICE CREAM.

Town	No. of Samples	Fat Content: Range		Fat Content: Average
		%	%	%
Ansonia	5	3.2	16.4	11.1
Bantam	1	...	...	10.2
Branford	1	...	...	9.0
Bridgeport	32	4.2	23.2	10.5
Bristol	5	11.6	12.8	12.3
Brooklyn	1	...	...	11.2
Cheshire	1	...	...	18.0
Danbury	7	8.4	11.6	9.9
Danielson	4	6.6	14.4	10.4
Derby	4	8.0	9.6	8.8
East Portchester	5	7.0	11.2	9.8
Forestville	4	8.6	12.6	9.9
Glastonbury	1	...	...	11.0
Gildersleeve	1	...	...	10.0
Greenwich	4	8.4	24.4	14.3
Groton	1	...	...	18.6
Hartford	28	3.4	20.4	13.5
Hazardville	1	...	...	11.2
Jewett City	1	...	...	10.2
Manchester	6	8.0	14.6	13.2
Marbledale	1	...	...	8.2
Meriden	6	8.0	16.8	13.9
Middletown	8	12.2	18.0	14.5
Montville	1	...	...	11.0
Moosup	2	9.6	22.8	16.2
Mystic	3	15.0	20.0	15.9
Naugatuck	7	6.8	12.2	10.1
New Britain	7	10.0	18.4	12.8
New Hartford	1	...	...	15.2
New Haven	23	7.8	17.4	11.3
New London	13	8.6	17.8	13.7
New Milford	5	7.8	20.3	12.1
North Grosvenordale	2	12.0	16.2	14.1
Norwalk	4	8.8	14.6	11.8
Norwich	17	6.8	20.4	13.7
Pawcatuck	2	9.4	11.1	10.2
Plainfield	3	10.1	13.6	12.2
Plainville	2	7.6	11.8	9.7
Pomfret	3	12.4	28.0	22.5
Portland	1	...	...	15.2
Putnam	6	10.4	13.2	12.3
Quinebaug	1	...	...	12.4
Rockville	5	8.6	14.8	12.9
Seymour	3	6.6	8.4	7.5
Shelton	1	...	...	10.6
Somers	1	...	...	15.4
Somerville	1	...	...	10.0
Southington	3	9.8	14.2	12.3

TABLE X. INSPECTION OF ICE CREAM—*Concluded.*

Town	No. of Samples	Fat Content		
		Range		Average
		%	%	%
South Norwalk	6	8.0	11.8	10.3
Stafford Springs	15	12.2	18.0	13.3
Stamford	13	3.9	15.0	9.6
Stratford	2	8.6	8.6	8.6
Stonington	4	10.2	17.3	13.4
Suffield	1	...	...	9.2
Terryville	1	...	...	10.3
Thomaston	2	15.2	15.2	15.2
Thompsonville	4	11.4	15.0	13.7
Torrington	11	8.1	16.2	11.2
Unionville	2	8.4	11.4	9.9
Wallingford	6	10.8	15.6	13.7
Waterbury	12	6.5	17.4	10.6
Waterville	1	...	...	9.6
West Wauregan	2	10.8	11.0	10.9
Winsted	6	8.0	14.0	11.2
Willimantic	4	13.4	20.6	17.0
Windsor Locks	6	8.2	12.4	10.0

INFANT FOODS.

In a previous[1] examination of these special preparations for infant feeding, particular attention was given to the composition of the product when prepared for feeding according to the directions. The examination of some of these products made during the past year has been of the material as sold, and the analyses include determinations of certain mineral constituents (calcium phosphorus and iron), of the ash.

Twenty-three samples have been analyzed and the results are given in Table XIII.

Accepting the analysis of milk ash as stated by Leach[2], the quantities of calcium, phosphorus and iron in whole milk are CaO 0.14, P_2O_5 0.17 and Fe_2O_3 0.0009 per cent. Substantially the same figures, except for iron, are obtained on the basis of the figures given by Sherman[3], viz., CaO 0.17, P_2O_5 0.21 and Fe_2O_3 0.0003 per cent. There is a considerable difference in iron content of milk as stated by different authorities[4]. Assuming 88 per cent. water in milk and 4 per cent. moisture in milk powder, the last named series of ash constituents becomes CaO 1.36, P_2O_5 1.71 and Fe_2O_3 0.003 per cent. for whole milk powder.

[1] Conn. Exp. Sta., Report on Foods and Drugs, 1915.
[2] Leach, *Food Inspection and Analysis*, p. 113.
[3] Sherman, *Chemistry of Food and Nutrition*, p. 424.
[4] Lane-Claypon, *Milk and Its Hygienic Relations*, p. 50.

TABLE XI. ICE CREAM BELOW STANDARD.

No.	Dealer	Manufacturer	Flavor	Fat
	Ansonia			%
23021	A. Romano	Own make	Strawberry	3.2
	Bridgeport			
23170	Frank Cuneo	Own make	Vanilla	7.8
23930	Frank Cuneo	Own make	Vanilla	7.6
23171	George Costeintis	Own make	Vanilla	4.2
23920	A. DeBarbieri	Own make	Vanilla	6.2
23922	A. Musante	Own make	Vanilla	7.0
23165	Bella Napoli	Reichert's	Vanilla	7.3
23174	Paris Conf. Co.	Own make	Vanilla	7.8
	Danielson			
23830	Mattie O'Brien	Own make	Vanilla	6.6
23832	Mary Sallotti	Own make	Vanilla	7.2
	East Portchester			
23068	Andre Esposito	Sup'r Ice Cream Co.	Chocolate	7.0
23066	Frank Port	Huber'	Vanilla	7.2
	Hartford			
23769	Rosario Cipolla	Own make	Vanilla	3.4
	New Milford			
23091	Park Pharmacy	Int'l Ice Cream Co	Vanilla	7.8
	Norwich			
23806	Marathon Ice Cream Co.	Own make	Vanilla	7.5
23816	Olympia Ice Cream Co.	Own make	Vanilla	6.8
	Plainville			
23933	Soda Shop	Own make	Vanilla	7.6
	Seymour			
23011	J. Casagrande	Own make	Vanilla	6.6
	Stamford			
23084	Alfonso Esposito	Own make	Vanilla	3.9
23074	Rocco Sessa	Star Conf. Co.	Vanilla	6.5
23082	Star Conf. & Ice Coream Co.	Own make	Vanilla	6.3
	Waterbury			
23945	Charles Musante	Own make	Vanilla	6.5
23942	Michael Whalen	Own make	Vanilla	7.6

Dryco and Mammala, both derived from milk which is in part skimmed, approximate these figures. The milk preparations are higher in phosphorus, and particularly in calcium, than those products intended for use as amendments to milk.

TABLE XII. CLASSIFICATION OF ICE CREAM ON THE BASIS OF FAT CONTENT.

Range of Fat, Per Cent	1919 Samples	1919 Per Cent	1920 Samples	1920 Per Cent	1921 Samples	1921 Per Cent	1922 Samples	1922 Per Cent
8.0 to 9.9	25	30.5	134	33.5	94	28.5	80	24.1
10.0 to 11.9	26	31.7	83	20.8	71	21.6	73	22.0
12.0 and above	28	34.1	125	31.2	123	37.4	151	45.5
Below 8.0	3	3.7	58[1]	14.5	41[2]	12.5	28[3]	8.4
Total	82	100.0	400	100.0	329	100.0	332	100.0

[1] Includes 11 fruit ice creams of legal standard, viz., 6 per cent.
[2] Includes 14 fruit ice creams of legal standard, viz., 6 per cent.
[3] Includes 5 fruit ice creams of legal standard, viz., 6 per cent.

TABLE XIII. ANALYSES OF

No.	Brand	Calcium, CaO	Phosphorus, P_2O_5	Iron, Fe_2O_3
	MILK PREPARATIONS.	%	%	%
15693	Allenbury's Milk Food No. 1	0.58	0.89	0.003
15661	Allenbury's Milk Food No. 2	0.40	0.80	0.003
15685	Borden's Malted Milk	0.46	0.87	0.003
15690	Borden's Malted Milk with Cocoa	0.84	1.34	0.007
15683	Dryco	1.57	2.00	0.003
15684	Horlick's Malted Milk	0.50	0.79	0.003
15662	Mammala	1.29	1.59	0.001
15660	Nestle's Milk Food	0.25	0.49	0.004
15699	Thompson's Hemo	0.40	0.89	0.004
15692	Thompson's Malted Milk	0.41	0.84	0.003
15688	Thompson's Peptonized Food	0.48	0.87	0.001
	USED WITH MILK.			
15697	Brooks' Baby Barley	0.04	0.83	0.006
15663	Eskay's Food	0.01	0.32	0.003
15695	Imperial Granum	0.01	0.27	0.003
15701	Johnson's Barley Flour	0.03	0.46	0.004
15696	Justfood	none	0.05	0.004
15691	Mead's Dextri-maltose No. 1	0.04	0.07	0.021
15689	Mead's Dextri-maltose No. 2	0.01	0.05	0.011
15698	Mead's Dextri-maltose No. 3	0.01	0.05	0.009
15694	Mellin's Food	0.03	0.72	0.009
15702	Peptogenic Powder (Fairchild Bros. & Foster)	0.05	0.07	0.001
15659	Ridge's Infant Food	0.03	0.24	0.001
15700	Robinson's Patent Barley	0.01	0.44	0.003

MEAT PRODUCTS.

HAMBURG STEAK.

Eight samples were examined for the Dairy and Food Commissioner, of which five were illegally preserved with sulphites or sulphite-containing substances and three were passed. State regulation 7 provides that no objection will be raised to foods which contain ordinary amounts of sulphur dioxide, provided the fact is declared. This is to exempt certain products such as molasses, dried fruits and wines which have been subjected, directly or indirectly, to the process known as sulphuring. Sulphites are used in meat chiefly to preserve its fresh appearance and to act as a deodorant, and is not contemplated by the regulation just quoted.

Samples containing sulphurous acid in amounts ranging from

INFANT FOODS.

Water	Ash	Protein (N x 6.25)	Fiber	Fat	Carbohydrate (other than fiber)	No.
%	%	%	%	%	%	
3.72	4.10	10.50	none	14.09	67.59	15693
4.23	3.67	9.13	none	15.15	67.82	15661
2.68	3.29	16.38	0.28	8.83	68.54	15685
4.47	4.67	20.00	0.43	4.27	66.16	15690
3.14	7.58	30.63	none	11.70	46.95	15683
2.83	4.19	15.31	0.26	8.00	69.41	15684
5.13	6.11	23.38	none	12.96	52.42	15662
2.98	1.56	12.00	0.27	6.13	77.06	15660
2.03	4.71	11.56	0.16	6.56	74.98	15699
0.93	4.21	10.56	none	8.10	76.20	15692
1.53	4.36	12.44	0.12	6.61	74.94	15688
8.87	1.62	11.50	1.13	1.40	75.48	15697
2.57	1.45	6.50	0.37	1.33	87.78	15663
6.79	0.50	12.88	0.26	0.52	79.05	15695
9.60	0.89	8.56	0.50	1.31	79.14	15701
7.39	0.27	0.75	none	none	91.59	15696
3.33	2.23	0.63	none	0.01	93.80	15691
2.68	1.04	0.63	none	0.09	95.56	15689
3.42	2.12	0.50	none	0.01	93.95	15698
3.65	3.24	11.19	0.32	1.58	80.02	15694
1.59	1.12	0.63	none	0.14	96.52	15702
9.59	0.57	10.13	0.20	0.25	79.26	15659
9.84	0.82	7.38	0.50	1.37	80.09	15700

260 mgs. to over 3300 mgs. per kilo were purchased at the following places:

D. C. No.	City.	Dealer.
21880	*Bridgeport*	M. Mishalke.
21884	*Bridgeport*	Aurora Market.
22112	*New Haven*	Broadway Market.
22109	*New Haven*	Liberty Market.
22108	*New Haven*	New Haven Public Market.

Sausage.

Eighty samples of sausage submitted by the Dairy and Food Commissioner were examined for excess starch and for sulphites. Twelve contained excessive amounts of starch, indicating added cereal, two contained sulphites (SO_2) and sixty-six were passed. The meat ordinarily used in the manufacture of sausage contains sufficient water to make the packing in thin casings readily possible. With inferior cuts of meat stock a further absorbent is necessary to facilitate this process and to prevent shrinkage of the product on cooking. For this purpose starchy material, such as bread or cracker crumbs, is used. The U. S. Bureau of Animal Industry regulations allow cereal in sausage not exceeding 2 per cent., which must be declared in all cases. The products which we have examined have been judged on that basis although there are no specific regulations on this point in this State.

The status of sulphites has already been discussed in connection with the subject of hamburg steak.

Samples in which more than 2 per cent. of cereal was indicated or which contained sulphites are given in the following list. Starch ranged from 1.07 to 3.15 per cent. indicating cereal contents of from 2.1 to 6.3 per cent.

No.	City or Town.	Dealer.	Manufacturer.
21870	*Bridgeport*	Washington Market	Own make.
21874	*Bridgeport*	John Colonness	Own make.
21875	*Bridgeport*	Erle's Market	Own make.
21879	*Bridgeport*	M. Michalke	Own make.
21210	*Hartford*	Chicago Market	Own make.
21215	*Hartford*	A. Loffmin	Hartford Provision Co.
21217	*Hartford*	L. Landers	Own make.
21200	*Hartford*	Eastern Provision Co.	Own make.
21246	*Middletown*	Public Market	Scofield Sausage Co.
22105	*New Haven*	Enterprise Market	Own make.
21239	*New Haven*	Palace Market	Own make.
21854	*Waterbury*	Mohican Market	Swift & Co.
21856	*Waterbury*	Rogers Market	Own make.
21859	*Waterbury*	E. O. Hearne	Swift & Co.

MILK AND MILK PRODUCTS.

Cryoscopy of Milk[1].

Influence of Acidity upon Freezing Point Depression of Milk.

The cause of the acidity which fresh milk shows toward phenolphthalein has been the subject of much investigation. Carbon dioxide, acid salts and casein, separately or in various combinations, generally have been regarded as responsible for the so-called apparent acidity of normal milk in a fresh condition. To accept the careful studies of Van Slyke and his co-workers, however, the acidity of fresh milk is due chiefly to the presence of acid phosphates[2]; the acidity decreases with increasing CO_2 content[3]; and casein is combined with calcium as calcium caseinate which is neutral to phenolphthalein. As milk ages another type of acidity appears due chiefly to bacterial decomposition of lactose with the formation of lactic acid. Examination of samples of milk, under induced souring, taken at intervals up to ninety-six hours showed that the figures representing the acidity increases in the milk are almost identical with those representing the determined amounts of lactic acid[4]. In their experiments the degree of acidity was determined by titration with N/10 alkali, using phenolphthalein as an indicator but first removing calcium by means of neutral potassium oxalate to avoid the error otherwise introduced by the hydrolysis of dicalcium phosphate during titration. The results obtained in this way are about one-half as great as those obtained by the usual method of titration.

In applying the freezing point test as a means of detecting added water in milk the question of the influence of acidity has been raised. Without other complicating factors it would be expected that the mere increase in amount of lactic acid would result in a corresponding increase in freezing point depression. Kiester[5] has studied this point and additional data have been obtained in this laboratory during the past year. The combined data are given in Table XIV. Acidity is the result of spontaneous souring in these trials, and it has been determined by titration without removal of calcium according to the uniform plan followed in work carried on last year.

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[1] Taken from the report of the writer as associate referee to the Association of Official Agricultural Chemists at the meeting at Washington in November, 1922.

[2] Van Slyke, L.L., and Bosworth, A. W. N. Y. Agr. Exp. Sta., Tech. Bull. 37, 1914.

[3] Van Slyke, L. L., and Baker, J. C. Jour. Biol. Chem. *40*, 345.

[4] Van Slyke, L. L., and Bosworth, A. W. N. Y. Agr. Exp. Sta., Tech. Bull. 48, 1916.

[5] Kiester, J. T. Jour. Ind. Eng. Chem., *9* 864, 1917.

TABLE XIV. INFLUENCE OF ACIDITY UPON THE FREEZING POINT DEPRESSION OF MILK.

No.	Description of Sample	Date, 1922	Acidity, %	Freezing Point, —° C.	Increase in Acidity, ° C.	Increase in F. P. Depression, ° C.	Increase in F. P. Depression per .01% Increase in Acidity
18169	Pasteurized	11/16	0.130	.530	....	....	....
		11/17	0.130	.530	....	....	....
		11/18	0.460	.627	0.330	0.097	.0029
	Average based on total increases				0.330	0.097	.0029
21667	Market	2/3	0.215	.560	....	....	....
		2/4	0.335	.600	0.120	.040	.0033
		2/5	0.405	.623	0.070	.023	.0033
		2/6	0.510	.653	0.105	.030	.0029
		2/7	0.580	.672	0.070	.019	.0027
	Average				0.365	.112	.0031
21668	Market	2/3	0.205	.550	....	....	....
		2/4	0.300	.584	0.095	.034	.0036
		2/5	0.400	.620	0.100	.036	.0036
		2/6	0.535	.656	0.135	.036	.0027
		2/7	0.600	.673	0.065	.017	.0026
	Average				0.395	.123	.0031
18706	Raw	2/6	0.140	.539	....	....	....
		2/7	0.140	.539	....	....	....
18707	Raw	2/7	0.150	.540	....	....	....
		2/11	0.250	.570	0.100	.030	.0030
		2/14	0.550	.660	0.300	.090	.0030
	Average				0.400	.120	.0030
18708	Raw	2/8	0.150	.541	....	....	....
		2/11	0.220	.567	0.070	.026	.0037
18733	Raw	2/15	0.145	.530	....	....	....
		2/16	0.150	.530	0.005	.000	....
		2/17	0.225	.555	0.075	.025	.0033
		2/18	0.415	.613	0.190	.058	.0031
	Average				0.270	.083	.0031
18734	Raw	2/16	0.150	.541	....	....	....
		2/18	0.310	.590	0.160	.049	.0031
	(From Kiester's Table III).						
1	Pasteurized	....	0.15	.545	....	....	....
			0.18	.548	0.03	.003	.0010
			0.42	.637	0.24	.089	.0037
	Average				0.27	.092	.0034
2	Pasteurized	....	0.15	.509	....	....	....
			0.18	.548	0.03	.009	.0030
			0.34	.602	0.16	.054	.0034
	Average				0.19	.063	.0033

TABLE XIV—*Concluded.*

No.	Description of Sample	Date, 1922	Acidity, %	Freezing Point, —° C.	Increase in Acidity, ° C.	Increase in F. P. Depression ° C.	Increase in F. P. Depression per .01% Increase in Acidity
3	Pasteurized	....	0.18	.496	...	....	....
			0.21	.515	0.03	.019	.0063
			0.24	.522	0.03	.007	.0023
			0.27	.536	0.03	.014	.0047
	Average				0.09	.040	.0044
4	Pasteurized	....	0.15	.552	...	....	....
			0.17	.555	0.02	.003	.0015
			0.20	.558	0.03	.003	.0010
			0.46	.636	0.26	.078	.0030
	Average				0.31	.084	.0027
5	Pasteurized	....	0.16	.541	...	....	....
			0.18	.546	0.02	.005	.0025
			0.22	.564	0.04	.018	.0045
	Average				0.06	.023	.0027

A study of the results in Table XIV shows that the effect of increased acidity upon freezing point depression is an additive factor, and that the magnitude of the increased depression closely approximates 0.003° C. for each 0.01 per cent. increase in acidity. If we may broadly assume acidities less than 0.25 per cent. due to normal variations in fresh milk and figures in excess of that amount due to lactic acid, then, with this distinction in mind, closer examination of the results shows that there is greater uniformity in depression increments per unit of acidity in the lactic acid stage than obtains in the stage of apparent acidity. The data on acidity intervals within the range of apparent or normal acidity are chiefly furnished by figures quoted from Kiester's tabulation; but, in any case, it is recognized that measurements within this restricted range, especially when acidity determinations are made by means of titration, are necessarily attended with greater chances of experimental error. The practical deduction to be drawn from these data is that a correction for acidity ought to be made in the observed freezing point depression of milk which is sensibly sour. The numerical definition of this point in terms of acidity will obviously vary in different samples. Steuart[1] observed that the acidity of fresh milk from individual cows varied from 0.10 to 0.21 per cent. and that of commercial mixed milk varied from 0.16 to 0.20 per cent. McNerney[2] noted practically the same limits and they are further substantiated by the figures contained in the report made on this subject last year[3]. Sommer and Hart[4], however,

[1] Steuart, D. W. Jour. Dairy Sci., *3*, 52, 1920.
[2] McNerney, T. J. Ibid. *3*, 227, 1920.
[3] Bailey, E. M. Jour. A. O. A. C., *5*, 4, 484.
[4] Sommer, H. H., and Hart, E. B. Jour. Dairy Sci., *4*, 7, 1921.

cite an instance of fresh herd milk with an acidity of 0.257 per cent. which was not sour as judged by the evidence of smell and taste. In general, it would appear that acidities in excess of 0.20 or 0.25 per cent. result from fermentation, and will represent milk which is sour or near the "turning" point. No correction of freezing point is recommended for acidity within the range normal for fresh milk, i.e., milk showing an acidity not exceeding 0.20 per cent.

FREEZING POINT OF MILK FROM TUBERCULAR COWS.

Milk from individuals in a herd consisting of six Jersey cows was examined. The first series of samples was taken three days after all the animals had been subjected to the tuberculin test. The second series of samples was taken about one week after the first series.

TABLE XV. FREEZING POINT OF MILK FROM TUBERCULAR COWS.

Herd	Cow No.	Date, 1922	Sp. Gr.	Solids	Fat	S-N-F.	Acidity	Freezing Point
				%	%	%	%	—° C.
M	1 Non-reactor	3/21 A.M.	1.0325	13.54	4.5	9.04	0.14	0.544
		P.M.	1.0323	13.40	4.5	8.99	0.13	0.549
		3/27 A.M.	1.0309	13.02	4.4	8.62	0.13	0.539
		P.M.	1.0317	13.12	4.3	8.82	0.12	0.546
	2 Reactor	3/21 A.M.	1.0333	13.62	4.4	9.22	0.14	0.543
		P.M.	1.0323	13.57	4.4	8.97	0.14	0.539
		3/27 A.M.	1.0323	13.22	4.3	8.92	0.13	0.546
		P.M.	1.0326	13.57	4.5	9.07	0.13	0.539
	3 Reactor	3/21 A.M.	1.0338	13.63	4.3	9.33	0.15	0.550
		P.M.	1.0333	14.10	4.8	9.30	0.14	0.549
		3/27 A.M.	1.0327	13.47	4.4	9.07	0.13	0.544
		P.M.	1.0327	13.47	4.4	9.07	0.13	0.540
	4 Reactor	3/21 A.M.	1.0343	15.08	5.4	9.68	0.14	0.550
		P.M.	1.0345	15.00	5.3	9.70	0.15	0.549
		3/27 A.M.	1.0323	14.08	5.0	9.08	0.13	0.540
		P.M.	1.0336	14.66	5.2	9.46	0.14	0.544
	5 Non-reactor	3/21 A.M.	1.0333	14.46	5.1	9.36	0.17	0.548
		P.M.	1.0335	15.00	5.5	9.50	0.16	0.549
		3/27 A.M.	1.0330	14.76	5.4	9.36	0.17	0.559
		P.M.	1.0331	15.02	5.6	9.42	0.17	0.545
	6 Reactor	3/21 A.M.	1.0335	14.27	4.9	9.37	0.17	0.562
		P.M.	1.0326	14.05	4.9	9.15	0.16	0.553
		3/27 A.M.	1.0318	14.09	5.1	8.99	0.16	0.554
		P.M.	1.0332	13.84	4.6	9.24	0.16	0.549

The data presented last year showed that freezing points of milk from tubercular reactors, or cows otherwise abnormal physically, were generally within the limits for normal milk. The few exceptions there noted were in the direction of decreased depressions.

In the case of the herd examined this year no figures outside the limits suggested a year ago for normal milk were obtained.

It is further noted in the work of Van Slyke and Baker[1] that a number of instances of garget did not cause the milk to show abormal freezing point depressions.

ABNORMAL MILK.

In the work reported last year a few samples of milk were examined which showed freezing point depressions which were outside the limits tentatively suggested for normal milk.[2] Since all of these samples were from one herd a further study of this herd was made. Forty samples from nineteen individual cows of the herd and two samples of the mixed milk were examined, with the result that only one instance of a freezing point depression outside the limits —0.530 to —0.566°C. was noted. The summaries for acidity and freezing point are as follows:

	Acidity %	Freezing point -o°C
Individual Cows.		
Maximum	0.15	0.568
Minimum	0.10	0.532
Average	0.13	0.547
Herd.		
A. M.	0.13	0.557
P. M.	0.14	0.550

The value of the cryoscopic method as an adjunct to present methods for detecting water is fully demonstrated by data covering a period of more than two years. Its use is unnecessary when present methods furnish conclusive evidence; but, in the opinion of the majority of experienced workers, its unique value is shown in those cases where the evidence of present methods is conflicting or inconclusive. The tentative limits for normal milk may have to be modified; but since the value of this, or any similar method, is lessened as the limits of normal variation are widened, it is believed that the limiting values as already defined should remain until they can be modified more advisedly.

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[1] New York Exp. Sta., Tech. Bull. 71 (1919).
[2] Conn. Exp. Sta., Bull. 236, p. 259.

TABLE XVI. ADULTERATED MILK.

No.	Dealer	Solids	Fat
	CONTAINING ADDED WATER		
	Ansonia.	%	%
21612	Jacob Gabok	10.48	3.4
	Beckley.		
22462	John Tonar	11.63	4.0
	Berlin.		
21665	Joseph Kannuski	10.85	3.5
21993	Argis Mileo	11.07	3.4
	Bridgeport.		
14506	Frank H. Edwards	10.38	3.0
14507	John Flynn	9.57	2.7
	Bridgewater.		
22262	William Dickinson	10.86	3.2
21968	C. C. Shannon	11.15	3.5
	Clintonville.		
21607	Ernest Armstead	11.67	3.8
21608	Ernest Armstead	11.03	3.3
21609	Ernest Armstead	11.50	3.7
21610	Ernest Armstead	11.60	3.7
	Colchester.		
23287	F. J. Sullavan	10.30	2.9
	Danbury.		
19910	P. Spoonheimer	8.42	2.9
19919	C. J. Wildman	12.63	5.1
	Goshen.		
23550	Morris Perregaux	9.38	2.9
23551	Morris Perregaux	8.73	2.9
23552	Morris Perregaux	8.94	2.8
	Hawleyville.		
21698	Frank Piskura	11.20	3.3
	Hebron.		
23294	J. T. Karas	10.60	3.5
	Jewett City.		
24137	Paul Geist	11.36	3.5
	Kensington.		
23591	Theo. Benjamin	9.41	3.0
	CONTAINING ADDED WATER—*Continued.*		
	Litchfield.	%	%
23555	W. L. Gray	11.00	3.5
23556	W. L. Gray	11.12	3.5
	Long Hill.		
14508	John Zabel	10.62	3.1
14509	John Zabel	10.36	3.3
14510	John Zabel	11.81	4.3
14511	John Zabel	9.25	2.6
	Manchester.		
18347	Manchester Lumber Co.	10.63	3.3
	Milford.		
22576	Schemerhorn Home	10.88	3.2
22577	Schemerhorn Home	10.99	3.3
22580	Schemerhorn Home	10.53	2.9
	New Britain.		
21590	James Portigo	10.11	3.2
21591	James Portigo	9.86	3.2
	New Haven.		
23396	Henry's Restaurant	10.84	3.7
23383	Italian American Restaurant	11.73	4.7
	Newington.		
23891	W. Bishupiak	10.83	3.7
23893	W. Bishupiak	8.27	2.5
	New London.		
23618	J. Josephson	11.93	4.1
23619	J. Josephson	10.90	3.4
23620	Wolf Rich	10.95	3.6
	New Milford.		
23529	Geo. Erickson	10.96	3.3
22009	Harry Kinney	9.53	3.4
22067	Daniel Canfield	10.25	2.5
	Niantic.		
21663	H. Solowitz	10.56	3.4
21664	H. Solowitz	10.55	3.5

TABLE XVI. ADULTERATED MILK—*Continued.*

No.	Dealer	Solids	Fat
	CONTAINING ADDED WATER—*Continued.*		
	Northford.	%	%
23363	Mike Dwzdz	10.47	3.2
	North Franklin.		
22544	T. Newmann	11.61	4.2
	Norwich.		
21674	Samuel Cisco	10.23	3.3
21675	L. E. Holden	11.33	4.3
	Orange.		
21394	E. S. Clark	10.65	3.0
	Rockville.		
22368	Louis Pestillo	9.87	3.0
24455	Louis Pestillo	9.92	3.6
24456	Louis Pestillo	9.95	3.5
	Seymour.		
21602	G. Wallace	5.04	1.7
21603	G. Wallace	6.50	2.4
	Southbury.		
21342	Robt. Dougal	10.94	3.2
	South Manchester.		
21538	Soda Shop	11.79	4.8
	Thompsonville.		
22359	Thomas Bostick	9.23	2.4
22360	Thomas Bostick	9.59	2.7
22361	Thomas Bostick	9.61	2.8
22362	Thomas Bostick	10.09	3.1
22663	Paul Russo	9.76	2.8
22363	Geo. Rutherford	9.38	2.8
22364	Geo. Rutherford	9.38	2.8
22365	Geo. Rutherford	9.38	2.8
	Washington.		
20878	E. J. Kriksci	9.90	2.9
20879	E. J. Kriksci	9.83	2.9
	West Cheshire.		
21630	J. Cutermash	8.85	2.9
	CONTAINING ADDED WATER—*Concluded.*		
	Westville.	%	%
21491	R. Edwards	10.72	3.0
	Wethersfield.		
22832	O. A. Davis	10.38	3.3
	Winsted.		
24042	Thomas Kavanough	10.55	3.4
	SKIMMED MILK		
	Amston.		
23265	J. Parelsky	9.35	1.4
	Barkhamsted.		
23652	H. Galpin	10.62	2.2
	Bethany.		
21396	Elbert S. Down	10.92	2.5
	Bloomfield.		
21800	Martin Larensen	11.92	3.2
21833	J. H. Francis	12.34	3.0
	Branford.		
22569	M. E. Taylor	11.20	2.6
	Canton.		
23307	S. W. Bristol	10.70	2.0
23308	S. W. Bristol	10.60	2.7
	Danbury.		
21911	Atlantic Lunch	10.99	2.6
21912	Bridge Lunch	10.18	2.3
21910	Sears Lunch	11.39	2.8
	Danielson.		
24133	S. Gingras	11.64	2.9
	East Granby.		
23579	W. C. Griffin	10.35	2.0

TABLE XVI. ADULTERATED MILK—*Continued.*

No.	Dealer	Solids	Fat
	SKIMMED MILK—*Continued.*		
	East Hartford.	%	%
23585	Salvadore Domfrino..	10.24	1.8
22356	Salvadore Domfrino ..	10.03	1.5
23589	H. L. Lee	11.17	2.7
22355	Mike McNeil	9.79	1.2
22655	J. Richards	10.06	1.8
	Kensington.		
23590	Theo. Benjamin	12.24	2.7
	Manchester.		
24458	Manchester Lumber Co.	11.65	3.0
	New Haven.		
24439	The Avenue Lunch...	11.47	2.7
23381	B. & L. Lunch	11.18	2.6
24301	Capitol Lunch	10.84	2.3
24355	Childs' Lunch	11.66	3.0
21357	Chilis Restaurant	10.46	2.3
24354	Coleman's Lunch	9.96	1.4
23369	Diamond Lunch	10.40	1.9
24352	Eli Lunch and Restaurant	11.31	2.9
21358	Eli Restaurant	10.99	2.6
24351	Far East Restaurant..	10.97	2.6
23136	Wm. Fortidos	11.54	3.0
24428	Gara Bros. Restaurant	11.88	3.1
23377	Gilbert Restaurant ...	11.24	2.7
24434	Grand Restaurant	10.55	1.9
23382	Hill Lunch	11.34	2.8
23147	Holcomb Lunch	11.15	2.5
23393	Home System	11.10	2.3
23384	Italian American Restaurant	10.98	2.3
23143	Italian Restaurant	11.26	2.5
23373	Kresge's 5 & 10 cent Store	12.23	3.1
24418	Lafayette Lunch.....	11.27	2.6
24357	M. & K. Restaurant...	11.88	3.1
23379	Mac's Restaurant	11.12	2.6
23142	Murray's Restaurant..	10.99	2.3
24412	New Idea Lunch	10.89	2.3
24356	Old English Coffee House	10.98	2.1
24423	Old Windsor Chop House	11.41	.29
	SKIMMED MILK—*Continued.*		
		%	%
21360	Presto Lunch	9.82	1.6
23389	Princeton Lunch	11.20	2.6
24446	R. R. Lunch	11.54	2.9
24444	Red Cross Candy Kitchen	9.74	1.2
24302	Speh Restaurant	11.37	2.7
24303	Volk Lunch	10.68	1.9
24361	Waldorf Lunch	10.23	1.5
24425	Waldorf Lunch	10.77	2.2
	Northford.		
23362	J. Jakubiszazn	11.11	2.7
	Norwich.		
24234	Louis Libo	11.10	2.2
22299	Udel Libo	11.38	2.5
21672	Vincent Micar	11.28	2.7
	Plainville.		
22315	Henry S. Tyler	11.39	2.7
	Plainfield.		
24131	Pete Raymond	11.34	2.8
	Putnam.		
22918	Harry Callas	11.14	2.7
22917	Louis Girard	11.07	2.6
22915	Frederick Krouer	11.20	2.6
	Quinebaug.		
22902	Arthur Piette	11.88	3.1
	Seymour.		
21371	Joe Scavone	12.14	2.9
	South Britain.		
19932	E. A. Scoville	11.90	3.1
	Southbury.		
21136	E. H. Pratt	11.49	2.9
	South Coventry.		
22942	Frank O. Boynton....	11.49	2.9

TABLE XVI. ADULTERATED MILK—*Concluded.*

No.	Dealer	Solids	Fat
	SKIMMED MILK—*Continued.*		
	South Manchester.	%	%
23879	J. Kalamonski	11.57	2.8
23880	J. Kalamonski	11.58	2.6
	Thompsonville.		
22493	K. Balambams	11.31	2.4
23580	K. Balambams	10.93	2.5
22496	John Kallar	10.81	2.3
22660	David Stillson	11.93	3.0
	Torrington.		
23616	Daniel M. Ryan	10.95	2.5
	Warehouse Point.		
22675	A. Rerser	11.61	2.9
	SKIMMED MILK—*Concluded.*		
	Watertown.	%	%
21533	S. Bachararhaig	9.44	1.1
	West Goshen.		
23576	Harrison H. Ives	10.02	2.4
	Wethersfield.		
23858	A. H. Griswold	11.59	2.9
	Willimantic.		
22926	Hyman Brettscheider.	9.20	1.5
	Unknown.		
23661	J. H. LeGeyt	11.76	3.0

MARKET MILK.

Ten hundred and thirty-seven samples of milk were examined in the past year for the Dairy and Food Commissioner. On the results of examination they may be grouped as follows:

Not found adulterated.....	597	57.6%
Adulterated by dilution with water.....	72	6.9
Adulterated by skimming.....	82	7.9
Adulterated by reason of being		
below standard in solids and solids-not-fat.....	112	10.8
below standard in solids and fat.....	24	2.3
below standard in solids, fat and solids-not-fat.....	150	14.5
Total	1037	100.0

The samples of skimmed milk were chiefly obtained from restaurants where the dipping of milk is practiced.

Samples adulterated by dilution with water or by skimming are given in Table XVI.

Forty-three samples were submitted by individual producers or consumers and require no comment.

TESTER'S LICENSE.

Eleven samples of milk and ten samples of cream were tested for milk fat to check candidates for license to test milk and cream as required by Section 2, Chapter 221, Public Acts of 1917.

Cream.

One sample of cream was submitted by the Dairy and Food Commissioner, six were examined for individuals and two were collected by the Station agent. Complete analyses of the two last were made as follows:

Table XVII. Analyses of Cream.

No.		Solids	Protein	Fat	Sugar	Ash
		%	%	%	%	%
20063	Heavy (40%)	45.13	2.13	41.00	1.53	0.47
20064	Light (20%)	28.14	2.82	22.00	2.73	0.59

Skim Milk Powder.

One sample of so-called milk powder from skimmed milk was found to contain 9.15 per cent. of fat. The milk was evidently imperfectly skimmed before drying.

Human Milk.

Twenty-one samples of breast milk have been submitted by physicians or nurses, and the results of analyses are given in Table XVIII. As noted in previous reports, the value of conclusions based upon these analyses depend upon whether or not the samples examined were representative. Fat varies widely in

Table XIX. Analyses of

Station No.	Manufacturer and Brand	Net Weight	
		Declared	Found
		Ozs.	Ozs.
18349	Acker, Merrall & Condit Co., New York..	4.00	3.95
18393	A. Colburn Co., Philadelphia, Pa.	2.00	2.15
18314	E. R. Durkee & Co., Elmhurst, N. Y. *Gauntlet*	4.00	3.95
18303	B. Fisher Co.	2.00	2.04
18374	R. T. French Co., Rochester, N. Y.....	2.00	2.08
18408	Globe Grocery Stores, Inc., New York *Pocono*	4.00	3.77
18370	Grand Union Tea Co., Brooklyn, N. Y.....	2.75	2.79
18298	Great Atlantic & Pacific Tea Co., Jersey City, N. J. *Red Front*	4.00	4.09
18384	Francis H. Leggett & Co., New York *Premier*	3.00	3.35
15714	Chas. G. Lincoln & Co. *Capitol Mills*	2.00	2.15
18335	McCormick & Co., Baltimore, Md. *Bee*....	1.75	1.44
18416	Stickney & Poor Spice Co., Boston	2.00	1.97

the different portions of the milk, and unless the entire secretion of the gland is drawn and well mixed before sampling the fat content may be very misleading.

Table XVIII. Analyses of Human Milk.

No.	Solids	Protein	Fat	Sugar	Ash
	%	%	%	%	%
18177	....	1.02	1.2	...	...
18178	....	1.34	1.8	...	...
18461	13.23	1.21	4.8	7.00	0.22
18525	13.80	1.60	5.0	7.01	0.19
18526	12.21	1.15	3.8	7.07	0.19
18528	....	...	5.8	...	...
18549	....	1.34	2.2	...	...
18620	....	1.28	3.0	...	...
18667	9.76	1.21	1.4	6.93	0.22
20002	....	1.40	4.5	...	...
19132	....	1.28	3.8	...	...
19139	....	...	3.4	...	...
19203	....	3.20	1.4	...	...
19225	12.40	1.28	3.6	7.29	0.23
19272	....	1.79	3.6	...	...
19585	....	1.53	2.0	...	...
19636	....	1.60	2.4	...	...
19637	....	1.98	6.4	...	...
19687	....	1.40	2.6	...	...
19733	....	1.15	4.0	...	...
19741	....	1.40	2.8	...	...

Allspice.

Moisture	Ash: Total	Ash: Insol. in HCL	Ash: P_2O_5 in Insol.	Ash: Alk. of Sol.	Ash: Alk. of Insol.	Nitrogen	Crude Fiber	Ether Extract: Volatile	Ether Extract: Non-Volatile	Station No.
%	%	%	%	%	%	%	%	%	%	
8.40	4.80	0.08	0.28	2.50	4.85	0.92	23.66	2.03	6.04	18349
8.10	4.33	0.03	0.23	2.60	4.40	0.98	23.00	1.30	5.89	18393
7.08	4.93	0.18	0.23	2.85	4.25	0.94	23.27	1.40	6.35	18314
8.13	4.73	0.08	0.27	2.50	4.75	0.90	23.20	0.79	6.65	18303
8.68	4.33	0.08	0.23	2.40	4.45	0.90	21.95	2.05	6.65	18374
5.73	4.75	0.15	0.22	2.75	4.50	0.92	22.78	2.45	6.43	18408
7.90	4.75	0.13	0.27	2.55	4.80	0.94	23.91	2.48	7.29	18370
7.15	4.88	0.05	0.27	2.50	5.25	1.05	27.17	1.68	5.23	18298
8.30	4.58	0.10	0.24	2.70	4.20	0.90	23.86	1.43	5.79	18384
7.53	4.40	0.05	0.23	2.50	4.25	0.89	22.12	1.65	6.28	15714
7.33	4.75	0.13	0.24	3.00	4.30	0.89	22.71	2.15	6.63	18335
5.58	4.48	0.08	0.24	2.50	3.95	0.90	23.49	2.25	6.98	18416

SPICES.

ALLSPICE.

Allspice, pimento, is the dried, nearly ripe fruit of *Pimenta officinalis* (L.) Karst. It contains not less than eight (8%) of quercitannic acid (calculated from the total oxygen absorbed by the aqueous extract), not more than twenty-five per cent. (25%) of crude fiber, not more than six per cent. (6%) of total ash, nor more than four-tenths per cent. (0.4%) of ash insoluble in hydrochloric acid[1].

Twelve samples, collected by the Station agent were examined with respect to the essential requirements of the standard and to other details. Analyses are given in Table XIX.

All samples conformed to the requirements of composition set by the standard so far as determined except **18298**, which somewhat exceeded the limit of fiber. Sample **18335** was considerably short weight.

TABLE XX. ANALYSES OF GROUND CINNAMON.

No.	Manufacturer and Brand	Net Weight		Ash	
		Declared	Found	Total	Insol. in HCL
		Ozs.	Ozs.	%	%
18432	Joseph Burnette Co., Boston	4.0	4.1	5.34	0.18
18330	James Butler, Inc., New York. *Peerless*	3.0	3.2	2.53	0.74
15712	E. R. Durkee & Co., Elmhurst, N. Y. *Gauntlet*	2.0	2.0	3.21	0.27
15706	R. T. French, Rochester, N. Y.	2.0	2.2	3.97	0.35
18407	Globe Grocery Stores, New York. *Pocono*	4.0	3.8	2.97	0.08
18372	Grand Union Tea Co., Brooklyn, N.Y.	2.8	2.6	3.10	0.14
18299	Great Atlantic & Pacific Tea Co., Jersey City, N. J.	4.0	3.9	2.91	0.51
18385	Francis H. Leggett & Co., New York. *Premier*	3.0	3.4	3.18	0.12
15716	Chas. G. Lincoln & Co., Hartford. *Capitol*	2.0	2.1	3.67	0.04
18334	McCormick & Co., Baltimore, Md. *Bee*	2.0	..	3.18	0.45
18436	Miner, Read & Tullock, New Haven. *Sunrise*	4.0	3.5	4.63	1.70
18310	The Mohican Co., New York	3.2	3.3	3.56	0.83
18302	D. & L. Slade Co., Boston	2.0	2.2	3.63	0.10
18345	James P. Smith & Co., New York	4.0	4.0	4.07	0.14
18292	Stickney & Poor Spice Co., Boston	2.0	1.8	3.37	0.38
18390	Ross W. Weir & Co., Inc., New York. *Tiger Head*	4.0	3.9	3.60	0.20

[1] Circ. 136, U. S. Dept. Agr., Office of the Secretary.

CINNAMON.

Ground cinnamon, ground cassia, is the powder made from cinnamon. It contains not more than five per cent. of total ash nor more than 2 per cent. of ash insoluble in hydrochloric acid.[1]

Sixteen samples collected by the Station agent have been examined and the results are given in Table XX. One sample, **18432**, exceeded the limit for ash and **18436** was considerably short in weight.

CLOVES.

Cloves are the dried flower buds of *Caryophyllus aromaticus L.* Among other specifications they contain not less than fifteen per cent. of volatile ether extract, not more than ten per cent. of crude fiber, not more than seven per cent. of total ash and not more than five-tenths per cent. of ash insoluble in hydrochloric acid.[2]

Fifteen samples collected by the Station agent have been examined and the results are given in Table XXI. Three samples exceeded the limit for ash, one of these, **18309**, by a substantial amount. Excess fiber was found in **18366** and **18309** was short weight. No statement of net contents was made for **18389**.

GINGER.

Ginger is the washed and dried, or decorticated and dried, rhizome of *Zingiber officinale* Roscoe. Among other specifications it contains not more than eight per cent. of crude fiber, not more than seven per cent. of total ash, not more than two per cent. of ash insoluble in hydrochloric acid and not less than two per cent. of ash soluble in cold water.[3]

Eleven samples were collected by the Station agent and examined with reference to these requirements. The results are given in Table XXII. All samples conformed substantially to the limits of composition stated above, and there were no serious deficiencies in net weight; the weight found exceeded the weight declared in many cases.

MUSTARD.

Mustard flour, known to the trade generally as ground mustard, is the powder made from mustard seed with hulls largely removed and with or without the removal of a portion of the fixed oil.[4]

It contains not more than one and five-tenths per cent. of starch nor more than six per cent. of total ash.

Four samples, submitted by the Dairy and Food Commissioner, were examined and the results are given in Table XXIII. All conformed to the requirements of the standard.

[1] Circ. 136, U. S. Dept. Agr., Office of the Secretary
[2] Ibid.
[3] Ibid.
[4] Ibid.

TABLE XXI. ANALYSES OF CLOVES.

No.	Manufacturer and Brand	Net Weight		Ash		Fiber	Volatile Ether Extract
		Declared	Found	Total	Insol. in HCl		
		Ozs.	Ozs.	%	%	%	%
18351	Acker, Merrall & Condit Co., New York	4.00	4.16	6.45	0.50	9.30	17.66
18394	Joseph Burnett Co., Boston	4.00	4.05	6.92	0.10	10.11	17.38
18329	James Butler, Inc., New York. *Peerless*	4.00	3.98	6.52	0.29	9.62	18.99
18366	Direct Importing Co., Inc., Boston. *Benefit*	2.00	1.94	5.95	0.20	11.58	16.85
15707	R. T. French Co., Rochester, N. Y.	1.50	1.80	6.56	0.53	10.15	19.58
18301	B. Fischer Co., Inc., New York	2.00	2.20	6.71	0.52	8.65	19.66
18333	Great Atlantic & Pacific Tea Co., Jersey City, N. J.	2.00	2.01	6.46	0.42	9.20	15.09
18399	Knickerbocker Mills Co., New York	2.00	1.90	6.54	0.52	9.25	15.31
18429	Chas. G. Lincoln & Co., Hartford. *Capitol*	2.00	2.11	7.12	0.74	9.16	15.41
18337	McCormick & Co., Baltimore, Md. *Bee*	1.50	1.37	6.63	0.48	10.07	16.72
18437	Miner, Read & Tullock, New Haven. *Sunrise*	4.00	4.49	7.31	0.74	9.70	15.83
18309	The Mohican Co., New York	3.20	2.80	7.71	1.44	10.27	18.04
18343	James P. Smith Co., New York	4.00	3.98	6.89	0.72	9.19	15.20
18293	Stickney & Poor Spice Co., Boston	1.50	1.50	6.64	0.41	7.28	19.57
18389	Ross W. Weir & Co., New York. *Tiger Head*	...	3.88	6.91	0.51	9.75	15.74

TABLE XXII. ANALYSES OF GINGER.

No.	Manufacturer and Brand	Net Weight		Ash			Fiber
		Declared	Found	Total	Soluble in Cold Water	Insoluble in HCl	
		Ozs.	Ozs.	%	%	%	%
18352	Acker Merrall & Condit Co., New York	4.00	3.98	7.03	2.73	1.15	6.17
18388	A. Colburn Co., Philadelphia, Pa.	2.00	1.81	7.30	2.08	1.70	3.21
18365	Direct Importing Co., Inc., Boston. *Benefit*	3.00	2.92	5.81	2.45	0.74	5.73
18326	E. R. Durkee & Co., Elmhurst, N. Y. *Gauntlet*	2.00	2.15	6.15	2.06	1.43	5.94
18360	B. Fischer & Co., Inc., New York	2.00	1.90	6.46	2.07	0.88	5.02
18371	Grand Union Tea Co., Brooklyn	2.75	2.71	6.38	2.29	1.43	5.79
18353	Great Atlantic & Pacific Tea Co., Jersey City, N. J. *Red Front*	4.00	4.09	6.60	2.64	0.42	4.05
18406	Jones Bros. Tea Co., New York. *Pocono*	4.00	3.73	6.71	2.47	1.56	4.97
18325	McCormick & Co., Baltimore, Md. *Bee*	1.50	1.69	6.24	1.90	0.68	4.42
18377	The Mohican Co., New York	3.20	3.31	6.76	2.50	1.49	5.74
18424	*L. B. C.*	2.00	2.08	5.81	2.39	1.00	5.00

TABLE XXIII. ANALYSES OF GROUND MUSTARD.

No.	Brand	Moisture	Ash		Nitrogen	Starch	Oil (Ether Extract)
			Total	Insol in HCl			
		%	%	%	%	%	%
21501	Colburn's	4.71	4.68	0.88	4.10	0.56	45.85
21503	Durkee's	3.38	5.23	1.15	4.64	0.68	41.14
21515	Stickney & Poor's	5.10	4.15	0.38	5.04	0.39	37.10
21502	Stickney & Poor's	4.99	5.79	1.28	5.70	0.96	22.74

TABLE XXIV. ANALYSES OF BLACK PEPPER.

Station No. or D. C. No.	Manufacturer or Dealer and Brand	Net Weight		Ash		Non-volatile Ether Extract
		Declared	Found	Total	Insol. in HCl	
		Ozs.	Ozs.	%	%	%
18350	Acker, Merrall & Condit Co., New York	4.00	3.80	7.35	1.80	7.52
18410	Austin, Nichols & Co., Inc., New York. *Sunbeam*	3.20	3.17	6.43	1.21	7.76
18431	Joseph Burnett Co., Boston	4.00	4.19	4.48	0.16	6.20
18392	A. Colburn Co., Philadelphia, Pa. *Natuna*	2.00	...	6.06	0.95	7.74
18363	Direct Importing Co., Boston. *Dico*	3.00	2.89	6.98	1.60	7.04
18313	E. R. Durkee & Co., Elmhurst, N. Y. *Gauntlet*	4.00	3.80	6.69	1.49	8.15
DC 21226	Hartford Market, Hartford (in bulk)	...	...	4.52	0.23	6.87
DC 21229	Boston Branch Co., Hartford (in bulk)	...	...	5.05	0.09	3.43
18297	Great Atlantic & Pacific Tea Co., Jersey City, N. J. *Red Front*	4.00	3.85	5.68	1.36	8.43
15713	Hanley & Kinsella, St. Louis, Mo.	4.00	3.77	5.61	0.82	9.81
18401	Knickerbocker Mills Co., New York	2.00	...	7.00	1.40	7.83
DC 21244	A. La Racca, Middletown (in bulk)	...	...	4.17	0.18	5.73
15715	Chas. G. Lincoln & Co., Hartford. *Capitol*	2.00	2.36	7.58	2.01	9.16
18308	The Mohican Co., New York	3.20	3.40	5.38	0.74	8.74
18417	Seeman Bros., New York. *White Rose*	2.00	1.94	6.94	1.65	8.83
18300	D. & L. Slade Co., Boston	2.00	1.94	4.10	0.07	9.48
18346	James P. Smith, New York	4.00	3.98	6.96	2.67	6.82
18391	Ross W. Weir & Co., New York. *Tiger Head*	4.00	3.70	5.43	0.44	6.54
18380	Williams & Carleton Co., Hartford	3.00	2.89	5.12	0.76	8.11

BLACK PEPPER.

Black Pepper is the dried immature berry of *Piper nigrum* L. Ground black pepper is made by grinding the entire berry. It contains not less than six and seventy-five hundredths per cent. of non-volatile ether extract, not more than seven per cent. of total ash and not more than one and five-tenths per cent. of ash insoluble in hydrochloric acid[1].

Sixteen samples were collected by the Station agent and three were submitted by the Dairy and Food Commissioner. Analyses are given in Table XXIV. Samples **18350** and **18715** contained excesses of ash and of insoluble ash. Two of the bulk samples were notably deficient in non-volatile ether extract.

WHITE PEPPER.

White pepper is the dried mature berry of *Piper nigrum* L. from which the outer coating, or the outer and inner coatings have been removed. It contains not less than seven per cent. of non-volatile ether extract, not more than five per cent. of crude fiber, not more than three and five-tenths per cent. of total ash, nor more than three-tenths per cent. of ash insoluble in hydrochloric acid.[2]

Nine samples, eight of which were collected by the Station agent, were examined and analyses are given in Table XXV. All samples conformed to the requirements except for non-volatile ether extract. Sample **18423** was the only one notably deficient in this respect. Three samples were found to be short weight.

CAYENNE PEPPER AND RED PEPPER.

Cayenne pepper, cayenne, is the dried ripe fruit of *Capsicum frutescens* L., *Capsicum baccatum* L., or some other small fruited species of *Capsicum*. It contains not less than fifteen per cent. of non-volatile ether extract, not more than twenty-eight per cent. of crude fiber, not more than seven per cent. of total ash, nor more than one per cent. of ash insoluble in hydrochloric acid.

Red pepper is the red, dried, ripe fruit of any species of *Capsicum*. It contains not more than eight per cent. of total ash nor more than one per cent. of ash insoluble in hydrochloric acid.[3]

Ten samples of cayenne and red pepper, nine of which were collected by the Station agent, were examined. One sample of cayenne was slightly deficient in non-volatile ether extract, while the

[1] Circ. 186, U. S. Dept. Agr., Office of the Secretary.
[2] Ibid.
[3] Ibid.

TABLE XXV. ANALYSES OF WHITE PEPPER.

No.	Manufacturer or Dealer and Brand.	Net Weight		Ash		Fiber	Non-volatile Ether Extract
		Declared	Found	Total	Insol. in HCl		
		Ozs.	Ozs.	%	%	%	%
18331	James Butler, Inc., New York. *Peerless*	4.00	4.23	1.66	0.07	4.89	6.90
18362	Direct Importing Co., Inc., Boston. *Benefit*	3.00	2.60	1.20	0.16	4.06	7.00
18306	E. R. Durkee & Co., Elmhurst, N. Y. *Gauntlet*	3.00	2.99	1.09	0.05	4.24	6.95
21228	Hartford Market, Hartford (in bulk)	...	...	1.39	0.09	4.91	7.47
18404	Globe Grocery Stores, Inc., New York. *Pocono*	4.00	3.35	1.11	0.07	3.99	6.84
18427	Chas. G. Lincoln & Co., Hartford. *Capitol*	2.00	1.94	1.41	0.29	3.00	7.49
18336	McCormick & Co., Baltimore, Md. *Bee*	2.00	1.86	1.02	0.07	3.75	6.93
18291	Stickney & Poor Spice Co., Boston	4.00	3.31	1.04	0.07	3.95	7.23
19423	*L. B. C.*	2.00	2.00	0.88	0.01	2.08	0.25

TABLE XXVI. ANALYSES OF CAYENNE AND RED PEPPER.

No.	Manufacturer and Brand	Net Weight		Ash		Fiber	Non-volatile Ether Extract
		Declared	Found	Total	Insol. in HCl		
		Ozs.	Ozs.	%	%	%	%
	CAYENNE						
18307	E. R. Durkee & Co. New York	3.00	3.06	5.93	0.46	25.86	14.56
18344	James P. Smith & Co., New York	4.00	3.88	7.19	1.52	27.17	12.37
	RED PEPPER						
18364	Direct Importing Co., Inc., Boston. *Benefit*	3.00	2.99	7.18	0.96	...	...
21227	E. R. Durkee & Co., Elmhurst, N. Y.	...	...	7.30	0.53	...	...
18373	R. T. French Co., Rochester, N. Y.	2.00	2.15	6.17	0.72	...	...
18400	Knickerbocker Mills Co., New York	2.00	2.08	7.70	0.94	...	...
18383	Francis H. Leggett & Co., New York. *Premier*	4.00	4.00	6.76	0.35	...	...
18428	Chas. G. Lincoln & Co., Hartford. *Capitol*	2.00	2.00	7.65	0.83	...	...
18311	The Mohican Co., New York	3.20	3.20	6.40	0.82	...	...
18425	*L. B. C.* Logan Bros. Co.	2.00	2.00	6.40	0.27	...	...

other, **18344**, was considerably deficient in this respect, and contained excesses of ash and acid insoluble ash. All samples of red pepper conformed to the standards.

Analyses are given in Table XXVI.

SAGE, ETC.

Sage is the dried leaf of *Salvia officinalis* L. It contains not less than one per cent. volatile ether extract, not more than twenty-five per cent. of crude fiber, not more than ten per cent. of total ash, nor more than one per cent. of ash insoluble in hydrochloric acid.[1]

Seven samples were collected by the Station agent, only one of which was labeled pure sage; the others were sold as poultry seasoning, for which there are no standards of composition. These consist largely or in part of sage.

The sample of sage contained an excess of total ash and a slight excess of acid-insoluble ash; fiber and volatile ether extract conformed to the standard.

The results of analyses are given in Table XXVII.

SYRUPS.

MAPLE SYRUP.

Maple syrup is syrup made by the evaporation of maple sap or by the solution of maple concrete, and contains not more than thirty-five per cent. of water.[2]

Six samples declared to be pure maple syrup were collected by the Station agent, and all were found to conform to the moisture standard just defined and to other limits of composition characteristic of the pure article. Analyses are given in Table XXVIII.

TABLE SYRUPS, ETC.

Table syrups may be one or mixtures of two or more of the following syrups: cane sugar, corn, refiners' and malt, with or without an admixture of maple syrup. There are no standards for such mixtures, but, in general, they should not exceed the moisture limit for sugar syrups, viz., thirty-five per cent.

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[1] Circ. 136, U. S. Dept. Agr., Office of the Secretary.
[2] Ibid.

TABLE XXVII. ANALYSES OF SAGE, ETC.

No.	Manufacturer and Brand	Net Weight		Ash		Volatile Ether Extract	Fiber
		Declared	Found	Total	Insol. in HCl.		
	SAGE						
15705	E. S. Kibbe Co., Hartford	4.00	3.98	12.71	1.16	1.33	18.89
	POULTRY SEASONING						
15717	Wm. G. Bell Co., Boston	1.00	0.98	8.15	0.66	....	16.29
18387	A. Colburn Co., Philadelphia, Pa.	1.50	1.02	17.06	1.56	....	14.17
18315	E. R. Durkee & Co., Elmhurst, N. Y.	2.00	2.20	11.52	2.28	....	14.59
18304	B. Fischer & Co., Inc., New York	2.00	2.10	13.91	1.66	....	16.93
18405	Globe Grocery Stores, Inc., New York. *Pocona*	2.50	2.52	14.38	2.38	....	16.00
18294	Stickney & Poor Spice Co., Boston	2.00	2.00	11.12	2.30	....	18.41

TABLE XXVIII. ANALYSES OF MAPLE SUGAR.

No.	Brand and Manufacturer	Moisture	Ash				Lead No.
			Total	Soluble in Water	Insol. in Water	Soluble Insol.	
19887	Acker Merrall & Condit Co., New York	32.93	0.61	0.39	0.22	1.77	1.51
19827	Austin, Nichols & Co., Inc., New York. *Sunbeam*	30.05	0.59	0.40	0.19	2.10	1.31
19873	Curtice Bros. Co., Rochester, N. Y. *Blue Label*	31.66	0.70	0.46	0.24	1.91	1.64
19886	Lewis De Groff & Son, New York	33.82	0.56	0.33	0.23	1.44	1.36
19866	The Great Atlantic & Pacific Tea Co., Jersey City, N. J.	34.13	0.58	0.36	0.22	1.64	1.39
19913	Vermont Farmers Co., Springfield. *Our Finest*	33.60	0.66	0.39	0.27	1.44	1.72

Nineteen samples collected by the Station agent were examined for moisture and ash. Only three samples exceeded thirty-five per cent. of moisture, the excesses ranging from 0.8 to 2.9 per cent. Ash ranged from 0.1 to 1.9 per cent.

MOLASSES, ETC.

Molasses is the product left after separating the sugar from massecuite, melada, mush sugar or concrete and contains not more than twenty-five per cent. of water and not more than five per cent. of ash.[1]

Eleven samples were collected by the Station agent. Two, **19876** and **19861**, were declared to be mixtures of molasses and other syrups. All of the remaining samples exceeded the moisture limit, four exceeding it by more than ten per cent. Two exceeded the limit for ash by more than ten per cent.

Sulphur dioxide was declared in all cases.

Analyses are given in Table XXIX.

TABLE XXIX. ANALYSES OF MOLASSES, ETC.

No.	Manufacturer and Brand	Moisture	Ash
		%	%
19850	Henry Adams, Jr., New York. *Atlantic*	25.96	5.79
19834	Alexander Molasses Co., Chicago, Ill. *Cherry Grove*	26.48	5.46
19863	Alexander Molasses Co., Chicago, Ill. *Dove*	27.33	4.97
19822	The American Molasses Co., New York. *New Home*	25.81	4.43
19876	American Sugar Refining Co., New York. *Dixiano*	26.51	5.49
19829	New Orleans Packing Co., Inc., New Orleans, La. *Woman's Club*	27.83	4.50
19819	Penick & Ford, Ltd., New Orleans, La. *Brer Rabbit*	27.33	4.69
19851	Penick & Ford, Ltd., New Orleans, La. *Aunt Dinah*	27.80	5.45
19861	Southern Moslasses Co., New York. *B. & O.*	24.52	2.17
19884	Southern Molasses Co., New York. *Moro*	29.05	6.03
19825	W. Wirt Wickes & Son, New York. *Giltedge*	28.00	2.79

TEA.

WATER EXTRACT.[2]

The present tentative method for the determination of hot water extract in tea, originally suggested by Doolittle and Woodruff[3], derived extractive matter indirectly by determining the percentage of insoluble leaf. This procedure involves a separate moisture determination, and is time-consuming due to slow filtrations which are generally encountered. Modifications have been suggested from

[1] Circ. 136, U. S. Dept. Agr., Office of the Secretary.
[2] Abstract of report of R. E. Andrew, referee on tea to the A. O. A. C., Nov., 1922.
[3] U. S. Bureau of Chemistry, Bull. 105, p. 48.

TABLE XXX. WATER EXTRACT IN TEA.

Sample No.	18616			18617			18618			18619		
	Moisture	Method		Moisture	Method		Moisture	Method		Moisture	Method	
		Tent'v.	Proposed		Tent'v.	Proposed		Tent'v.	Proposed		Tent'v.	Proposed
	%	%	%	%	%	%	%	%	%	%	%	%
Maximum ..	8.21	45.5	42.3	7.42	48.6	42.7	7.17	43.4	40.8	8.95	39.6	36.2
Minimum ..	4.93	36.7	38.7	3.20	38.2	38.4	4.75	35.9	34.5	4.92	30.4	32.9
Average ...	6.12	40.1	40.9	4.29	42.4	41.1	5.63	39.8	39.0	6.81	34.5	35.0

time to time. One was devised in this laboratory[1] which largely eliminated the filtration difficulties. McGill[2] and Allen[3] have described methods which obtain extractive matter by direct evaporation of the aqueous extract of the ground tea. Preliminary trials of this process in comparison with the present method gave satisfactory results, and the proposed procedure was submitted to collaborative study. The tentative method was followed as now described[4] except that a longer condenser was used. The proposed method is as follows:

To two grams of the ground sample in a 500 cc graduated flask add 200 cc of hot water and boil over a low flame for one hour, rotating the flask occasionally. The flask should be closed with a rubber stopper through which passes a glass tube 30 inches long for a condenser. Boil very slowly so that no steam escapes from the top of the air condenser. Cool, dilute to volume, mix thoroughly and filter through a dry filter paper. Take an aliquot of 50 cc and evaporate to dryness over a steam bath. Then place in oven and heat to 100° C for one hour, cool and weigh.

Four samples were sent out and twelve analysts from various laboratories participated and reported results for moisture and for hot water extract by the two methods suggested. The results need not be reported here in detail but maximum, minimum and average figures are given in Table XXX.

The results showed that checks by the same analyst were closer by the proposed method and also the variation between different workers was less by this method.

ANALYSES OF MARKET TEAS, ETC.

Complete analyses of twenty-five samples of market tea and two samples of Cassina, supplied by courtesy of Mr. Mitchell of the Bureau of Chemistry are given in Table XXXI.

Cassina is obtained from the shrub *Ilex Cassine,* and the infusion of the dried and cured leaf resembles tea in some of its characters. Caffeine and nitrogen contents are distinctly less than in tea. Water-insoluble ash is considerably greater. The official ether extract in tea is that obtained by means of petroleum ether. Ethyl ether, prepared as directed for feeding stuffs gives higher results; in a limited number of trials the figures were about twice as great.

VINEGAR.

Seventy-six samples of vinegar were examined for the Dairy and Food Commisioner, of which fifteen were below standard. Twenty-six samples were collected by the Station agent of which

[1] Conn. Exp. Sta. Bull. 210, p. 182.
[2] Inland Revenue Dept., Ottawa, Canada, Bull. 359.
[3] Commercial Organic Analysis, *4,* p. 623.
[4] Methods of Analysis, A. O. A. C., p. 273.

TABLE XXXI. ANALYSES OF

Station No.	Description	Moisture	Petroleum Ether Extract	Hot Water Extr.		Nitrogen	Crude Fiber
				Official	Proposed*		
		%	%	%	%	%	%
15711	Black	6.33	1.13	35.29	36.70	3.80	12.00
18312	"	6.85	0.93	38.06	37.90	4.06	10.30
18322	"	5.90	1.21	37.92	37.70	3.48	12.58
18368	"	6.80	1.61	37.75	38.20	3.83	11.37
18367	"	5.78	1.02	40.72	39.80	3.85	11.21
18409	"	5.83	0.60	38.56	39.00	3.84	11.47
18320	Black, Orange Pekoe	6.98	0.87	40.67	41.00	3.97	9.11
18332	Blk. O. P.	6.50	0.98	38.90	39.50	3.96	10.50
18382	" " "	7.40	0.92	....	37.60	4.10	10.40
18616	" " "	6.21	...	40.35	40.00	4.39	....
18339	" Ceylon ...	7.15	0.82	39.05	38.50	4.07	9.82
18342	" " ...	7.79	0.87	....	37.75	4.13	10.12
18356	" Oolong ..	6.58	1.03	41.57	39.40	3.61	11.26
18617	" " ..	4.40	...	41.28	39.82	4.04	....
18619	" English Breakfast ..	6.93	...	34.26	34.65	4.41	....
15709	Gr. Japan	5.55	2.00	37.52	35.80	3.64	13.94
18317	" "	5.08	1.75	37.49	36.05	3.64	14.06
18359	" "	4.45	2.10	35.84	35.50	3.44	14.29
18381	" "	5.28	1.58	36.66	37.40	3.52	13.36
18395	" "	5.48	2.11	35.03	35.80	3.48	14.35
18618	" Gunp'wd'r..	5.81	...	40.16	37.30	3.90	....
18369	Mixed	5.93	1.80	38.36	38.20	3.50	12.48
18375	"	6.18	1.29	36.74	36.50	3.50	11.34
18386	"	6.50	1.34	37.59	37.40	3.21	12.96
18397	"	5.67	1.60	34.53	33.70	3.44	12.90
18613	Blk. Cassina ..	3.15	1.68	....	31.00	2.25	14.13
18612	Gr. Cassina ...	3.68	1.98	....	40.00	2.30	12.29

* By R. E. Andrew.
† Bailey-Andrew method.

three were below standard. Thirteen samples were submitted by individuals and of these three were below standard. Of the total number of one hundred and fifteen, ninety-four were not found adulterated and were passed. Of nineteen samples, not found to be adulterated, sulphate was determined in terms of milligrams of SO_3 per 100 cc of vinegar, and the amount ranged from 1.6 to 6.2 the average being 3.9. In five other samples amounts ranging from 7.6 to 12.6 were found. It would appear that the sulphate (SO_3) content of vinegar stock will not exceed six or seven milligrams per 100 cc, and that for amounts greater than this vinegar derived wholly or in part from sulphured apple stock may be suspected.

TEA, ETC.

Caffeine†		Ash									Station No.
By Weight	From Nitrogen	Total	Soluble in Water	Insoluble in Water	Soluble in Acid	Insoluble in Acid	Soluble P_2O_5	Insoluble P_2O_5	Alk. of Soluble	Alk. of Insoluble	
%	%	%	%	%	%	%	%	%			
2.49	2.43	6.15	3.17	2.98	5.45	0.70	0.22	0.47	3.15	4.25	15711
3.08	3.00	5.63	3.43	2.20	5.37	0.26	0.19	0.54	3.55	3.80	18312
2.39	2.23	6.30	3.28	3.02	5.42	0.88	0.22	0.40	2.60	4.00	18322
2.44	2.33	6.14	3.46	2.68	5.94	0.20	0.35	0.41	3.00	3.70	18368
2.95	2.88	5.98	3.66	2.32	5.03	0.95	0.32	0.43	3.65	3.45	18367
3.00	2.88	5.88	3.90	1.98	5.75	0.13	0.26	0.45	4.00	3.30	18409
2.81	2.72	5.25	3.27	1.98	5.12	0.13	0.23	0.45	3.50	3.40	18320
3.32	3.26	6.10	3.57	2.53	5.70	0.40	0.23	0.56	3.80	3.85	18332
3.17	3.12	5.35	3.02	2.33	5.12	0.23	0.24	0.47	3.00	3.55	18382
...	...	...	...	...	...	...	...	...	...	...	18616
3.22	3.15	5.63	3.68	1.95	5.41	0.22	0.29	0.46	3.75	3.50	18339
3.14	3.06	5.40	3.52	1.88	5.32	0.08	0.29	0.45	3.45	3.55	18342
2.92	2.84	6.05	3.65	2.40	5.60	0.45	0.24	0.45	3.50	3.80	18356
...	...	...	...	...	...	...	...	...	...	...	18617
...	...	...	...	...	...	...	...	...	...	...	18619
2.27	2.13	5.68	3.38	2.30	5.40	0.28	0.20	0.43	3.30	3.70	15709
2.09	2.04	5.68	3.30	2.38	5.40	0.28	0.13	0.51	3.40	4.05	18317
2.02	1.91	5.75	3.02	2.73	5.30	0.40	0.09	0.49	3.45	4.25	18359
1.91	1.86	5.50	3.30	2.20	5.20	0.30	0.19	0.45	3.50	3.35	18381
2.07	1.84	5.83	3.40	2.43	5.43	0.40	0.14	0.46	3.15	3.90	18395
...	...	...	...	...	...	...	...	...	...	...	18618
2.17	2.13	6.10	3.32	2.78	5.42	0.68	0.23	0.41	3.10	3.70	18369
2.20	2.16	6.50	3.27	3.23	5.65	0.95	0.19	0.42	2.90	3.90	18375
2.04	1.99	6.43	2.95	3.48	5.50	0.93	0.24	0.36	2.60	3.65	18386
1.99	1.86	6.85	2.95	3.90	5.42	1.43	0.20	0.42	2.50	3.70	18397
0.79	0.69	6.00	1.71	4.29	4.91	1.09	0.03	0.58	2.30	5.35	18613
0.51	0.38	6.00	1.72	4.28	4.60	1.40	0.14	0.63	2.10	5.65	18612

Samples showing in excess of seven milligrams SO_3 per 100cc were as follows:

No.	Dealer	Manufacturer
D. C. 24452	Capitol Pickling Co., Hartford.	Powell Corporation, Canandaigua, N. Y.
19849	Hartford Market Co., Hartford.	Hartford Market Co.
19848	Wise, Smith & Co., Hartford.	National Fruit Products Co., Washington, D. C.
19820	People's Grocery, Madison.	G. N. Ayer, Buffalo, N. Y.
19830	P. Vong New Haven.	Canandaigua Products Corp., Canadaigua, N. Y.

MATERIALS SUSPECTED OF POISON OR OTHER INJURIOUS SUBSTANCES.

Twenty-four samples, two of which were sent by the Dairy and Food Commissioner, have been examined for poisons or to identify suspicious elements therein. The samples include foods, medicines, stomach contents, animal viscera, etc. The results of the examinations did not reveal anything of public interest or value, and no comment of individual cases is therefore necessary. The Station refuses to accept work of this kind when it is evidently submitted to satisfy idle curiosity or with little likelihood of fruitful results; however, it co-operates so far as time and facilities permit, with health officers, food officials and physicians where there is reasonable ground for suspicion. It is difficult to rule consistently in the premises and it often happens that the results of examinations do not appear to justify the amount of work involved. Many of these cases should more properly be referred to one of the State chemists.

II. DRUGS.

U. S. PHARMACOPOEIAL PREPARATIONS.

All samples of drugs were submitter by the Dairy and Food Commissioner unless otherwise stated.

Acetic Acid.

Acetic Acid is an aqueous solution containing not less than 36 per cent. nor more than 37 per cent. of acetic acid.[1]

Diluted acetic acid contains not less than 5.7 per cent. nor more than 6.3 per cent. acetic acid.[2]

Forty-three samples of acetic acid and 28 of diluted acetic acid were examined. Three samples of the stronger solution and three of the dilute preparation did not conform to the specifications noted above. One was glacial acetic acid not so marked and therefore presumed to be the 36 per cent. solution. Sample **23680** contained no acetic acid; a second sample from the same dealer, **23739**, conformed to the requirements.

Samples not conforming to the U. S. P. requirements are listed in Table XXXII.

Table XXXII. Assays of Acetic Acid.

No.	City or Town	Dealer	Acetic Acid %
22837	*Bristol*	Perry N. Holley	99.7
23677	*Hartford*	H. F. Ruby & Co.	31.4
22778	*Meriden*	Victor W. Schmelzer	44.0
23708	*Winsted*	G. L. Fancher	29.2
22843	*Bristol*	Madden Drug Store	3.7
23212	*Danielson*	M. H. Berthiaume	8.3
23683	*Hartford*	W. H. Coleman	none

[1] U. S. P. IX, p. 6.
[2] Ibid, p. 7.

Tincture of Aconite.

One hundred mils of tincture of aconite yields not less than 0.045 gm. nor more than 0.055 gm. of the ether-soluble alkaloids of aconite[1].

Six samples were examined, all of which conformed substantially to the limits stated.

Ammonia Water.

Ammonia water is an aqueous solution of ammonia (NH_3) containing not less than 9.5 per cent. nor more than 10.5 per cent. by weight of ammonia. Stronger ammonia water contains not less than 27 per cent. nor more than 29 per cent. of ammonia[2]. The solutions deteriorate and should be tested frequently.

Twenty-four samples were examined, three of which were stronger ammonia. Twelve of the samples were passed and 12 did not conform to the U. S. P. requirements. One sample, **22747**, was 50 per cent. too strong for the diluted article. Sample **23215** was labeled 26 per cent. Samples varying from the U. S. P. standard by more than 10 per cent. are given in Table XXXIII.

Table XXXIII. Assays of Ammonia Water.

D. C. No.	City or Town.	Dealer	Ammonia (NH_3) %
22841	*Bristol*	The Madden Drug Store	7.2
23201	*Hartford*	James W. Lynch	2.5
23693	*Hartford*	City Drug Co.	7.6
22715	*East Hartford*	W. B. Noble	7.8
22747	*Norwich*	Utley & Jones	15.9
23215	*Putnam*	Edward H. Burt	19.9
22889	*Rockville*	John Lee	8.4
22881	*Rockville*	Mrs. E. F. Wilson	8.4
22878	*Rockville*	Thomas Pharmacy	4.4
22717	*Thompsonville*	Steel's Cor. Drug Store	7.6
22861	*West Hartford*	Allen B. Judd Co.	4.1
22863	*West Hartford*	Henry C. Kottenhoff	6.9

Calcium Hydroxide.

Lime water is an aqueous solution containing not less than 0.14 per cent. of calcium hydroxide, $Ca(OH)_2$, at 25°C.[3]

Sixty-nine samples were examined of which five contained substantially less than 0.14 per cent. of $Ca(OH)_2$. The deficient samples are listed in Table XXXIV.

[1] U. S. P. IX, p. 445.
[2] Ibid, p. 53.
[3] Ibid, p. 239.

TABLE XXXIV. ASSAYS OF LIME WATER.

No.	Town or City.	Dealer	Calcium Hydroxide %
22713	*East Hartford*	W. B. Noble	0.05
22894	*Hartford*	T. A. Lynch	0.07
22849	*New Britain*	Louis K. Liggett Co.	0.12
23217	*Putnam*	James F. Donahue	0.09
22892	*Rockville*	E. N. Metcalf	0.02

CHLOROFORM.

Two samples said to be stock released by the U. S. Army did not comply with the specifications as required by the U. S. P.[1] Impurities decomposable by sulphuric acid and chlorinated decomposition products were present. When evaporated on filter paper a camphoraceous odor remained and there was a considerable amount of dirt in the bottom of the can. One sample was obtained at the Bay State Drug Co., Willimantic, and the other at Burroughs Drug Store, Danielson. Both containers were marked Squibb & Son N. Y.

TINCTURE OF CINCHONA AND COMPOUND TINCTURE OF CINCHONA.

One hundred mils of this tincture yield not less than 0.8 gm. nor more than 1. gm. of the alkaloid of cinchona[2]. One hundred mils of the compound tincture yield not less than 0.4 gm. nor more than 0.5 gm. of the alkaloid of cinchona.[3]

One sample of each of these preparations was examined and found to comply with the requirements.

SOLUTION OF FERRIC SUBSULPHATE.

This is an aqueous solution containing basic ferric sulphate corresponding to not less than 13 per cent. nor more than 14 per cent. of iron (Fe)[4].

Sixteen samples were assayed which, with one exception, conformed substantially to the limits defined. One sample was about one-half strength (7.2 per cent. iron), and not so marked. It was purchased at the Apothecaries Hall Co., Waterbury.

DILUTE HYDROCHLORIC ACID.

Hydrochloric acid, diluted, is an aqueous solution containing not less than 9.5 per cent. nor more than 10.5 per cent. of hydrochloric acid (HCl)[5].

Twenty-three samples were examined, of which only three varied from the U. S. P. requirements by more than ten per cent. Assays of these are given in Table XXXV.

[1] U. S.P. IX, p. 108.
[2] Ibid, p. 451.
[3] Ibid, p. 452.
[4] Ibid, p. 243.
[5] Ibid, p. 14.

TABLE XXXV. ASSAYS OF HYDROCHLORIC ACID, DILUTED.

No.	Town or City.	Dealer	Hydrochloric Acid (HCl) %
23674	*Hartford*	Nelson Drug Co.	11.8
23717	*Waterbury*	Apothecaries Hall Co.	12.1
22757	*Willimantic*	Bay State Drug Co.	13.1

FLUID EXTRACT OF HYOSCYAMUS. (FLUID EXTRACT OF HENBANE).

One hundred mils of fluid extract of hyoscyamus yield not less than 0.055 gm. nor more than 0.075 gm. of the alkaloids of hyoscyamus[1].

Ten samples were examined and all found to conform closely to the limits required for this preparation.

TINCTURE OF IODINE.

This tincture contains in 100 mils not less than 6.5 gms. nor more than 7.5 gms. of iodine; and not less than 4.5 gms. nor more than 5.5 gms. of potassium iodide[2].

Two samples were assayed, both of which conformed to the requirements.

FLUID EXTRACT OF IPECAC.

One hundred mils of this prepartion yield not less than 1.8 gms. nor more than 2.2 gms. of the ether-soluble alkaloids of ipecac[3].

Six samples were assayed and all conformed to the limits defined or closely thereto.

MERCURY WITH CHALK.

This powder contains not less than 37 per cent. nor more than 39 per cent. of mercury (Hg)[4].

Six samples were assayed and all conformed substantially to the limits of the standard.

SACCHARATED FERROUS CARBONATE.

Saccharated Ferrous Carbonate contains not less than 15 per cent. of ferrous carbonate ($FeCO_3$)[5]. There is no maximum limit stated in the pharmacopoeia.

Ten samples were assayed, seven of which ranged from 15.6 per cent. to 20.3 per cent. of $FeCO_3$. Three were practically double the strength of the pharmacopoeial standard, containing 27.5, 29.5 and 29.5 per cent. $FeCO_3$ respectively.

[1] U. S. P. IX, p. 187.
[2] Ibid, p. 457.
[3] Ibid, p. 187.
[4] Ibid, p. 221.
[5] Ibid, p. 165.

Diluted Sulphuric Acid.

Sulphuric acid, diluted, is an aqueous solution containing not less than 9.5 per cent. nor more than 10.5 per cent. of sulphuric acid (H_2SO_4)[1].

Fifteen samples were examined, of which six varied from the specification by considerable amounts. The variations were excesses in all cases. The explanation in one case was found to be that the strong acid was measured instead of weighed in preparing the diluted solution.

Samples not conforming to the U. S. P. requirements are given in Table XXXVI.

Table XXXVI. Assays of Sulphuric Acid, Diluted.

No.	Town or City.	Dealer	Sulphuric Acid %
23675	*Hartford*	Nelson Drug Co.....	13.7
22722	*Middletown*	The Woodward Drug Co.....	17.3
22730	*Middletown* ...	John J. Cronin.....	15.0
22735	*Middletown*	The Hartman Drug Co.....	16.5
22853	*New Britain* ...	The Clark & Brainerd Co.....	17.2
23220	*Putnam*	Geo. E. Dresser.....	15.3

Distilled Water.

Among other specifications distilled water is colorless, without odor or taste, and is neutral to official indicators. One hundred mils, evaporated to dryness and the residue further dried at 100°C., yield not more than 0.001 gm. of residue. The limit of organic or other oxidizable substances is the equivalent of not more than 0.1 mil of N/10 potassium permanganate[2].

Seventeen samples were examined with respect to these requirements. Only five conformed strictly to the pharmacopoeial limits for residue on evaporation and for oxidizable substances. Six gave residues of from 1 to 2 milligrams; six gave residues of from 3 to 7 milligrams. Two samples required 0.35 cc and 0.50 cc N/10 potassium permanganate solution to oxidize organic and other oxidizable material. The markedly deficient samples are given in Table XXXVII.

Table XXXVII. Distilled Water.

D. C. No.	City or Town.	Dealer	Residue, gm./100cc	$KMnO_4$ requirement cc N/100 soln.
22712	*Hartford*	Fox & Co.....	0.0045	0.35
22852	*New Britain*	Clark & Brainerd..	0.0064	none
22799	*South Manchester*	McNamara's Pharm.	0.0030	0.50
22876	*Stafford Springs*	D. H. McCormick..	0.0052	none
22874	*Stafford Springs*	E. H. Wickes.....	0.0070	none
22867	*West Hartford* .	West Hill Pharm...	0.0046	none

[1] U. S. P. IX, p. 25.
[2] Ibid, p. 57.

Witch Hazel Water.

Witch Hazel water, although listed in the pharmacopoeia, is chiefly used as a toilet water. The restrictions placed upon the use of pure alcohol for such preparations has resulted in the approval of a number of formulas for denaturing alcohol to be used in the manufacture of toilet lotions.

The one sample, **22486,** of witch hazel water examined was labeled Barber's Special and declared to have been rendered non-potable. It was evidently made with denatured alcohol; the solids on evaporation were about ten times the amount contained in the official preparation, and the test for salicylates was positive.

MISCELLANEOUS.

Eleven samples were submitted by individuals for identification of medicament, active principles or injurious ingredients. These included two samples of cutting oil, two rheumatism remedies, two cleaning fluids and one sample of sodium benzoate, the last named being for an assay.

BABCOCK GLASSWARE.

Chapter 237, Section 4788 of the General Statutes provides that all test bottles and pipettes used in testing milk and cream, which are to be paid for on the basis of the Babcock test, shall be tested and stamped as accurate by this Station.

The following classification shows the apparatus tested under this provision during the past year.

Babcock Glassware Examined.

	Total	Broken[1]	Accurate	Inaccurate
Cream test bottles.....	486	9	477	0
Milk test bottles	1075	12	1053	10
Pipettes	342	15	327	0
Skim milk test bottles.....	36	0	36	0
Acid measures	34	0	34	0
Totals	1973	36	1927	10

Four dairy thermometers were checked for the Department of Health, New Haven.

[1] Broken in transit.

SUMMARY.

Materials	Sampled by, or at request of: Station Agent	Dairy and Food Commissioner	Individuals	Total	Adulterated, below standard or otherwise illegal
FOODS.					
Carbonated Beverages	5	104	3	112	6
Cereal Products	5	...	...	5	...
Cider	...	2	1	3	...
Clams	18	...	...	18	2
Diabetic and Special Foods	12	...	8	20	...
Eggs	...	22	...	22	15
Eskimo Pie	3	...	...	3	...
Fats and Oils:					
Olive Oil	...	45	...	45	12
Cottonseed Oil	1	...	...	1	...
Butter	...	...	2	2	1
Flavoring Extracts:					
Lemon	17	...	...	17	1
Lemon Substitute	3	...	...	3	...
Vanilla	18	...	...	18	1
Vanilla Substitute	2	...	...	2	...
Flour:					
Bread and Pastry	15	...	...	15	...
Self-raising	9	...	5	14	1
Ice Cream	...	332	...	332	23
Infant Foods	23	...	...	23	...
Meat Products:					
Hamburg Steak	...	8	...	8	5
Sausage	...	80	...	80	14
Milk and Milk Products:					
Cryoscopy of Milk	54	...	...	54	...
Market Milk	...	1037	43	1080	440
Tester's License (milk and cream)	21	...	...	21	...
Cream	2	1	6	9	...
Milk Powder	...	1	...	1	...
Human Milk	...	...	21	21	...
Spices:					
Allspice	12	...	...	12	2
Cinnamon	16	...	...	16	2
Cloves	15	...	...	15	3
Ginger	11	...	...	11	...
Mustard	...	4	...	4	...
Black Pepper	16	3	...	19	4
White Pepper	8	1	...	9	4
Cayenne Pepper and Red Pepper	9	1	...	10	1
Sage, etc.	7	...	...	7	1

SUMMARY—*Concluded.*

Materials	Sampled by, or at request of: Station Agent	Dairy and Food Commissioner	Individuals	Total	Adulterated, below standard or otherwise illegal
Syrups:					
Maple Syrup	6	...	...	6	...
Table Syrup	19	...	...	19	...
Molasses	11	...	...	11	9
Tea, etc.	31	...	...	31	...
Vinegar	26	76	13	115	21
Materials Examined for Poisons, etc.	...	2	22	24	...
Total	395	1719	124	2238	568
DRUGS.					
U. S. P. Drugs:					
Acetic Acid	...	43	...	43	4
Acetic Acid Dilute	...	28	...	28	3
Aconite, Tincture of	...	6	...	6	...
Ammonia Water	...	24	...	24	12
Calcium Hydroxide, Solution of	...	69	...	69	5
Chloroform	...	2	...	2	2
Cinchona, Tincture of	...	2	...	2	...
Ferric Subsulphate, Solution of	...	16	...	16	1
Hydrochloric Acid, Dilute	...	23	...	23	3
Hyoscyamus, Fluid Extract of	...	10	...	10	...
Iodine	...	2	...	2	...
Ipecac	...	6	...	6	...
Mercury with Chalk	...	6	...	6	...
Saccharated Ferrous Carbonate	...	10	...	10	...
Sulphuric Acid, Dilute	...	15	...	15	6
Water, Distilled	..	17	...	17	6
Witch Hazel Water	...	1	...	1	...
Miscellaneous	...	...	7	7	...
Vitamine Preparations[1]	21	...	...	21	...
Total	21	280	7	308	42
Total for Foods and Drugs	416	1999	131	2546	610

[1] Published in Bulletin 240, as Part I of this Report.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 249 APRIL, 1923

BEING THE

Report on Commercial Feeding Stuffs

1922

By E. M. BAILEY

CONTENTS

Commercial Feeding Stuffs

By E. M. BAILEY.*

PROVISIONS OF THE STATUTES RELATING TO FEEDING STUFFS.

Under the Connecticut statutes the term "concentrated commercial feeding stuffs" covers practically all feeds excepting hay and straw, whole seed, unmixed meal made directly from any of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Under the new fertilizer law cottonseed meal is classed as a commercial fertilizer and, as such, is subject to analysis fees and tonnage tax. Provision is made, however, to exempt meal sold exclusively for feeding purposes.[1]

Section 4775 requires that every lot or parcel of concentrated commercial feeding stuff shall bear a statement giving the name and address of the manufacturer or importer, the number of net pounds in the package, the name of the article, and the percentage of protein and fat contained in it. The law forbids the use of any metal in affixing tags.

No registration of feed or payment of analysis or license fees is required.

The penalty for violation of the statute is not more than $100 fine for the first offense and not more than $200 for each subsequent offense.

The law authorizes this station to take samples from any manufacturer or dealer, in a prescribed manner, and requires the station to analyze annually at least one sample of each brand which it has collected, and to publish these analyses "together with such additional information in relation to the character, composition and use thereof as may be of importance."

CLASSIFICATION OF SAMPLES.

The classification and summary of commercial feeding stuffs and other materials requiring fodder analysis which have been examined during the past year are as follows:

* Analyses are by Messrs. Shepard, Nolan, and Fisher; inspection and sampling are by Mr. Churchill; and the compilation of results for publication is largely due to Mrs. Storrs.

[1] Chapt. 204, Public Acts, 1919.

Official samples taken by the Station agent	163
Samples submitted by individuals	35
Samples examined in connection with field and other experiments at Storrs Experiment Station	160
Samples examined in connection with field experiments, this Station	13
Total	371

Official samples taken by this Station are classified as follows:

Cottonseed Meal	12	Distillers' Products	1
Linseed Meal	7	Brewers' Products	3
Wheat Bran	11	Dried Beet Pulp	4
Wheat Middlings	22	Proprietary Stock Feed	55
Wheat Mixed Feed	10	Poultry Feed	19
Rye Products	2		
Oat Products	1	Total	163
Maize Products	16		

Only official samples collected by the Station agent and those submitted by individuals are included in this report. Other data are discussed elsewhere.

SIGNIFICANCE OF THE NUTRIENT GROUPS.

The significance of the several nutrient groups as expressed in the conventional proximate analysis has been discussed in previous bulletins[1]. The terms "carbohydrate" and "nitrogen-free extract" are still confused in practice. It should be borne in mind that the term "carbohydrate" includes two of the groups as stated in a conventional fodder analysis, viz., "crude fiber" and "nitrogen-free extract". The reason for differentiating between the last named groups is that, in general, fiber is much less digestible than the remainder of the carbohydrate material or so-called "nitrogen-free extract", and it is also an aid in determining the genuineness or quality of certain feeds. If a feed tag or label bears declarations of both *fiber* and *carbohydrate*, then carbohydrate is used in the narrower sense of "nitrogen-free extract". "Carbohydrate-other-than-fiber" is less difficult to understand but more cumbersome to use.

COEFFICIENTS OF DIGESTIBILITY AND NET ENERGY VALUES.

The question of digestion coefficients and energy values of feeding stuffs has been discussed in previous reports.[2] These factors for most of the types of concentrates reported herein are given in Table I, and for others the reader is referred to the authorities cited.

[1] Conn. Exp. Sta., Bull. 206, 1918; Bull. 212, 1919; Bull. 221, 1920.
[2] Conn. Exp. Sta., Bull. 212, 1918; Bull. 221, 1919.

TABLE I. COEFFICIENTS OF DIGESTIBILITY AND NET ENERGY VALUES OF FEEDING STUFFS.[1]

Feed.	Average dry matter, lbs. per hundred.	Coefficient of digestibility.				Net energy value, Therms per hundred lbs.
		Protein.	Carbohydrate.		Fat.	
			Fiber.	Nitrogen-free extract.		
Cottonseed Meal	92.2	84	37	75	95	90.0
Cottonseed Feed	...	58	45	61	90	...
Linseed Meal (old process)	90.0	89	57	78	89	88.9
Linseed Meal (new process)	90.4	86	73	87	95	85.1
Wheat Bran	89.9	76	43	74	62	53.0
Wheat Feed	...	77	36	76	87	...
Wheat Middlings	89.6	77	30	78	88	59.1
Red Dog Flour	...	88	36	88	86	...
Rye Flour	...	80	..	88	90	...
Barley, ground	90.7	88	70	93	86	89.9
Barley Bran	...	85	20	86	87	...
Corn Gluten Meal	90.9	85	55	90	93	84.2
Corn Gluten Feed	91.3	85	76	88	85	80.7
Hominy Feed	89.9	66	76	90	91	81.3
Brewers' Grains	92.5	81	49	57	89	53.4
Malt Sprouts	92.4	77	87	80	85	72.7
Distillers' Grains, Corn	93.4	73	95	81	95	85.1
Distillers' Grains, Rye	92.8	51	..	17	77	56.0
Beet Pulp, dried	91.8	52	83	83	..	75.9
Peanut Cake, without shells	89.3	90	9	84	90	93.6
Soybean Oil Meal	88.2	92	99	100	68	99.7
Cocoanut Cake	90.4	90	23	87	100	83.5

[1] Henry and Morrison, 18th Ed., pp. 722-723; Armsby and Putney, Penn. Exp. Sta. Bull., 142, 1916.

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REMARKS ON ANALYSES.

(*Analyses on pages 456-473*).

The definitions of the various feeding stuffs here given are those adopted by the Association of Feed Control Officials revised to October, 1921. The costs are those quoted when the samples were taken, mostly during November and December, 1922.

COTTONSEED MEAL.

41.12 *Per cent. Protein Cottonseed Meal, Choice Quality,* must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and by analysis must contain at least 41.12 per cent. crude protein, equivalent to 8 per cent. of ammonia.

Cotton seed meal not fulfilling the above requirements as to color, odor or texture, shall be branded Off Quality.

38.56 *Per cent. Protein Cottonseed Meal, Prime Quality,* must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color,

yellow, not brown or reddish, free from excess of lint, and by analysis must contain at least 38.56 per cent. crude protein, equivalent to 7.5 per cent. of ammonia.

Cottonseed meal not fulfilling the above requirements as to color, odor or texture, shall be branded Off Quality.

36 *Per cent. Protein Cottonseed Meal, Good Quality,* must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and by analysis must contain at least 36 per cent. crude protein equivalent to 7 per cent. of ammonia.

Cottonseed meal not fulfilling the above requirements as to color, odor or texture, shall be branded Off Quality.

Twelve samples were examined, all of which satisfied their guaranties. Two brands, **20317** and **20345,** had tags attached by means of wire, which is illegal in this State.

The average composition of all samples is protein 39.2, fiber 11.2, and fat 6.5, which is substantially the same as the average found a year ago except that fat is about one per cent. lower. The cost per ton averages about $10 higher than last year.

The average cost per ton of the 43 per cent. protein group of meals is $61.25, and that of the 36 per cent. group $57.92. The average amounts of protein, nitrogen-free extract and fat, in lbs. per 100 lbs. of feed, and the amounts of these constituents purchased for $1.00 in each of these groups are as follows:

	Protein, lbs.	Nitrogen-free extract, lbs.	Fat, lbs.	Cost per 100 lbs.
43 *per cent. group,* average.....	44.1	28.5	7.1	$3.06
lbs. nutrients for $1.00.....	14.4	9.3	2.3	
36 *per cent. group,* average.....	36.3	31.6	6.0	2.90
lbs. nutrients for $1.00.....	12.5	10.8	2.1	

Protein was therefore purchased to the best advantage in 43 per cent. goods.

Linseed Meal.

Linseed Meal is the ground product obtained after extraction of part of the oil from ground flaxseed screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over six per cent. of weed seeds and other foreign materials and provided further that no portion of the stated six per cent. of weed seeds and other foreign materials shall be deliberately added.

Old Process Oil Meal is the ground product obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "Old Process Oil Meal" shall be understood to designate linseed meal as defined, made by the old process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "old process oil meal."

Seven samples were examined, all of which exceeded their guaranties. The cost per ton was $10 in advance of last year's cost.

Wheat Bran.

Wheat Bran is the coarse outer coating of the wheat kernel as separated from cleaned and scoured wheat in the usual process of commercial milling.

Eleven samples were analyzed, none of which showed deficiencies in protein or in fat. So far as fiber guaranties were given or recorded only one excess was found, viz., in **20236,** where 9.12 per cent. was found, which was 1.52 more than the maximum guaranteed. The cost of wheat bran was $7.50 per ton more than the average price noted last year.

Wheat Middlings.

Standard Middlings (*Red Shorts or Brown Shorts*) consists mostly of the fine particles of bran, germ and very little of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual commercial process of milling.

Gray Shorts (*Gray Middlings or Total Shorts*) consists of the fine particles of the outer bran, the inner bran or bee-wing bran, the germ, and the offal or fibrous material obtained from the "tail of the mill." This product must be obtained in the usual process of commercial milling.

White Shorts or White Middlings consists of a small portion of the fine bran particles and the germ and a large portion of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual process of flour milling.

Twenty-two samples were analyzed and no deficiencies of protein or of fat, and no excesses of fiber, so far as statements of fiber are recorded, were found. The average composition as regards protein, fiber and fat is practically the same as observed in last year's inspection, but an advance in price of $6.00 per ton is shown.

Mixed Feed.

Wheat Mixed Feed (*Mill Run Wheat Feed*) consists of pure wheat bran and the gray or total shorts of flour middlings combined in the proportions obtained in the usual process of commercial milling.

Ten samples of wheat mixed feed showed an average for protein, fiber and fat of 16.8, 7.3 and 5.1 respectively, which is substantially the composition maintained for several years past. Only one sample contained more than 8.5 per cent of fiber, the tentative standard adopted[1] for this class of wheat products, but the excess was not considerable. The cost per ton is about $5.00 in advance of the price prevailing a year ago.

[1] By the A. F. C. O., 1921.

Rye Products.

Rye Middlings or Rye Feed is the by-product obtained from the manufacture of ordinary "100 per cent." rye flour from cleaned and scoured rye grain.

The two samples of rye products examined exceeded their guaranties for both protein and fat.

Oat Products.

Oat Middlings are the floury portion of the oat groat obtained in the milling of rolled oats.

One sample was analyzed which conformed fully to the guaranty.

Corn Gluten Feed.

Corn Gluten Feed is that portion of commercial shelled corn that remains after the separation of the larger part of the starch and the germs by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

The four samples of this feed were found to satisfy their guaranties in all respects. The average price was $10.00 per ton more than was paid last year.

Corn Gluten Meal.

Corn Gluten Meal is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran, by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Only one sample was examined. It exceeded its guaranty in both protein and fat.

Corn Meal.

Only one sample was examined. It was of normal composition and quality.

Hominy Feed.

Hominy Feed, Hominy Meal or Hominy Chop is the kiln-dried mixture of the mill run bran coating, the mill run germ, with or without a partial extraction of the oil and a part of the starchy portion of the white corn kernel obtained in the manufacture of hominy, hominy grits and corn meal by the degerminating process.

Nine samples were examined and all conformed to their guaranties except **20329**, which wa sslightly deficient (0.26 per cent.) in fat. The average price per ton was $7.00 more than last year.

Distillery and Brewery Products.

One sample of distillers' grains and three of brewers' grains were analyzed. No deficiencies were found except that **20323** was found to contain 0.94 per cent. less curde fat than was claimed.

Dried Beet Pulp.

Dried Beet Pulp is the dried residue from sugar beets which have been cleaned and freed from crowns, leaves and sand, and which have been extracted in the process of manufacturing sugar.

The four samples examined were of satisfactory quality and satisfied their guaranties. The average cost per ton last year was $33.66, while for the corresponding period this year it was over $58.00.

Proprietary Stock Feeds.

To this class of feeding stuffs belong mixtures which are intended to furnish ready mixed a "balanced" ration for various classes of farm animals. Although the guaranteed amounts of the several nutrients may remain constant, the ingredients which make up the mixture will vary depending upon the available supply of basic materials. When these materials are of good quality the results obtained will no doubt justify their use; many of these mixtures are approved by experienced feeders. In many cases the ingredients used in compounding such feeds are stated on the labels and, while this practice is not required in this State, it is a useful guide in feeding practice.

Fifty-five samples were examined this year, and few deficiencies in composition were noted. Three samples, **20319** Elmore, **20301** Delaware and **20290** Red Wing Dairy Ration, were deficient in protein by amounts exceeding 1 per cent. A number of others were deficient in fat, but the amounts did not exceed 0.5 per cent., except in **20340** Pennant, **20356** Davis and **20333** Red Wing Growing Feed, where the shortages were 0.63, 1.17 and 0.69 per cent. in the order named.

Poultry Feeds.

Nineteen samples of poultry feeds were analyzed, all of which conformed to their guaranties for protein and fat.

SUMMARY OF DEFICIENCIES.

In Table II is given a summary of those feeds found deficient in nutrients as compared with their guaranties. Only variations greater than 1 per cent. in protein and fiber and one-fourth per cent. in fat are noted.

Attention is called to two corrections which should be made in Table II of Bulletin 238 (being the Report of this Station on Commercial Feeding Stuffs for 1921).

Item under *Wheat Feed* (Mixed Feed) should read: **15722** Wirthmore, St. Albans Grain Co., St. Albans Vt.....0.30.

Item under *Poultry Feeds* should read: **18008** Chick-Chuck. Russia Cement Co., Gloucester, Mass. 5.75 0.38 ....

These corrections have already been acknowledged and notice thereof distributed with Station Bulletin 241. They are repeated here to reach those readers more particularly interested.

MISCELLANEOUS SAMPLES.

Partial or complete analyses of feeding stuffs submitted by individuals during the past year are given in Table IV. This station is not responsible for the sampling of these materials but only for the accuracy of the analyses of the samples as received by us. We are justified in making such examinations only insofar as they may be of public interest and concern, and to this end as complete information as may be given should accompany samples thus submitted; that is to say, brand, name, manufacturer and guaranty should be stated if known. Most of the samples thus examined were for the purpose of checking guaranties or for information to be used in the compounding of rations.

Eight samples, not included in Table IV, were examined for foreign or injurious substances. Some of these were poultry feeds suspected of having caused the death of fowls or chicks. Complaints of this kind cannot be satisfactorily answered by chemical tests unless conspicuously toxic substances can be detected, which is seldom the case. In our experience such substances have been found only in cases of accidental contamination or of malicious or revengeful intent.

TABLE II. FEEDS NOT CONFORMING TO GUARANTIES OR OTHERWISE ILLEGAL.

Station No.	Manufacturer and Brand	Protein Deficiency	Fat Deficiency	Fiber Excess	Remarks
	COTTONSEED MEAL.	%	%	%	
20317	Paramount. Ashcraft-Wilkinson Co., Atlanta, Ga.	...	...	...	Wire tags, illegal.
20345	Owl. F. W. Brode & Co., Memphis, Tenn.	...	...	...	Wire tags, illegal.
	WHEAT BRAN.				
20236	Bell Cow. The Quaker Oats Co., Chicago, Ill.	...	...	1.52	.....
	HOMINY.				
20329	Plymouth. Plymouth Milling Co., Lemars, Iowa	...	0.26	...	.....
	BREWERS' PRODUCTS.				
20323	Dried Grains. Fleischmann Co., Peekskill, N. Y.	...	0.94	...	.....
	PROPRIETARY MIXED FEEDS.				
20322	Elmore Calf Meal. Elmore Milling Co., Oneonta, N. Y.....	...	0.33	...	.....
20319	Elmore Horse Feed. Elmore Milling Co., Oneonta, N. Y....	1.25	...	...	.....
20272	Riverdale Dairy Ration. Arcady Farms Milling Co., Chicago, Ill.	...	0.34	...	.....
20249	Basic Dairy Ration. R. G. Davis & Sons, New Haven.....	...	0.45	...	.....
20301	Delaware Dairy Feed. Delaware Mills, Deposit, N. Y.....	1.50	...	...	.....
20290	Red Wing Dairy Ration. Meech & Stoddard, Inc., Middletown	1.94	...	...	.....
20340	Pennant Stock Feed. E. W. Bailey & Co., Swanton, Vt.....	...	0.63	...	.....
20356	Davis Stock Feed. R. G. Davis, New Haven	...	1.17	...	.....
20372	Haskell's Stock Feed. Haskell Mills, Toledo, Ohio	...	0.35	...	.....
20333	Red Wing Growing Feed. Meech & Stoddard, Inc., Middletown	...	0.69	...	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	OIL SEED PRODUCTS.	
	Cottonseed Meal.	
20367	Longhorn. American Cotton Oil Co., Memphis, Tenn.	*Willimantic*: Willimantic Grain Co...
		Guaranty
20227	Surety. American Cotton Oil Co., Memphis, Tenn.	*East Haven*: F. A. Forbes
		Guaranty
20280	Monarch. Ashcraft-Wilkinson Co., Atlanta, Ga.	*New Milford*: Geo. E. Ackley Co....
		Guaranty
20317	†Paramount. Ashcraft-Wilkinson Co., Atlanta, Ga.	*Rockville*: Rockville Grain & Coal Co
		Guaranty
20345	†Owl Brand 43. F. W. Brode & Co., Memphis, Tenn.	*Winsted*: E. Manchester & Sons ....
		Guaranty
20370	Bull. Humphreys-Godwin Co., Memphis, Tenn.	*Yantic*: Yantic Grain & Products Co.
		Guaranty
20330	Danish. Humphreys-Godwin Co., Memphis, Tenn.	*Hartford:* Garber-Northam Grain Co.
		Guaranty
20267	Dixie. Humphreys-Godwin Co., Memphis, Tenn.	*Danbury*: H. E. Meeker
		Guaranty
20189	Thirty-Six. L. B. Lovitt & Co., Memphis, Tenn.	*Storrs*: Conn. Agr. College
		Guaranty
20335	Thirty-Six. L. B. Lovitt & Co., Memphis, Tenn.	*Middletown*: Meech & Stoddard, Inc.
		Guaranty
20297	Economy. Lyle & Lyle, Huntsville, Ala.	*Plantsville*: C. A. Cowles
		Guaranty
20305	Marianna. Marianna Cotton Oil Co., Marianna, Ark.	*Bristol*: Goodsell Bros.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Linseed Meal, Old Process.	
20276	American Linseed Co., Buffalo, N. Y.	*New Milford*: Geo. T. Soule
		Guaranty
20315	Amco. American Milling Co., Peoria, Ill.	*Rockville*: Rockville Grain & Coal Co.
		Guaranty
20294	Archer Daniels Linseed Co.. Buffalo, N. Y.	*West Cheshire*: G. W. Thorpe
		Guaranty
20257	Kellogg & Miller, Amsterdam, N. Y...	*Norwalk*: C. E. Slauson Co.
		Guaranty
20233	Mann Bros. Co., Buffalo, N. Y.	*Guilford*: F. C. Morse
		Guaranty
20253	Midland Linseed Products Co., Toledo, O.	*Southport*: C. Buckingham & Co....
		Guaranty
20328	Spencer Kellogg & Sons, Buffalo, N. Y.	*Thompsonville*: Geo. S. Phelps & Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible

† Wire tags.

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Station No.	Pounds per Hundred. Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	Price per ton
20367	6.27	6.43	45.00	7.96	27.14	7.20	$61.00
.....	...	...	43.00	12.00	25.00	6.00	.....
20227	6.93	5.96	36.00	13.52	30.82	6.77	57.00
.....	...	...	36.00	14.00	27.00	5.50	.....
20280	5.19	7.04	44.00	7.50	28.62	7.65	60.00
.....	...	...	43.00	10.00	18.00	6.00	.....
20317	6.66	6.02	37.63	12.65	31.24	5.80	62.00
.....	...	...	36.00	14.00	27.00	5.50	.....
20345	5.83	7.01	42.56	10.02	27.66	6.92	60.00
.....	...	...	43.00	10.00	22.00	6.00	.....
20370	7.00	6.69	45.00	7.88	26.67	6.76	64.00
.....	...	...	43.00	10.00	26.00	5.00	.....
20330	6.73	5.75	35.63	14.42	31.33	6.14	62.00
.....	...	...	36.00	15.00	25.00	5.00	.....
20267	7.22	6.62	40.44	9.01	29.15	7.56	59.00
.....	...	...	41.00	10.00	26.00	5.00	.....
20189	6.93	5.85	35.81	12.50	32.97	5.94	.....
.....	...	...	36.00	....	....	5.00	.....
20335	6.60	5.55	36.31	13.80	32.22	5.52	55.50
.....	...	...	36 00	14.00	28.50	5.00	.....
20297	7.92	5.85	35.75	12.71	31.83	5.94	55.00
.....	...	...	36.00	14.00	27.00	5.00	.....
20305	6.89	6.12	36.25	12.96	31.84	5.94	56.00
.....	...	...	36.00	14.00	28.50	5.75	.....
.....	...	...	**38.75**	**12.44**	**25.45**	**5.39**	.....
.....	**6.68**	**6.24**	**39.20**	**11.24**	**30.13**	**6.51**	**59.22**
.....	...	...	**33.0**	**4.2**	**22 6**	**6.2**	.....
20276	8.60	5.68	35.00	7.16	37.89	5.67	55.00
.....	...	...	32.00	....	....	5.00	.....
20315	8.99	5.70	33.00	8.36	37.72	6.23	62.00
.....	...	...	30.00	....	....	5.00	.....
20294	9.12	4.90	34.63	8.13	36.99	6.23	62.00
.....	...	...	34.00	....	....	5.00	.....
20257	7.61	6.03	33.31	7.81	38.10	7.14	65.00
.....	...	...	30.00	....	....	4.00	.....
20233	9.12	5.87	33.06	7.46	36.88	7.61	58.00
.....	...	...	31.00	10.00	....	6.00	.....
20253	9.62	5.70	34.31	7.26	36.63	6.48	62.00
.....	...	...	30.00	....	....	5.00	.....
20328	8.25	5.75	34.13	7.43	38.62	5.82	64.00
.....	...	...	31.00	....	....	5.00	.....
.....	...	...	**31.14**	....	....	**5.00**	.....
.....	**8.76**	**5.66**	**33.92**	**7.66**	**37.55**	**6.45**	**61.14**
.....	...	...	**30.2**	**4.4**	**29.3**	**5.8**	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	WHEAT PRODUCTS.	
	Wheat Bran.	
20342*	Cataract City Milling Co., Niagara Falls, N. Y.	*Granby*: E. H. Rollins
		Guaranty
20289*	Choice. Hecker-Jones-Jewell Milling Co., New York	*Meriden*: Meriden Grain & Coal Co.
		Guaranty
20293*	Lakewood's. Lake of the Woods Milling Co., Montreal, Can.	*West Cheshire*: G. W. Thorpe
		Guaranty
20366	Maple Leaf Milling Co., Toronto, Can.	*Willimantic*: Willimantic Grain Co...
		Guaranty
20303	Niagara. Niagara Falls Milling Co., Niagara Falls, N. Y.	*Bristol*: Goodsell Bros.
		Guaranty
20231	Ogilvie Flour Mills Co., Montreal, Can.	*Branford*: S. V. Osborn
		Guaranty
20369*	Pillsbury Mills, Minneapolis, Minn....	*Willimantic*: Willimantic Grain Co...
		Guaranty
20236	Bell Cow. Quaker Oats Co., Chicago	*Hamden*: I. W. Beers
		Guaranty
20337*	Red Wing. Red Wing Milling Co., Red Wing, Minn.	*Middletown*: Meech & Stoddard, Inc.
		Guaranty
20188*	Red Wing Special. Red Wing Milling Co., Red Wing, Minn.	*Storrs*: Conn. Agr. College
		Guaranty
20381*	Washburn-Crosby Co., Minneapolis, Minn.	*Mystic*: Mystic Grain Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Wheat Middlings.	
20281*	E-A-Co. Everett Aughenbaugh & Co., Waseca, Minn.	*North Haven*: Wm. L. Thorpe
		Guaranty
20226*	Dominion Flour Mills, Montreal, Can.	*East Haven*: F. A. Forbes
		Guaranty
20338*	Dominion Flour Mills, Montreal, Can.	*Middletown*: Meech & Stoddard, Inc.
		Guaranty
20321	Snow. Elmore Milling Co., Oneonta, N. Y.	*Somers*: W. C. Everett
		Guaranty
20288*	Hecker-Jones-Jewell Milling Co., New York	*Meriden*: Meriden Grain & Coal Co.
		Guaranty
20348*	W. J. Jennison Co,. Minneapolis, Minn.	*Winsted*: E. Manchester & Sons....
		Guaranty
20246*	Rex Grey. Kehlor Flour Mills Co., St. Louis, Mo.	*Ansonia*: Ansonia Flour & Grain Co.
		Guaranty
20244*	Lakewood's. Lake of the Woods Milling Co., Montreal, Can.	*Ansonia*: Ansonia Flour & Grain Co.
		Guaranty

* With screenings.

INSPECTION OF 1922—*Continued.*

Station No.	Pounds per Hundred.						Price per ton
	Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	
20342	7.49	6.08	16.75	9.05	55.39	5.24	33.00
.....	...	...	14.00	....	....	4.20	.....
20289	9.03	6.20	14.88	9.56	55.11	5.22	38.00
.....	...	...	14.50	14.00	48.50	3.50	.....
20293	10.20	5.91	16.13	9.96	51.99	5.81	35.00
.....	...	...	15.00	....	....	3.50	.....
20366	8.75	5.01	18.00	9.51	52.71	6.02	36.00
.....	...	...	15.00	....	....	4.50	.....
20303	8.70	6.33	16.94	9.37	53.30	5.36	36.00
.....	...	...	15.00	....	....	3.50	.....
20231	9.79	5.50	16.88	9.51	52.71	5.61	35.00
.....	...	...	14.00	10.00	....	3.00	.....
20369	9.19	6.19	16.75	9.97	53.00	4.90	36.00
.....	...	...	14.00	....	....	4.00	.....
20236	9.46	5.72	16.00	9.12	54.26	5.44	37.00
.....	...	...	15.30	7.60	56.00	5.50	.....
20337	7.20	6.03	15.63	9.68	55.79	5.67	36.00
.....	...	...	13.50	....	....	4.00	.....
20188	9.16	6.86	16.25	9.13	53.25	5.35	....
.....	...	...	13.50	....	....	4.00	.....
20381	9.12	5.84	15.94	9.65	53.91	5.54	.....
.....	...	...	14.00	....	....	4.00	.....
.....	...	...	14.35	....	....	3.97	.....
.....	8.92	5.97	16.38	9.50	53.76	5.47	35.78
.....	...	...	12.4	4.1	39.8	3.4	.....
20281	8.70	4.66	16.50	8.46	56.89	4.79	38.00
.....	...	...	15.00	....	....	3.00	.....
20226	10.20	4.19	17.50	7.01	55.36	5.74	37.00
.....	...	...	15.00	8.00	....	4.00	.....
20338	9.85	4.14	18.56	7.17	53.96	6.32	37.00
.....	...	...	15.00	....	....	4.00	.....
20321	9.11	4.10	17.50	5.91	58.26	5.12	40.00
.....	...	...	17.00	....	....	4.00	.....
20288	8.38	4.66	16.63	8.47	56.04	5.82	38.00
.....	...	...	15.50	10.00	52.30	4.50	.....
20348	9.55	3.84	16.63	5.76	58.77	5.45	43.00
.....	...	...	16.50	....	....	4.50	.....
20246	10.21	3.94	18.25	4.45	59.30	3.85	40.00
.....	...	...	16.00	5.50	56.00	3.50	.....
20244	10.40	4.20	18.38	6.88	54.32	5.82	40.00
.....	...	...	16.00	....	....	5.00	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	WHEAT PRODUCTS—*Continued.*	
	Wheat Middlings—Concluded.	
20252*	Rex. Maple Leaf Milling Co., Toronto, Can.	*Southport*: C. Buckingham & Co.
		Guaranty
20384*	Millbourne Mills, Philadelphia, Pa.	*New London*: P. Swartz Co.
		Guaranty
20235*	National Milling Co., Toledo, Ohio	*Guilford*: F. C. Morse
		Guaranty
20327*	Niagara. Niagara Falls Milling Co., Niagara Falls, N. Y.	*Thompsonville*: Geo. S. Phelps & Co.
		Guaranty
20232*	Ogilvie Flour Mills Co., Montreal, Can.	*Branford*: S. V. Osborn
		Guaranty
20373*	Pembroke Milling Co., Pembroke, Ont.	*Yantic*: Yantic Grain & Products Co.
		Guaranty
20275	A. Pillsbury Mills, Minneapolis, Minn.	*New Milford*: Geo. T. Soule
		Guaranty
20237	B. Pillsbury Mills, Minneapolis, Minn.	*Hamden*: I. W. Beers
		Guaranty
20357	XX Daisy. Pillsbury Mills, Minneapolis, Minn.	*New Haven*: R. G. Davis & Sons, Inc.
		Guaranty
20240*	Bell Cow. Quaker Oats Co., Chicago, Ill.	*Orange*: E. D. Meade & Co.
		Guaranty
20263	Red Wing. Red Wing Milling Co., Red Wing, Minn.	*Stamford*: W. L. Crabb
		Guaranty
20352*	Blue Moose Robin Hood Mills. Galgary, Can.	*Torrington*: F. L. Wadhams & Sons.
		Guaranty
20295*	Gold Medal. Washburn-Crosby Co., Minneapolis, Minn.	*West Cheshire*: G. W. Thorpe
		Guaranty
20286*	Standard. Washburn-Crosby Co., Minneapolis, Minn.	*Wallingford*: A. E. Hall
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Wheat Feed (Mixed Feed).	
20354*	Fancy. Bay State Milling Co., Winona, Minn.	*Torrington*: D. L. Talcott
		Guaranty
20344*	C. W. Brister & Son, Auburn, N. Y.	*Granby*: E. H. Rollins
		Guaranty
20316	Boston. Duluth Superior Mills, Duluth, Minn.	*Rockville*: Rockville Grain & Coal Co.
		Guaranty
20239	National Milling Co., Toledo, Ohio.	*Orange*: E. D. Mead & Co.
		Guaranty
20243	Niagara. Niagara Falls Milling Co., Niagara Falls, N. Y.	*Derby*: Peterson & Hendee
		Guaranty
20251*	Fancy. Pillsbury Mills, Minneapolis, Minn.	*Southford*: H. R. Stone
		Guaranty

* With screenings.

INSPECTION OF 1922—*Continued.*

Station No.	Pounds per Hundred. Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	Price per ton
20252	10.15	4.51	17.88	8.23	53.61	5.62	$36.00
.....	...	...	16.00	....	....	5.50	.....
20384	10.60	3.98	16.13	4.92	60.10	4.27	40.00
.....	...	...	15.00	8.00	....	4.00	.....
20235	8.56	4.65	17.63	6.19	57.59	5.38	36.00
.....	...	...	17.00	....	....	3.50	.....
20327	10.05	4.19	17.75	6.76	55.77	5.48	37.00
.....	...	...	15.50	....	....	3.50	.....
20232	9.72	4.05	18.25	7.69	54.65	5.64	36.00
.....	...	...	15.00	....	....	4.00	.....
20373	10.79	4.47	17.69	5.63	56.01	5.41	36.00
.....	...	...	15.00	8.00	....	4.00	.....
20275	9.10	3.82	17.25	5.24	59.47	5.12	40.00
.....	...	...	16.00	....	....	4.00	.....
20237	9.70	5.08	17.25	8.21	54.95	4.81	38.00
.....	...	...	15.00	....	....	4.00	.....
20357	10.50	3.03	19.25	2.85	60.26	4.11	43.00
.....	...	...	16.00	....	....	4.00	.....
20240	9.69	3.77	17.81	6.41	56.97	5.35	37.00
.....	...	...	16.00	....	....	4.00	.....
20263	10.49	4.66	17.88	6.98	53.88	6.11	34.00
.....	...	...	15.00	....	....	5.00	.....
20352	8.75	4.83	19.75	7.59	52.75	6.33	36.00
.....	...	...	17.00	....	....	4.50	.....
20295	10.40	4.72	17.63	6.87	54.91	5.47	35.00
.....	...	...	15.00	....	....	4.00	.....
20286	10.24	4.32	18.00	6.68	55.41	5.35	34.00
.....	...	...	15.00	....	....	4.00	.....
.....	...	...	**15.66**	....	....	**4.11**	.....
.....	**9.78**	**4.26**	**17.73**	**6.56**	**56.34**	**5.33**	**37.77**
.....	...	...	**13.7**	**2.0**	**43.9**	**4.7**	.....
20354	7.50	4.94	16.38	6.21	59.92	5.05	41.00
.....	...	...	14.60	....	....	4.30	.....
20344	10.37	4.77	16.00	6.80	58.14	3.92	35.00
.....	...	...	12.00	10.00	....	3.00	.....
20316	8.84	5.01	18.06	7.02	55.88	5.19	38.00
.....	...	...	15.00	....	....	4.00	.....
20239	9.89	6.11	16.31	7.86	55.40	4.43	39.00
.....	...	...	15.00	....	....	3.75	.....
20243	9.41	5.02	16.88	7.17	56.97	4.55	39.00
.....	...	...	14.50	....	....	2.50	.....
20251	9.43	4.46	17.13	6.43	57.41	5.14	37.00
.....	...	...	15.00	....	....	4.00	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	WHEAT PRODUCTS—*Concluded.*	
	Wheat Feed (Mixed Feed)—Concluded.	
20326*	Richardton Milling Co., Richardton, No. Dakota	*Thompsonville*: Geo. S. Phelps & Co.
		Guaranty
20268	Occident. Russell Miller Milling Co., Minneapolis, Minn.	*Danbury*: H. E. Meeker
		Guaranty
20245	Gold Mine. Sheffield King Milling Co., Minneapolis, Minn.	*Ansonia*: Ansonia Flour & Grain Co.
		Guaranty
20309*	Washburn-Crosby Co., Minneapolis, Minn.	*Manchester*: Little & McKinney
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	RYE PRODUCTS.	
20353	Rye Middlings. Washburn-Crosby Co., Minneapolis, Minn.	*Torrington*: F. L. Wadhams & Sons.
		Guaranty
20300	Irving Mills Rye Feed. Van Vechten Milling Co., Rochester, N. Y.	*Plantsville*: C. A. Cowles
		Guaranty
	OAT PRODUCTS.	
20346	Oat Middlings. Armour Grain Co., Chicago, Ill.	*Winsted*: E. Manchester & Sons
		Guaranty
	MAIZE PRODUCTS.	
	Corn Gluten Feed.	
20277	Buffalo. Corn Products Refining Co., New York	*New Milford*: Geo. T. Soule
		Guaranty
20363	KKK. J. C. Hubinger Bros. Co., Keokuk, Iowa	*New Haven*: Crittenden-Benham Co.
		Guaranty
20307	Douglas. Penick & Ford, Inc., Cedar Rapids, Iowa	*Plainville*: Eaton Bros.
		Guaranty
20242	A. E. Staley Mfg. Co., Decatur, Ill.	*Derby*: Peterson & Hendee
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Corn Gluten Meal.	
20313	Diamond. Corn Products Refining Co., New York	*Rockville*: Rockville Milling Co.
		Guaranty
	Corn Meal.	
20190	Meech & Stoddard, Inc., Middletown.	*Storrs*: Conn. Agr. College
	Hominy Feed.	
20282	Homco. American Hominy Co., Indianapolis, Ind.	*North Haven*: Wm. L. Thorpe
		Guaranty

INSPECTION OF 1922—*Continued.*

Station No.	Pounds per Hundred. Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	Price per ton
20326	7.30	5.78	19.69	8.07	53.37	5.79	$37.00
.....	...	...	15.00	....	....	4.00	.....
20268	9.24	5.04	16.38	7.62	55.68	6.04	40.00
.....	...	...	15.00	....	....	4.50	.....
20245	10.01	5.19	15.38	8.85	55.09	5.48	38.00
.....	...	...	15.00	....	....	4.50	.....
20309	10.04	4.77	16.00	7.01	57.26	4.92	38.00
.....	...	...	15.00	....	....	4.00	.....
.....	...	...	14.61	....	....	3.86	.....
.....	9.20	5.11	16.82	7.30	56.52	5.05	38.20
.....	...	...	13.0	2.6	43.0	4.4	.....
20353	10.14	4.20	17.25	5.16	59.86	3.39	38.00
.....	...	...	14.00	....	....	3.00	.....
20300	9.72	3.50	15.50	3.27	65.08	2.93	35.00
.....	...	...	13.00	....	....	2.00	.....
20346	6.98	4.32	15.00	9.82	58.07	5.81	44.00
.....	...	...	15.00	10.00	....	5.00	.....
20277	8.73	5.07	26.25	6.84	50.15	2.96	48.00
.....	...	...	23.00	....	....	1.00	.....
20363	5.85	1.70	23.88	7.37	56.01	5.19	50.00
.....	...	...	23.00	7.50	....	2.40	.....
20307	7.17	4.55	29.50	5.61	50.48	2.69	48.00
.....	...	...	23.00	....	....	1.00	.....
20243	6.87	4.55	26.94	5.63	53.42	2.59	49.00
.....	...	...	23.00	....	....	1.00	.....
.....	...	...	23.00	....	....	1.32	.....
.....	7.16	3.97	26.64	6.36	52.52	3.35	48.75
.....	...	...	22.6	4.8	46.2	2.8	.....
20313	9.56	1.87	40.63	2.32	43.63	1.99	58.00
.....	...	...	40.00	....	....	1.00	.....
20190	11.59	1.48	9.88	1.88	71.41	3.78	.....
20282	6.71	2.73	12.25	4.15	65.65	8.51	40.00
.....	...	...	10.00	6.00	....	6.00	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS.

Station No.	Manufacturer and Brand	Retail Dealer
	MAIZE PRODUCTS—*Concluded.*	
	Hominy Feed—Concluded.	
20359	Yellow. Armour Grain Co., Chicago, Ill.	*New Haven*: R. G. Davis & Sons, Inc.
		Guaranty
20250	Aunt Jemima Mills. St. Joseph, Mo..	*Southford*: H. R. Stone
		Guaranty
20258	B.C. Kellogg Toasted Corn Flake Co., Battle Creek, Mich.	*Norwalk:* C. E. Slauson Co.
		Guaranty
20265	Maizco. Miller Cereal Mills, Omaha, Neb.	*Stamford*: W. L. Crabb
		Guaranty
20284	Choice Steam Cooked. Miner-Hillard Milling Co., Wilkes-Barre, Pa.	*Wallingford*: A. E. Hall
		Guaranty
20374	National Feed Co., St. Louis, Mo.	*Yantic*: Yantic Grain & Products Co.
		Guaranty
20329	Plymouth Milling Co., Lemars, Iowa.	*Hartford*: Garber-Northam Grain Co.
		Guaranty
20229	Burt's. Postum Cereal Co., Inc., Battle Creek, Mich.	*Branford*: S. V. Osborn
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Miscellaneous.	
20349	Dried Corn Flake Feed. Kellogg Toasted Corn Flake Co., Battle Creek, Mich.	*Winsted*: E. Manchester & Sons
		Guaranty
	DISTILLERS' PRODUCTS.	
20347	Distillers' Dried Grains. Rossville Co., Lawrenceburg, Ind.	*Winsted*: E. Manchester & Sons
		Guaranty
	BREWERS' PRODUCTS.	
20362	Malt Feed. Clover Leaf Milling Co., Buffalo, N. Y.	*New Haven*: Crittenden-Benham Co.
		Guaranty
20325	Bull. Farmers Feed Co., Buffalo, N. Y.	*Thompsonville*: Geo. S. Phelps & Co.
		Guaranty
20323	Dried Grains. Fleischmann Co., Peekskill, N. Y.	*Hazardville*: A. D. Bridge's Sons
		Guaranty
	DRIED BEET PULP.	
20383	The Larrowe Milling Co., Detroit, Mich.	*New London*: P. Swartz Co.
		Guaranty
20336	Meech & Stoddard, Inc., Middletown.	*Middletown*: Meech & Stoddard, Inc.
		Guaranty
20365	The Ubiko Milling Co., Cincinnati, Ohio	*Willimantic*: Willimantic Grain Co..
		Guaranty
20376	Yantic Grain & Products Co., Yantic	*Yantic*: Yantic Grain & Products Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible

INSPECTION OF 1922—*Continued.*

Station No.	Pounds per Hundred.						Price per ton
	Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	
20359	8.80	3.13	12.25	5.42	62.36	8.04	$42.00
.....	...	...	9.50	5.00	68.00	5.00	.....
20250	9.50	2.77	11.44	4.06	67.26	4.97	38.00
.....	...	...	10.00	....	....	5.00	.....
20258	7.08	2.55	11.63	4.16	66.78	7.80	45.00
.....	...	...	10.00	5.00	55.00	6.00	.....
20265	7.87	2.79	12.00	4.89	64.30	8.15	38.00
.....	...	...	10.00	....	....	7.00	.....
20284	9.06	2.28	11.88	3.79	67.71	5.28	39.00
.....	...	...	10.00	....	....	4.00	.....
20374	7.51	2.79	11.38	3.46	66.38	8.48	40.00
.....	...	...	10.00	10.00	....	5.00	.....
20329	8.39	2.35	11.38	3.83	65.81	8.24	46.00
.....	...	...	10.00	....	....	8.50	.....
20229	9.62	2.66	12.00	3.85	65.64	6.23	37.00
.....	...	...	10.00	5.00	60.00	6.00	.....
.....	...	...	9.94	....	....	5.83	.....
.....	8.29	2.67	11.80	4.18	65.78	7.28	40.55
.....	...	...	7.8	3.2	59.2	6.6	.....
20349	5.47	3.77	9.88	1.42	75.90	3.56	34.00
.....	...	...	6.91	0.42	78.62	2.15	.....
20347	4.96	3.65	31.31	8.95	39.94	11.19	59.00
.....	...	...	30.00	13.00	....	10.00	.....
20362	4.29	3.00	26.38	9.95	49.22	7.16	47.00
.....	...	...	26.00	12.50	46.50	5.20	.....
20325	5.30	3.66	25.50	9.23	49.20	7.11	45.00
.....	...	...	21.00	12.00	....	5.30	.....
20323	5.73	2.70	17.63	18.05	50.83	5.06	30.00
.....	...	...	17.00	21.00	....	6.00	.....
20383	8.82	3.31	9.75	18.65	57.98	1.49	58.00
.....	...	...	8.00	20.00	58.00	0.50	.....
20336	6.79	4.55	8.06	19.42	60.56	0.62	55.00
.....	...	...	8.00	....	....	0.50	.....
20365	4.55	2.27	10.13	19.47	62.72	0.86	60.00
.....	...	...	8.00	20.00	60.00	0.50	.....
20376	7.58	3.68	8.19	18.45	61.46	0.64	60.00
.....	...	...	8.00	....	....	0.50	.....
.....	...	...	8.00	....	....	0.50	.....
.....	6.93	3.45	9.03	18.99	60.70	0.90	58.22
.....	...	...	4.7	15.8	50.4	....	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	PROPRIETARY MIXED FEEDS. *Horse, Dairy and Stock Feeds.*	
20332	Blatchford's Calf Meal. Blatchford Calf Meal Co., Wauregan, Ill.	*Hartford*: Meech Grain Co. ..... Guaranty .....
20322	Elmore Calf Meal. Elmore Milling Co., Oneonta, N. Y.	*Somers*: W. C. Everett ..... Guaranty .....
20311	Ryde's Cream Calf Meal. Ryde & Co., Chicago, Ill.	*Manchester*: Little & McKinney .... Guaranty .....
20261	Armour's Horse Feed. Armour Grain Co., Chicago, Ill.	*Stamford*: W. L. Crabb ..... Guaranty .....
20273	Iroquois Horse Feed. Armour Grain Co., Chicago, Ill.	*Danbury*: F. C. Benjamin ..... Guaranty .....
20319	Elmore Horse Feed. Elmore Milling Co., Oneonta, N. Y.	*Somers*: W. C. Everett ..... Guaranty .....
20271	Arcady Dairy Feed. Arcady Farm Milling Co., Chicago, Ill.	*Danbury*: F. C. Benjamin ..... Guaranty .....
20272	Riverdale Dairy Ration. Arcady Farms Milling Co., Chicago, Ill. ..	*Danbury*: F. C. Benjamin ..... Guaranty .....
20377	Dairy Feed. C. W. Campbell Co., Westerly, R. I.	*Mystic*: J. L. Manning ..... Guaranty .....
20270	Ajax Dairy Ration. Chapin & Co., Hammond, Ind.	*Danbury*: F. C. Benjamin ..... Guaranty .....
20283	Paragon. Chas. M. Cox Co., Boston.	*North Haven*: Wm. L. Thorpe ..... Guaranty .....
20249	Basic Dairy Ration. R. G. Davis & Sons, Inc., New Haven, Conn.....	*Southford*: H. R. Stone ..... Guaranty .....
20301	Delaware Dairy Feed. Delaware Mills, Deposit, N. Y.	*Plantsville*: C. A. Cowles ..... Guaranty .....
20318	Elmore Milk Grain. Elmore Milling Co., Oneonta, N. Y.	*Somers*: W. C. Everett ..... Guaranty .....
20247	Eshelman's 20 Dairy Feed. John W. Eshelman & Son, Lancaster, Pa...	*Seymour*: Seymour Grain & Coal Co. Guaranty .....
20355	Eshelman's 25 Dairy Feed. John W. Eshelman & Son, Lancaster, Pa....	*Torrington*: D. L. Talcott ..... Guaranty .....
20368	Grandin's Twin Six Dairy Feed. D. H. Grandin, Jamestown, N. Y.	*Willimantic*: Willimantic Grain Co... Guaranty .....
20299	H-O Algrane Feed. The H-O Cereal Co., Inc., Buffalo, N. Y.	*Plantsville*: C. A. Cowles ..... Guaranty .....
20302	Kramco Dairy Ration. C. A. Krause Milling Co., Milwaukee, Wis.	*Plantsville*: C. A. Cowles ..... Guaranty .....
20260	Larro Ready Ration. Larrowe Milling Co., Detroit, Mich.	*Norwalk*: C. E. Slauson Co..... Guaranty .....
20350	Red Star Dairy Feed. E. Manchester & Sons, Winsted	*Winsted*: E. Manchester & Sons .... Guaranty .....
20334	Barford's Balanced Dairy Ration. Meech & Stoddard, Inc., Middletown	*Middletown*: Meech & Stoddard, Inc. Guaranty .....

INSPECTION OF 1922—*Continued.*

Station No.	Pounds per Hundred. Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	Price per ton
20332	9.63	5.90	24.44	5.99	48.93	5.11	$96.00
.....	...	...	24.00	....	....	5.00	.....
20322	9.33	4.05	24.56	2.74	54.65	4.67	95.00
.....	...	...	24.00	....	....	5.00	.....
20311	8.68	5.21	24.75	6.95	49.60	4.81	95.00
.....	...	...	25.00	....	....	5.00	.....
20261	7.78	4.90	12.31	9.11	60.69	5.21	39.00
.....	...	...	11.00	....	....	4.00	.....
20273	5.65	4.85	10.38	9.84	66.23	3.05	45.00
.....	...	...	10.00	....	....	2.00	.....
20319	8.16	4.18	8.75	12.00	63.61	3.30	38.00
.....	...	...	10.00	12.00	....	3.00	.....
20271	7.63	8.27	17.63	11.70	49.19	5.58	38.00
.....	...	...	16.00	....	....	3.50	.....
20272	7.64	4.62	25.13	7.42	50.53	4.66	52.00
.....	...	...	24.00	....	....	5.00	.....
20377	9.35	3.61	21.00	5.88	55.07	5.09	46.00
.....	...	...	20.00	8.00	....	4.00	.....
20270	8.49	5.79	27.06	8.13	44.05	6.48	51.00
.....	...	...	20.00	....	....	5.00	.....
20283	7.92	4.16	24.50	9.80	49.62	4.00	46.00
.....	...	...	22.00	....	....	4.00	.....
20249	9.31	5.48	21.00	8.11	51.55	4.55	46.00
.....	...	...	20.00	9.00	50.00	5.00	.....
20301	8.10	5.16	21.50	8.72	51.51	5.01	52.00
.....	...	...	23.00	....	....	4.00	.....
20318	7.55	4.58	25.13	9.28	47.48	5.98	52.00
.....	...	...	25.00	11.00	....	6.00	.....
20247	5.42	6.99	22.63	8.12	52.91	3.93	45.00
.....	...	...	20.00	....	....	4.00	.....
20355	7.92	5.37	27.19	7.76	46.35	5.41	54.00
.....	...	...	25.00	12.00	....	5.00	.....
20368	8.34	4.76	22.00	8.93	50.60	5.37	53.00
.....	...	...	22.00	....	....	5.00	.....
20299	6.79	5.43	18.44	10.81	54.53	4.00	39.00
.....	...	...	16.00	15.00	....	4.00	.....
20302	8.24	5.68	21.75	9.35	50.18	4.80	52.00
.....	...	...	20.00	....	....	4.00	.....
20260	7.98	5.71	21.00	10.65	50.10	4.56	57.00
.....	...	...	20.00	....	....	3.50	.....
20350	6.95	5.13	23.00	7.98	51.42	5.52	49.00
.....	...	...	23.00	10.00	....	4.00	.....
20334	7.60	4.42	20.38	8.63	51.29	7.68	53.50
.....	...	...	19.00	....	....	5.50	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	PROPRIETARY MIXED FEEDS—*Continued.*	
	Horse, Dairy and Stock Feeds—Continued.	
20191	Dairy Ration. Meech & Stoddard, Inc., Middletown	*Storrs*: Conn. Agr. College
20290	Red Wing Dairy Ration. Meech & Stoddard, Inc., Middletown	*Meriden*: Meriden Grain & Coal Co.. Guaranty
20324	Stevens 44 Dairy Ration. Park & Pollard Co., Boston	*Hazardville*: A. D. Bridge's Sons... Guaranty
20266	Pillsbury's Dairy Ration. Pillsbury Mills, Minneapolis, Minn.	*New Canaan*: C. H. Fairty Co. Guaranty
20234	Pillsbury's 24 Dairy Feed. Pillsbury Mills, Minneapolis, Minn.	*Guilford*: Fred C. Morse Guaranty
20351	Purina Cow Chow Feed. Purina Mills, St. Louis, Mo.	*Torrington*: F. L. Wadhams & Sons. Guaranty
20312	Big Q Dairy Ration. Quaker Oats Co., Chicago, Ill.	*Rockville*: Rockville Milling Co. Guaranty
20314	Our Own Dairy Feed. Rockville Grain & Coal Co., Rockville	*Rockville*: Rockville Grain & Coal Co. Guaranty
20341	Syragold Dairy Feed. Syracuse Milling Co., Syracuse, N. Y.	*Granby*: E. H. Rollins Guaranty
20255	Red Brand Ti-O-Ga Dairy Feed. Tioga Mill & Elevator Co., Waverly, N. Y.	*Southport*: C. Buckingham & Co.... Guaranty
20298	Unicorn Dairy Ration. Chapin Co., Hammond, Ind.	*Plantsville*: C. A. Cowles Guaranty
20371	Biles Ready Dairy Ration. Ubico Milling Co., Cincinnati, Ohio	*Yantic*: Yantic Grain & Products Co. Guaranty
20380	Favorite Dairy Ration. Westerly Grain & Flour Co., Westerly, R. I.	*Mystic*: Mystic Grain Co. Guaranty
20262	Armour's Steam Cooked Feed. Armour Grain Co., Chicago	*Stamford*: W. L. Crabb Guaranty
20340	Pennant Stock Feed. E. W. Bailey & Co., Swanton, Vt.	*Granby*: E. H. Rollins Guaranty
20274	Wirthmore. Chas. M. Cox Co., Boston	*New Milford*: Geo. T. Soule Guaranty
20356	Davis Stock Feed. R. G. Davis & Sons, Inc., New Haven	*New Haven*: R. G. Davis & Sons, Inc. Guaranty
20269	Grandin's Stock Food. D. H. Gradin Milling Co., Jamestown, N. Y.	*Danbury*: .H E. Meeker Guaranty
20372	Haskell's Stock Feed. Haskell Mills, Toledo, Ohio	*Yantic*: Yantic Grain & Products Co. Guaranty
20379	H-O New England Stock Feed. H-O Cereal Co., Inc., Buffalo, N. Y.	*Mystic*: J. L. Manning Guaranty
20375	Homestead Stock Feed. Illinois Feed & Elev. Co., Bloomington, Ill.	*Yantic*: Yantic Grain & Products Co. Guaranty

INSPECTION OF 1922—*Continued.*

Station No.	Pounds per Hundred. Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	Price per ton
20191	9.64	4.40	18.94	7.32	54.76	4.94	.....
20290	7.64	5.48	22.06	7.78	50.10	6.94	$50.00
.....	...	...	24.00	....	....	6.00	.....
20324	6.04	7.10	25.63	10.44	44.61	6.18	53.00
.....	...	...	24.00	....	....	5.00	.....
20266	8.07	6.40	20.25	9.39	50.70	5.19	52.00
.....	...	...	20.00	....	....	4.00	.....
20234	8.46	4.93	24.88	8.99	47.04	5.70	50.00
.....	...	...	24.00	....	....	5.00	.....
20351	8.43	6.04	24.75	8.87	46.13	5.78	54.00
.....	...	...	24.00	....	....	4.30	.....
20312	7.21	6.38	22.13	9.54	50.07	4.67	50.00
.....	...	...	21.00	....	....	4.50	.....
20314	9.08	5.74	20.88	8.73	51.12	4.45	51.00
.....	...	...	20.00	....	....	4.00	.....
20341	8.57	4.72	25.13	7.67	49.03	4.88	49.00
.....	...	...	24.00	....	....	4.50	.....
20255	8.12	6.05	25.63	7.76	46.45	5.99	50.00
.....	...	...	23.00	10.00	....	3.50	.....
20298	7.95	6.59	25.00	8.40	46.42	5.64	52.00
.....	...	...	24.00	....	....	5.00	.....
20371	8.89	5.05	23.75	7.05	49.52	5.74	54.00
.....	...	...	24.00	10.00	50.00	5.00	.....
20380	8.28	3.62	21.06	6.31	54.74	5.99	45.00
.....	...	...	18.00	9.50	....	4.50	.....
20262	7.33	3.67	10.06	9.79	62.76	6.39	38.00
.....	...	...	9.00	....	....	4.00	.....
20340	8.69	2.92	9.31	8.07	66.64	4.37	37.00
.....	...	...	9.00	10.00	....	5.00	.....
20274	7.70	3.14	10.56	7.03	65.80	5.77	38.00
.....	...	...	9.00	....	....	4.00	.....
20356	8.52	4.89	9.75	12.36	61.65	2.83	36.00
.....	...	...	10.50	....	....	4.00	.....
20269	7.83	3.48	9.88	10.14	63.35	5.32	39.00
.....	...	...	9.00	....	...	3.00	.....
20372	8.30	4.04	10.50	6.32	65.19	5.65	40.00
.....	...	...	8.00	....	....	6.00	.....
20379	8.36	3.99	12.06	9.58	60.81	5.20	40.00
.....	...	...	9.50	9.75	....	4.00	.....
20375	9.21	2.86	9.13	9.93	65.61	3.26	40.00
.....	...	...	9.00	....	....	3.50	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	PROPRIETARY MIXED FEEDS—*Concluded.*	
	Horse, Dairy and Stock Feeds—Concluded.	
20248	Lancaster Stock Feed. Lancaster Mill & Elev. Co., Lancaster, Pa.	*Seymour*: Seymour Grain & Coal Co.
		Guaranty
20279	M. & S. Stock Feed. Meech & Stoddard, Inc., Middletown	*New Milford*: Geo. E. Ackley Co.
		Guaranty
20333	Red Wing Growing Feed. Meech & Stoddard, Inc., Middletown	*Hartford*: Meech Grain Co.
		Guaranty
20339	Red Wing Stock Feed. Meech & Stoddard, Inc., Middletown	*Middletown*: Meech & Stoddard, Inc.
		Guaranty
20241	Fidelity Stock Feed. Nowak Milling Corp., Buffalo, N. Y.	*Derby*: Peterson & Hendee
		Guaranty
20308	Bison Stock Feed. Park & Pollard Co., Boston	*Plainville*: Eaton Bros.
		Guaranty
20331	Growing Feed. Park & Pollard Co., Boston	*Hartford*: Meech Grain Co.
		Guaranty
20228	Schumacher Feed. Quaker Oats Co., Chicago, Ill.	*East Haven*: F. A. Forbes
		Guaranty
20285	Schumacher Sugared Feed. Quaker Oats Co., Chicago, Ill.	*Wallingford*: A. E. Hall
		Guaranty
20291	Richford White Diamond Stock Feed. Quaker Oats Co., Chicago, Ill.	*New Britain*: Stanley Svea Grain Co.
		Guaranty
20256	White Star Stock Feed. Quaker Oats Co., Chicago, Ill.	*Norwalk*: C. E. Slauson Co.
		Guaranty
20254	Syragold Stock Feed. Syracuse Milling Co., Syracuse, N. Y.	*Southport*: C. Buckingham & Co.
		Guaranty
	POULTRY FEEDS.	
20264	Cak-Cak Laying Mash. Armour Grain Co., Chicago, Ill.	*Stamford*: W. L. Crabb
		Guaranty
20360	Iroquois Poultry Mash. Armour Grain Co., Chicago, Ill.	*New Haven*: R. G. Davis & Sons, Inc.
		Guaranty
20378	Nobotheration Dry Mash. C. W. Campbell Co., Westerly, R. I.	*Mystic*: J. L. Manning
		Guaranty
20296	Dry Mash. C. A. Cowles, Plantsville	*Plantsville*: C. A. Cowles
		Guaranty
20230	Wirthmore Buttermilk Mash Feed. Chas. M. Cox Co., Boston	*Branford*: S. V. Osborn
		Guaranty
20358	Davis Buttermilk Mash Feed. R. G. Davis & Sons, Inc., New Haven	*New Haven*: R. G. Davis & Sons, Inc.
		Guaranty
20310	Delaware Laying Mash with Milk. Delaware Mills, Deposit, N. Y.	*Manchester*: Little & McKinney
		Guaranty
20320	Elmore's Egg Mash. Elmore Milling Co., Oneonta, N. Y.	*Somers*: W. C. Everett
		Guaranty

INSPECTION OF 1922—*Continued.*

Station No.	Pounds per Hundred.						Price per ton
	Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	
20248	8.26	3.77	10.13	10.40	62.13	5.31	$38.00
.....	...	...	10.00	....	....	3.00	.....
20279	7.45	5.53	10.50	10.35	61.62	4.55	36.00
.....	...	...	8.00	....	....	3.00	.....
20333	8.35	11.77	20.75	5.32	48.50	5.31	64.00
.....	...	...	10.00	....	....	6.00	.....
20339	6.56	4.72	10.50	9.59	63.15	5.48	39.00
.....	...	...	9.00	....	....	3.00	.....
20241	8.59	4.04	10.63	11.81	60.75	4.18	38.00
.....	...	...	8.00	....	....	3.00	.....
20308	7.79	5.92	9.63	14.69	58.21	3.76	38.00
.....	...	...	8.00	14.00	....	2.00	.....
20331	9.12	7.95	15.50	5.44	57.50	4.49	64.00
.....	...	...	10.00	....	....	1.50	.....
20228	7.78	4.18	10.50	10.42	62.90	4.22	39.00
.....	...	...	10.00	12.00	58.00	3.25	.....
20285	7.11	4.23	10.56	9.47	64.56	4.07	37.00
.....	...	...	10.00	12.00	58.00	3.25	.....
20291	6.91	4.35	9.50	12.73	61.76	4.75	41.00
.....	...	...	8.00	14.00	60.00	3.00	.....
20256	7.53	4.25	8.81	12.89	63.33	3.19	35.00
.....	...	...	8.00	....	....	3.00	.....
20254	8.07	4.98	10.19	11.94	60.97	3.85	37.00
.....	...	...	9.00	....	....	3.00	.....
20264	8.51	6.10	21.38	3.68	54.74	5.59	57.00
.....	...	...	20.00	....	....	3.00	.....
20360	8.61	3.71	17.38	6.12	58.40	5.78	55.00
.....	...	...	15.00	....	....	4.00	.....
20378	7.02	10.20	20.38	7.53	48.39	6.48	60.00
.....	...	...	18.00	....	....	2.00	.....
20296	8.54	8.69	20.19	5.68	50.71	6.19	55.00
.....	...	...	18.00	....	....	5.00	.....
20230	9.33	8.17	20.75	6.13	49.86	5.76	58.00
.....	...	...	20.00	8.50	....	4.00	.....
20358	8.88	7.79	20.50	6.15	50.68	6.00	57.00
.....	...	...	18.00	....	....	5.00	.....
20310	9.54	4.55	16.94	5.49	58.22	5.26	60.00
.....	...	...	16.00	....	....	3.00	.....
20320	7.86	8.72	20.69	6.45	50.76	5.52	58.00
.....	...	...	18.00	8.00	....	4.00	.....

TABLE III. ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand	Retail Dealer
	POULTRY FEEDS—*Concluded.*	
20364	Grandin's Poultry Dry Mash with Buttermilk. D. H. Grandin, Jamestown, N. Y.	*Willimantic*: Willimantic Grain Co.. Guaranty
20292	Red Comb Egg Mash with Buttermilk. Hales & Hunter Co., Chicago, Ill.	*New Britain*: Stanley Svea Grain Co. Guaranty
20304	H-O Laying Mash. H-O Cereal Co., Inc., Buffalo, N. Y.	*Bristol*: Goodsell Bros. Guaranty
20382	Kasco. Kasco Mills, Waverly, N. Y...	*New London*: Conn. Grain Corp..... Guaranty
20278	Jersey Dry Mash. Maritime Milling Co., Buffalo, N. Y.	*New Milford*: Geo. E. Ackley Co... Guaranty
20287	Red Wing Dry Mash. Meech & Stoddard, Inc., Middletown	*Meriden*: Meriden Grain & Coal Co.. Guaranty
20259	Vitality Egg Mash. Rosenbaum Bros., Chicago, Ill.	*Norwalk*: C. E. Slauson Co. Guaranty
20306	Lay or Bust Dry Mash. Park & Pollard Co., Boston	*Bristol*: Goodsell Bros. Guaranty
20361	Purina Chicken Chowder. Purina Mills, St. Louis, Mo.	*New Haven*: Crittenden-Benham Co. Guaranty
20238	Full-O-Pep Dry Mash. Quaker Oats Co., Chicago, Ill.	*Hamden*: I. W. Beers Guaranty
20343	Syragold Egg Mash. Syracuse Milling Co., Syracuse, N. Y.	*Granby*: E. H. Rollins Guaranty

INSPECTION OF 1922—*Concluded.*

Station No.	Pounds per Hundred. Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract (Crude fat)	Price per ton
20364	7.67	8.58	22.19	6.55	50.07	4.94	$56.00
.....	...	...	20.00	....	....	3.00	.....
20292	7.89	11.56	20.50	4.52	49.77	5.76	66.00
.....	...	...	20.00	....	....	4.50	.....
20304	7.69	10.47	19.13	5.11	52.18	5.42	46.00
.....	...	...	17.00	6.00	....	4.50	.....
20382	8.53	8.11	24.06	6.60	46.60	6.10	60.00
.....	...	...	20.00	....	....	3.50	.....
20278	7.85	7.86	19.00	6.13	53.57	5.59	60.00
.....	...	...	18.00	....	....	5.00	.....
20287	8.17	9.18	15.69	5.30	56.36	5.30	58.00
.....	...	...	12.00	....	....	3.00	.....
20259	8.15	8.53	19.13	6.40	51.90	5.89	75.00
.....	...	...	20.00	....	....	4.00	.....
20306	8.44	10.13	23.44	5.86	47.01	5.12	58.00
.....	...	...	18.00	....	....	1.50	.....
20361	8.54	6.81	20.50	7.40	51.66	5.09	71.00
.....	...	...	18.00	....	....	4.00	.....
20238	7.04	9.79	22.25	7.98	46.97	5.97	68.00
.....	...	...	20.00	10.00	....	4.00	.....
20343	8.59	6.61	19.75	6.87	53.26	4.92	55.00
.....	...	...	18.00	....	....	3.00	.....

TABLE IV. ANALYSES OF FEEDING STUFFS

Station No.	Material	Submitted by
	ENSILAGE, ETC.	
18793	Ensilage, millet	*Watertown*: Birch Farm
18794	Ensilage, corn	Birch Farm
18736	Ensilage	*New Haven*: Fairlea Farm
18737	Ensilage	Fairlea Farm
	CORN PRODUCTS.	
19134	White Hominy Feed	*Torrington*: F. L. Wadhams & Sons.
19322	Hominy Meal	*Hartford*: Rodney J. Hardy & Sons.
	COTTONSEED PRODUCTS.	
20765	Cottonseed Meal	*Middletown*: The Coles Co.
18738	Sweet Gluten	*New Haven*: Fairlea Farm
18739	Sour Gluten	Fairlea Farm
	BREWERS' GRAINS.	
19063	Brewers' Dried Grains	*Mt. Carmel*: Russell Harned
	STOCK FEED, POULTRY FEED, ETC.	
20771	Uncle John 24% Cream Pot Dairy Ration	*Middletown*: The Coles Co.
19673	Dairy Ration	Conn. State Hospital
19674	Dairy Ration	Conn. State Hospital
18740	Fairlea Dairy Ration	*New Haven*: Fairlea Farm
18863	Dairy Feed	*Norwich*: H. F. Johnson (County Agent)
18782	Par-ex Dry Mash	*Putnam*: Bosworth Bros.
18783	Par-ex Scratch Feed	Bosworth Bros.
18784	Par-ex Stock Feed	Bosworth Bros.
19098	Dairy Feed	*Rockville*: Rockville Grain & Coal Co.
19049	Feed	*South Manchester*: Greenway Farm.
19255	Cattle Feed	*Waterbury*: E. D. Curtis
19256	Cattle Feed	E. D. Curtis
19257	Cattle Feed	E. D. Curtis
19258	Cattle Feed	E. D. Curtis
19259	Cattle Feed	E. D. Curtis
19260	Cattle Feed	E. D. Curtis
18817	Dry Mash	*Hartford*: C. A. Pease

SUBMITTED BY INDIVIDUALS.

Station No.	Pounds per Hundred						Remarks
	Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free Extract (Starch, gum, etc.)	Ether Extract Crude fat)	
18793	76.56	1.82	1.93	19.01		0.68	
18794	69.75	1.31	2.20	25.96		0.78	
18736	65.09	...	2.60	8.30	....	0.66	
18737	70.53	...	2.19	7.69	....	0.72	
19134	....	...	10.63	...	....	3.88	Guaranty: protein 8.50, fat 4.0
19322	....	...	10.13	...	....	...	
20765	....	...	34.75	...	....	...	Guaranty: protein 36.0
18738	8.45	...	18.19	6.55	....	4.58	
18739	9.15	...	24.25	7.35	....	2.53	
19063	7.47	4.81	18.63	...	....	6.05	
20771	....	...	23.88	...	....	...	Guaranty: protein 24.0
19673	11.85	5.65	22.00	8.20	45.51	6.79	
19674	11.33	5.54	22.44	7.97	45.71	7.01	
18740	8.89	...	18.81	7.99	....	5.11	
18863	8.61	4.75	21.38	59.53		5.73	
18782	6.54	7.40	19.00	6.96	54.74	5.36	Guaranty: protein 18.0, fat 4.00
18783	7.91	1.83	11.25	2.81	72.60	3.60	Guaranty: protein 10.00, fat 1.50
18784	7.26	3.46	9.50	10.93	65.56	3.29	Guaranty: protein 9.00, fat 3.25
19098	7.75	...	21.38	...	....	4.71	Guaranty: protein 19.00, fat 6.00
19049	....	...	12.94	...	....	...	
19255	....	...	21.19	...	....	...	
19256	....	...	22.00	...	....	...	
19257	....	...	19.50	...	....	...	
19258	....	...	23.00	...	....	...	
19259	....	...	21.25	...	....	...	
19260	....	...	22.63	...	....	...	
18817	5.84	...	25.94	...	....	5.51	

INDEX.

The numerals marked T refer to pages of the report of the tobacco sub-station which immediately follow this report.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

First Report

OF THE

Tobacco Sub-Station

at Windsor, Connecticut

The Connecticut Agricultural Station,
E. H. JENKINS, Director, and
The Connecticut Valley Tobacco Improvement Association,
G. H. CHAPMAN, (Windsor), Research Director, Coöperating

The First Report

OF

The Tobacco Sub-Station

To His Excellency, Everett J. Lake, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith submits the first report of the Tobacco-Sub-Station which was established by act of the General Assembly (Chapter 184, Public Acts, 1921).

A full account of the plan for coöperation of the Station with the Connecticut Valley Tobacco Improvement Association and of the preliminary work in 1921, are given in the report of the director of the Station (Bulletin 232). This coöperation has been most satisfactory and has added greatly to the effectiveness of the work.

A statement of the Station's expenditures which were paid from the State appropriation for the fiscal year ending June 30, 1922, will be found with the other financial reports.

The results of the work of the Station, as far as they have been prepared for publication, appear in Bulletins 1, 2 and 3 herewith transmitted.

The full report of the field, shed and warehouse work has been delayed by the resignation of the research director, Dr. Chapman, but it is hoped that it can be published in bulletin form shortly.

The work which has been done at this Sub-Station in the last two years, together with the previous work of Dr. Clinton, the botanist of the Agricultural Station, reported in Bulletin 239, has resulted in the practical control of wildfire which threatened ruin of the tobacco crop year after year.

The chief matters under experiment in the field have been the following:

A further study of the Round Tip type of tobacco, and the effect of different rates of planting on its yield and quality;

The breeding of certain promising hybrids;

The testing of some local strains of the Broadleaf and Havana types;

The testing of a number of strains grown under shade;

A study of spraying and dusting to control wildfire both in the seedbeds and in the fields;

The effect of applying different amounts of phosphoric acid in the fertilizer on the yield and quality of the crop;

The effect of substituting mineral forms of nitrogen for a part or all of the nitrogen in organic forms which is usually applied to the crop;

Experiments and observations of the use of magnesia in tobacco fertilizers, and studies on the brown rot disease.

The last two subjects were studied by the United States Department of Agriculture in coöperation with this station.

All which is respectfully submitted.

G. A. HOPSON,
Secretary.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN NO. 1 OF THE TOBACCO EXPERIMENT STATION

The Connecticut Agricultural Station,
E. H. JENKINS, Director, and
The Connecticut Valley Tobacco Improvement Association,
G. H. CHAPMAN, (Windsor), Research Director, Co-operating

Condensed Recommendations

FOR THE

Control of Wildfire

January, 1922

Notice to Growers:

If you wish to receive future bulletins regarding tobacco, please send your correct address to the Station at New Haven or to the Association.

Condensed Recommendations for the Control of Wildfire

In this circular, only recommendations for control of the disease are given without reference to the experimental data which have led up to the conclusions. For these, the various bulletins of the Connecticut and Massachusetts Stations may be obtained by writing to the Director's Office, Connecticut Agricultural Experiment Station, New Haven, Conn., or the same, Massachusetts Agricultural Experiment Station, Amherst, Mass.

SEEDBED

1. *Seed Selection.* If possible, save seed only from disease-free plants, and if in doubt, sterilize the seed.

2. *Seed Sterilization.* Sterilize the seed either with formaldehyde or corrosive sublimate. Occasionally some little difficulty has been met in using formaldehyde, due to para-formaldehyde effects resulting in low or delayed germination, but with care the method can be used successfully. According to Fromme of Virginia, the corrosive sublimate method is to be preferred, as no seed injury has ever been noted from using this substance. Both methods are given below:

a. *Formaldehyde.* "Soak the seed for fifteen minutes in a solution made by adding one fluid ounce of formaldehyde (commercial strength) to a pint of water. Stir the seeds all the time that they are in the solution. At the end of the time, cover the pail or jar with cheesecloth and wash in running water, or wash in several changes of water until all trace of formaldehyde odor has disappeared. Spread the seed in a thin layer and dry as rapidly as possible at room temperature. Do not heat during the drying."

b. *Corrosive Sublimate.* "All seeds should be soaked for fifteen minutes (no longer and no less) in a one-part corrosive sublimate to 1,000 parts of water solution of corrosive sublimate (bichloride of mercury), then washed thoroughly, dried, and stored in a clean bag or package in a place where they cannot become contaminated. The treatment may be given any time prior to seeding. Any farmer can practice this treatment who will follow the directions carefully. Bichloride of mercury tablets can be bought at the drug store. Directions for making a 1 to 1,000 solution are printed on the package. Tablets of different sizes are sold; one of the large tablets or four of the small tablets make the proper strength solution when dissolved in 1 pint of water. One pint of solution is sufficient for treating the average size lot of seed.

Corrosive sublimate is a deadly poison for man or animals if taken internally and it must be handled with great care. It should be prepared in glass or wooden vessels; it must not come in contact with metal. A quart Mason jar is convenient to treat the seed in They may be poured into the solution and stirred, then strained off through cheesecloth at the end of fifteen minutes, or they may be placed in a cheesecloth bag and immersed in the solution. The bag should be poked or stirred about with a stick occasionally to make certain that the solution reaches all the seed. After washing, the seed may be dried in a few hours by placing them in a warm room. There is no danger of injuring seed with this treatment if the directions are followed carefully."

Note. Treated seed should always be put in new or sterile containers.

Note. The seed treated by either method must first be thoroughly washed and dried, even if it is to be immediately sprouted.

3. *Sterilization of Seedbeds.* No precautionary measures should be overlooked, and although it has not appeared to make much difference whether beds were sterilized or not, if all preventive measures are taken together, benefit will result. Sterilization by steam will kill the wildfire bacteria if in the soil of the beds, and this should be done, especially if the disease was present in 1921.

4. *Location of Beds.* If the disease was present in 1921 and if sterilization cannot be practiced, the beds should be changed to new land if practicable.

5. *Sterilization of Sash, etc.* Wash or spray the sash, plank or cloth with a solution of formaldehyde and water (1-50), equal to 1 pint formaldehyde to 6 gallons of water, and dry in the sun before using.

6. *Spraying or Dusting the Plants.* Spray or dust the plants with a fungicide (in this case acting as a bactericide) every week or ten days from the time that they are as large as a dime until setting is finished. Any good fungicide of the Bordeaux type may be used, such as home-made Bordeaux 4-4-50 formula, NuRexo, Pyrox or other similar commercial mixtures. NuRexo should be diluted at the rate of 8 pounds to 50 gallons of water, and Pyrox at the rate of 10 pounds to 50 gallons of water. The home-made Bordeaux sticks to the leaves best of any of the sprays according to Massachusetts' results and the Pyrox washes off sooner than any other. This lessens slightly the control. Sanders Dust (6% copper) gives excellent control as would dusts of similar copper content free from sulphur, and dusting is preferred by many on account of ease of application and also the apparently better covering of the unexposed parts of the leaves.

Apply the liquid sprays preferably in the afternoon when the

plants are dry, to escape the possible burning effects of the sun on the leaves wet with spray. Do dusting shortly after watering, before the plants have completely dried off.

For spraying, a good compressed air sprayer with a fine nozzle throwing a fine mist should be used. This will cover the leaves without drenching. For dusting, a good rotary hand duster is recommended.

7. *Watering.* Water the beds only sufficiently to keep the plants growing satisfactorily.

8. *Ventilation.* Ventilate even in cool weather as much as possible without checking growth materially. A little ventilation at night is also advisable when temperatures permit. Cross ventilation is to be preferred to ventilation all on one side. *Air circulation is important.*

9. *Planting.* Set plants in field from disease-free beds only. It would be advisable to have more plant beds than needed, planted at a later date, to permit of getting sufficient plants if a bed becomes infected.

Plants pulled and put in baskets should not be allowed to stand over night, as it has been found that if any infection is present, it will spread very rapidly under such conditions.

FIELD

1. If only a few badly diseased plants are found in the field, remove and destroy them.

2. If the infection is slight and occurs on a few leaves only, pick and destroy them. This should be done when the plants are dry.

3. If a field shows a heavy infection before the first of July, reset the field with plants from healthy beds. Growers of small acreages can very profitably do this.

GENERAL

Avoid using an excess of nitrogen to force the plants in the seedbed. There are grounds for the belief that where large amounts of nitrogen have been applied, resulting in a quick growing, sappy plant, the disease has spread more rapidly in infected beds. An addition of potash in the bed fertilization at the rate of 1 pound of sulfate of potash to 100 square feet of bed is recommended.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN NO. 2 OF THE TOBACCO SUB-STATION

The Connecticut Agricultural Station,
E. H. JENKINS, Director,
The Connecticut Valley Tobacco Improvement Association,
G. H. CHAPMAN, (Windsor), Research Director, Co-operating.

Wildfire of Tobacco in 1922

January, 1923

Notice to Growers:

If you wish to receive further bulletins regarding tobacco, please send your correct address to the Station at New Haven or to the Association.

TABLE OF CONTENTS.

TOBACCO SUB-STATION BULLETIN No. 2

Wildfire of Tobacco in 1922*

By G. H. CHAPMAN and P. J. ANDERSON.[1]

INTRODUCTION.

Wildfire is the most serious disease with which the tobacco growers of the Connecticut Valley have ever been confronted. It appeared first in Connecticut in 1919 and was found in three places in Massachusetts in 1920, but its destructiveness was first fully demonstrated during the season of 1921, when the study of this disease was actively undertaken in both states. Owing to its alarming spread in the seed-beds during April and May of that year the writers began a special investigation with the primary object of finding some method or methods of preventing its ravages. A preliminary report of the work was published in September, 1921, as Bulletin 203 of the Massachusetts Agricultural Experiment Station and a detailed study, "Wildfire of Tobacco in Connecticut" (Clinton and McCormick) was issued as Bulletin 239 of the Connecticut Station in May, 1922. Chapman, subsequent to that time, has been located in Windsor at the new Connecticut Tobacco sub-station, but since the wildfire problem is not divided by state lines, the work has been continued in co-operation between the two stations. The most important results of the experiments and observations of the last year are presented in this second bulletin. A number of important publications from other workers along the same line have appeared during the year. These are freely quoted and referred to here in order that the grower may have the advantage of all that has been learned concerning this problem. Just as in 1921, so in 1922, most attention has been given to developing methods of control, and although such methods have not been perfected as yet, nevertheless some improvements have been made, and by means of another season of work we have been able to confirm more fully certain controls which were recommended last year, while others have been found to be of less importance. Some further studies have been made in regard to the life history of the causal organism, especially with reference to overwintering and dissemination.

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* A report of co-operative work carried on at the Tobacco Sub-Station of the Connecticut Agricultural Experiment Station and at the Massachusetts Agricultural Experiment Station. Published with a different introduction as Bulletin 213 of the latter Station.

(1) Dr. Anderson is on the staff of the Mass. Station.

SYMPTOMS OF WILDFIRE.

Wildfire spots may occur on any part of the plant above ground, but are most abundant and damaging on the leaves. New spots may appear at any stage of development from the emergence of the first leaves in the seed-bed until the plant is harvested. After the plant is cut, however, and during all subsequent operations, no new spots appear and the old ones do not spread. The reader who is not familiar with the disease will learn the symptoms quickly by examining the colored figures on Plate I. In figures 1 and 2 small greenish-yellow spots may be found which show no dead brown tissue at the center. These are the youngest spots, —probably 4 days old. In the same figures may be found other spots, a little older, each of which contains a brown dead area of pinhead size at the center, surrounded by a broad chlorotic band or halo. This broad greenish-yellow halo of definite shape and delimitation is the most reliable character for the diagnosis of wildfire. Spots produced by other diseases may—and usually do—have a certain amount of yellow tissue about them, but it is narrower or of irregular shape or fades away indefinitely into the green of the surrounding leaf. As the wildfire spot becomes mature, however, the central dead brown part becomes larger by the dying of more of the surrounding halo and, especially if the weather is dry, a stage may be reached when there is very little halo left. Such a stage is represented in figure 3 and may be certainly diagnosed as wildfire only by examination of occasional younger spots where the halo is still evident. Figure 2 shows a leaf suffering from the results of two different infection periods, the first one evidenced by large brown dead areas which have been produced by enlargement of the original dead centers or partly by dying of the intervening tissues, the second infection represented by younger spots with broad halos and little or no dead centers. In advanced stages, the dead part of the leaf may become torn or cracked, or parts of it may fall out. Such a stage is represented in figure 4. Severely affected leaves may die, but most of them remain partly alive. When the leaf is cured the spots do not assume the reddish brown color of the healthy leaf, but they become straw-colored or paler to almost white. Consequently they are very noticeable. They are stiff and brittle and easily break, leaving holes in the leaf. Naturally such leaves cannot be used for wrappers and must sell at a lower figure if they can be sold at all.

In the seed-bed the plants in certain definite round areas are usually found to be infected first. Here the seedlings are close-planted with overlapping leaves and the disease spreads rapidly from plant to plant. If the air is very humid, the badly affected leaves in these areas undergo a wet rot and the whole diseased area may become a slimy mass, most of the plants being killed. This wet rot is not confined to the seed-beds. The writers have seen it in the field under very moist conditions, but the seed-bed conditions are most favorable for it. It has not been demonstrated that this wet rot is caused by the wildfire organisms alone. Leaves attacked while they are rapidly expanding become puckered and drawn about the spots. The entire leaf may become distorted and twisted.

CAUSAL ORGANISM.

Wildfire is produced by the parasitic growth of enormous numbers of bacteria (*Bacterium tabacum* Wolf and Foster) in the leaves. Since various investigators who have published concerning the organism do not agree as to some of the morphological characters, Anderson during the past season has made and studied permanent slides on which the

bacteria have been stained by (1) the Duckwell modification of the Pitfield method, (2) the Shunk method* and (3) to a less extent by other methods. The organisms are short cylindrical rods with rounded ends and usually straight sides, but not infrequently individuals will be found which are slightly curved or somewhat dumb-bell shaped. Frequently two or three of them remain end to end in a chain on the slide. Those in chains are shorter, indicating immaturity. Only those which were free from each other were used in measuring. An average size of fifty taken from five slides stained in different ways was 2.3 x .8u. The longest one measured was 3.8u and the shortest 1.4u. Attached to one end there are 1-4 flagella several times as long as the body of the bacterium.

PREVALENCE AND SPREAD OF THE DISEASE DURING 1922 IN CONNECTICUT.

The first wildfire infection in the seed-beds was found May 7. This date is a little later than that of the first reported infection last year. From May 7 until June 20 many reports of infected seedlings were received, particularly from the Broadleaf section where compartively few infections had been noted in 1921. One hundred and fifty-six seed beds, in which trouble was reported, were examined and in all but eight of these wildfire was found. By June 10 approximately 30 per cent. of the seed-beds showed wildfire. In some instances the infection was very slight and local, in others the entire bed was practically destroyed. During the middle seed-bed period, rain and weather conditions were extremely favorable for wildfire development. It was difficult to air the beds sufficiently to maintain a low humidity under the sash. These factors also to some extent reacted against the application of sprays or dusts as preventive measures. The weather during the latter part of the seed-bed period was unfavorable for the development and spread of wildfire, and such seed-beds as had escaped infection earlier remained free in most instances.

Field infection was quite prevalent shortly after the setting of plants, particularly in cases where plants from slightly infected seedbeds had been used. It was noted that the Broadleaf section developed a much more general field infection than was the case in 1921.

The localities which were most heavily infected last year, however, either due to more careful application of preventive measures or for some other reason, did not show as heavy a general infection as in 1921. Early in July infection spread rapidly, but later in the month when dry warm weather was the rule, the spread of the disease was extremely slow and could scarcely be noted. As in 1921, when the plants matured (and this was true of Havana as well as of Broadleaf) after topping, the infection spread very

*Journ. Bact. 5:181. 1920.

rapidly, and in some instances, particularly in fields which showed a remarkably healthy vigorous growth, it spread to the top of the plant in a very few days. Many of the growers who had a slight *foot-leaf* infection at the time of topping profited by their experience of last year and did not wait for the tobacco to ripen, but cut it "on the green side" and in this way reduced appreciably the damage from wildfire.

On the whole, observations through the state lead to the conclusion that field wildfire infection was much more general than in 1921, but the per cent. of infected fields showing a heavy loss was smaller than in the previous season.

IN MASSACHUSETTS.

During the early seed-bed period no wildfire was found in this state, although considerable time was spent in visiting the beds of the growers. Since the disease had been found earlier in 1921 it was hoped that we would escape an outbreak this year, but on May 25 a diseased bed was found in Hadley and within the next week it was found in 20 other beds in Hampshire and Franklin Counties. Throughout June and early July continuous and almost unprecedented rains furnished ideal conditions for spread of the disease, and it not only became widespread in the beds, but was found to be prevalent in the fields almost as soon as they were set. The weather almost prevented effective control measures. On July 4 it was estimated that more than 50 per cent. of the fields had more or less wildfire in them and many of them were very seriously affected. The situation looked decidedly worse than last year. The growers were discouraged both by the prevalence of the disease and the poor growing condition of the crop and some of them plowed up their fields. After the first week in July, however, the weather cleared, there were no more long rains and such rains as occurred were followed by hot clear weather. For the next three or four weeks wildfire spread hardly at all and the tobacco grew rapidly, covering the diseased leaves with healthy ones, and many growers felt that the disease had disappeared. Rain storms (frequently and locally accompanied by hail) became more frequent and continued from about the 27th of July, and another outbreak occurred which continued with some slight interruptions throughout August until the crop was harvested. It is probably no exaggeration to say that there was some wildfire in 90 per cent. of the fields. Some were so badly affected that not one disease-free plant could be found in the field. In other fields the infection was so light that the market value was probably not affected at all. Many fields were harvested before mature, with the idea of saving the crop before wildfire became too serious. That there has been a considerable spread of the disease since last year is indicated by the fact that it has now been found in every tobacco-growing town in the state.

OUTSIDE THE CONNECTICUT VALLEY.

During the summer one of the writers had occasion to visit the tobacco regions of New Hampshire and Vermont, where conditions were found to be very similar to those which prevailed in Massachusetts. A serious outbreak occurred in Wisconsin (Pl. Dis. Bul. 6: 40, 139) from which state the disease had not been reported previously. It was also reported for the first time from New York and Georgia (Pl. Dis. Bul. 6: 62, 63). It occurred with more or less severity in Pennsylvania, Maryland, Kentucky (Pl. Dis. Bul. 6: 21) and Ohio. It is rather surprising to find that in North Carolina and Virginia, in which states the disease was first found and where it was very destructive five years ago, there has been no damage from wildfire during 1922. Under date of August 19, Dr. F. D. Fromme, plant pathologist of the Virginia Agricultural Experiment Station, wrote "We have yet to see a case of wildfire in the 1922 crop in Virginia. We have inspected well over 100 fields in counties where it has occurred in the past year. Plant beds were equally free from it this year." Under date of August 21, Dr. F. A. Wolf, plant pathologist of the North Carolina Agricultural Experiment Station, wrote, "I have not received this season a single authentic specimen of tobacco wildfire from this state."

Previous to this year wildfire was not known to occur outside the United States. It has now been reported from South Africa. (2: 366-368)*

LIFE HISTORY STUDIES.

OVERWINTERING OF THE BACTERIA.

As a basis for control measures, probably no problem in regard to life history of the causal organism is more important than determination of the method or methods by which the bacteria survive the winter and thus serve as starting points for wildfire of the next year. Certain experiments with the object of solving this problem were conducted during the winter of 1921-22, and though some of the results are not conclusive, progress to date

*The first number in the parenthesis refers to the bibliography on p. 38 of this bulletin, and the numbers after the colon refer to pages of these publications.

will be reported at this time. Other experiments with the same object are now in progress and it is hoped that they will be more satisfactory.

Effect of freezing the bacteria. In studying the problem of overwintering, the first point which must be determined is the effect which freezing has on the organisms. If they are not able to withstand the exposure of a New England winter, then the measures of control will be quite different from those which should be tried if they are resistant to cold. Pure cultures of *B. tabacum* on agar were placed out-of-doors at various times during the winter of 1921-22, some of them being frozen solid for months, but in every case when they were brought back into the laboratory and transferred to other media they grew normally. The result was about what one would expect when it is remembered that few species of bacteria are killed by freezing. It is certain from data presented below that freezing does not kill them while in the leaf in the tobacco barn.

On the seed. It has been suspected by most workers who have investigated this disease that the bacteria may survive the winter on or with the seed and that early infections in sterilized beds start from the seed. Although this would seem possible, there is as yet no experimental evidence to prove that such is the case in the Connecticut Valley. In Virginia, Fromme and Wingard (3) find conclusive evidence that the organism of blackfire (*Bacterium angulatum*) overwinters in this way. Their evidence for the wildfire organism, however, is not so convincing. A number of experiments were undertaken by the writers for the purpose of determining the possibility of overwintering in the seed. In the interest of brevity these experiments need not be given in detail, but the results may be summarized:

(1) All attempts to islolate the organism directly from suspected seed have failed. (2) Suspected seed has been planted and no wildfire has appeared on the seedlings where other sources of infection have been eliminated. (3) Seed inoculated by soaking in a pure culture of the bacteria and kept in a dry room all winter produced only clean plants in the spring. (4) In another experiment seed was artificially inoculated after it had been sterilized and killed by heat. The seed remained wet from the culture for two weeks. In the spring it was sprinkled on healthy leaves and wildfire resulted, but the conditions are not the same as where seed are kept in a dry room. All the evidence in these experiments was negative and has only the weight of such. The possibility is not precluded that there may be conditions under which the bacteria may winter directly on the seed coat.

There is no evidence that in nature a lesion may come into direct contact with the seed. No one has ever reported seeing a lesion on the seed. It is a well known fact, however, that lesions do occur on the calyx of the flower and on the seed pod. During 1921 in Connecticut, and during the late summer of 1922 in Massachusetts, pod lesions were found on plants being kept for seed. Similar lesions were also produced by artificial inoculation. In threshing out the seed, small broken bits of the pods remain with the seed as chaff and no amount of sifting and cleaning will remove every particle of chaff. If the bacteria overwinter in the seed, it is probably not directly on the seed, but in these fragments of pods, etc., which are with the seed. Since it is known that they survive the winter in leaf lesions, there could hardly be any doubt that they could live over in similar lesions on the pods. Fromme and Wingard (3: 20) present experimental evidence showing that the percentage of wildfire is increased by top-dressing the seed-bed with chaff from infected pods of the previous year. It seems improbable, however, that any considerable proportion of the spring infection in the Connecticut Valley beds starts from the seed, because: (1) Growers now know the disease well enough so that few of them would save seed from infected plants; (2) Many of the growers during the last season used old seed (grown previous to 1920), and yet they did not escape infection; (3) Those who sterilized the seed were apparently no more successful in eliminating the disease from the beds than those who did not*; (4) Even those who advocate most strongly the sterilization of seed do not present convincing data to prove that the disease organism is carried on the seed.

In the soil. From the plant, the bacteria may get into the soil in two ways: (1) they may be washed from the plant by the rain during the growing season, and (2) when the leaves or other infected parts are turned into the soil or left to rot on the soil the bacteria probably remain alive for a long time. It is important that we should know how long they remain alive there and capable of infection and whether they may survive the winter in this habitat.

During some control experiments in Whately, it was observed that even when all diseased leaves were removed from the plants, others became infected after rains and almost always on the tips where were beaten down into the soil. It appeared as though the bacteria had been washed from the diseased leaves into the soil and splashed from the soil to the other leaves.

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*Records were kept on the beds of 11 growers in Massachusetts who treated their seed with mercuric chloride. Wildfire afterward appeared in 5, while the other 6 had no wildfire in the beds.

In two fields in Hadley and North Hadley which were under constant observation by one of the writers during 1922 the plants became so badly diseased during June that all were pulled and carted from the fields. Both fields were set later with healthy plants, but in both cases there was a very heavy reinfection before the new plants were half grown. The second infection must have come by way of the soil.

Clinton and McCormick (2:404) buried wildfire leaves under healthy plants, and by this means the infection was increased to 63 per cent. as compared with 13 per cent. on adjacent plants not so treated.

The above data furnish very strong evidence that the pathogene may be carried from one plant to another or from one crop to another by means of the soil. The failure to get infection in some of the experiments by planting in infected soil shows, however, that infection will not always result necessarily because the soil was infected.

None of the experiments just quoted furnish evidence of the length of time during which the bacteria may remain alive in the soil or indicate whether they will live through the winter in this habitat. The following experiments and observations throw some light on the latter point:

Experiment 1. In order to see whether the organisms could be carried from one crop to the next through the medium of naturally infected soil, such soil was taken from three beds of diseased plants at different times during the summer of 1921 and seeded with sterilized seed. The plants grown in the soil did not become infected. On the other hand in one of the greenhouse beds which had grown a number of diseased crops, sterile seed was planted in the spring of 1922 and the seedlings became diseased before the plants were an inch high.

Experiment 2. In this experiment one pot of soil was inoculated by spraying a suspension of bacteria over it, while another pot had an equal amount of water sprayed on it. Both were seeded shortly after sprinkling and wildfire developed in the inoculated plot but not in the check.

Experiment 3. On July 1, 1921, Erlenmeyer flasks of soil were sterilized and later inoculated with the bacteria. Part were plugged only with cotton, others were paraffined to prevent drying out. At various times during the winter, soil was taken from these flasks and plated out. Then when bacteria developed about the particles of earth they were shaken in a suspension of water and atomized on healthy plants. The flasks which did not have paraffined plugs became very dry, while the others remained muddy. Heavy infection resulted when inoculations were made, March 10, and others on March 20, 1922, from the dry flasks but none from the tightly closed wet flasks. These flasks were kept in the laboratory and were not frozen. In this case the bacteria were still able to produce infection after 8 months.

In two instances in Connecticut, wildfire was found starting in the edge of the beds in soil which had been outside the pans when the remainder of the beds were steamed. In both cases wildfire was present in the beds in 1921. The fact that the planks

were new and the sash had been sterilized with formaldehyde eliminated these as the source of infection.

In a number of cases, in both states, it was found that those parts of the field which were diseased in 1921 showed the heaviest infection in 1922.

On the other hand, fields have been observed which were badly diseased in 1921 and on which the tobacco was free from wildfire in 1922.

On one of the fields at the Connecticut Experiment Station the 1921 crop, which was badly infected with wildfire, was cut late in September and left lying on the ground over winter with a view to getting data on the overwintering under natural conditions. In this case both leaves and stalks were left to weather. In 1922 this field was planted with Havana and Broadleaf wildfire-free seedlings, the stalks and leaves of the 1921 crop having been disked and plowed under two weeks prior to setting. Throughout the season close examinations were made by Slagg and Chapman for wildfire in this field. Wildfire was not found on this particular field during the growing season, but at harvest an occasional infected plant was found, yet nothing to what should have developed if any considerable amount of direct infection occurred as a result of the refuse being left on the field. A careful estimate of the wildfire plants on this plot made at harvesting time showed that plants infected were not more than one-half of one per cent. of the total number, and on all of these the infection was light. This slight infection may have come from plants in the wildfire experimental field, since all the station plots—except for the experimental field—showed about this same percentage of infection late in the season.

Clinton and McCormick (2: 376,419) succeeded in one experiment in infecting tobacco plants in the greenhouse by direct application of wintered-over soil which had been exposed to infection the previous year. Wolf and Moss (4: 30) in North Carolina, and Fromme and Wingard (3: 24) in Virginia present considerable evidence that in the South the organism winters in the soil, but we cannot accept this as conclusive proof of the same condition in New England.

Altogether the weight of laboratory data and field observations indicates that *B. tabacum* is able in some cases to survive the winter in the soil and start new infection from this source in the spring. On the other hand, it is apparently possible under some conditions to raise a clean crop of tobacco on a field that had borne diseased crops during preceding years. The evidence as to soil wintering is, however, not so convincing as it should be and further experiments are now under way which it is hoped will remedy the deficiency.

In Cured Leaves. That the bacteria do not die when the diseased leaves are cured in the tobacco barn has been demonstrated in a number of our experiments.

Experiment 4. On March 5, 1922, diseased cured leaves were taken from the Hampshire County warehouse just before they were ready to go into the case. They had been in the tobacco barn under normal conditions all winter. They were ground to a powder in a mortar and the powder sprinkled on wet plants in the greenhouse. After two weeks the plants developed typical lesions of wildfire. Other leaves were ground and the experiment repeated with the same result on March 28. On March 8, some diseased leaves were received from M. H. C. Wells in Deerfield. Some of them were ground and used for inoculation just as the above. Dilution plates were made from the others and the organism thus isolated used for making inoculations. Wildfire developed on the plants inoculated in both ways.

Experiment 5. At Windsor, several times during the winter, wildfire spots from leaves kept in the station shed were brought to the laboratory and the wildfire organism isolated in pure culture. Cultures of wildfire bacteria were obtained from these leaves until the middle of March in this way, and no doubt living bacteria could have been found later than this.

These experiments were conclusive and there can now be no doubt that the wildfire organism can overwinter in cured leaves. It might get back from the cured leaves to the next year's crop in any one of a number of ways: (1) Refuse containing lesions from the shed may be thrown back to the land. (2) Sash and plank are sometimes stored in the tobacco sheds. Bits of broken diseased leaves could easily be carried out on such sash and plank and serve to start infection in the seed-bed. (3) While drawing the tobacco to the warehouse across or near the fields, parts of the diseased leaves might be scattered on the land.

Clinton and McCormick (2: 417) isolated *B. tabacum* from tobacco leaves which had been dried and kept in the herbarium for periods ranging from 198 to 298 days. They were unable, however, to secure the bacteria from other leaves which had been kept for two years.

In leaves which have been left in the field. Sometimes leaves when too badly diseased are picked ff and thrown on the ground. At other times the whole diseased plant may be left. The suckers which grow from the old stubs after a diseased crop has been cut are usually infected. These are left on the field all winter. If the bacteria live over in these parts, they might easily start infection the following year. Being subjected to more frequent freezing and thawing and other changes of weather, it is possible that they might not survive in these leaves as they do in cured leaves in the tobacco sheds. We have very little data bearing on this point.

Experiment 6. On April 24, 1922, diseased leaves were collected from plants at Windsor, which had been cut down in the fall and left in the field all winter. These leaves were ground to a powder in a mortar, some of the powder immediately applied to punctured leaves in the greenhouse at Amherst, some of it soaked in water and the wet material applied after 24 hours to other plants. No infection resulted. Similar tests were made with the same material by Chapman and Slagg, but with negative results. This negative evidence should not be considered conclusive. Further experiments are in progress.

Clinton and McCormick (2: 376,419) succeeded in one case in infecting tobacco plants in the greenhouse with tobacco refuse which was wintered out-of-doors.

Occurrence of Lesions on Stalks.

Wildfier lesions have been reported previously as occurring only on the leaves and occasionally on the pods. During the inspection of a field of tobacco at S. Amherst, some lesions were found on the stalks which were suspected of being wildfire. On further examination it was found that they were not uncommon, but that they were present on a large part of the stalks in this field. Probably they had escaped previous notice because they are inconspicuous and somewhat different in appearance from the lesions on the leaves. They are commonly ⅛-¼ inch in diameter, white or, at most, light brown and sunken. The halo is not distince on most of them, but can be seen about some. A number of them were brought to the laboratory and the typical bacteria isolated from them. Inoculation on leaves with these bacteria produced wildfire spots. In this same field and in various others examined through the summer, it was observed that lesions are common on the "ears" or clasping bases of the leaves. When tobacco is stripped, these bases remain mostly on the stalk. Clinton and McCormick (2: 416) inoculated stalks and produced elongated blackened lesions. The occurrence of lesions on stalks and attached leaf bases may be important in answering the question as to whether land may become infested by throwing tobacco stalks on it. Since the organism overwinters in the leaves, there is no reason why it should not also remain alive in the stalk.

Occurrence of Lesions on Midribs.

In the process of "stemming" tobacco, the midribs are stripped from the leaf and are sold as fertilizer (incorrectly called tobacco stems). The question has frequently been raised as to whether the land may become infected by the use of "stems" from diseased tobacco. Observations as to the occurrence of lesions on midribs were made at various times in fields during the summer. Fre-

quently lesions were found running along both sides and encroaching on the midrib and often extending directly across the midrib. When the leaf was stripped from the midrib, parts of the lesion remained with the "stem." *B. tabacum* was isolated directly from them. This does not prove that the disease may be carried back to the land by using stems, since it has still to be demonstrated that the bacteria can survive the sweating process, but there can be no doubt that they occur in the midribs and may survive the winter thus in the tobacco shed. Clinton and McCormick (2: 416) produced lesions similar to those described above by inoculating the midribs with pure cultures of the bacteria.

Relation of Condition of Plant to Infection.

No set of experiments has been planned to determine the relation of the growth and vigor of the plant to susceptibility, but incidental to other experiments a number of observations have been made which indicate that a rapidly growing plant is much more susceptible than one which is growing slowly. During the fall of 1921 two beds were planted in the greenhouse at Amherst, one on very poor soil, one on soil rich in rotted compost. Both were inoculated at various times and the rapidly growing plants of the fertile bed became infected, but all inoculations failed in the other bed until late in the spring, when the plants suddenly began to grow rapidly. In the course of some experiments at the Massachusetts Station during the summer of 1922 numerous unsuccessful attempts were made to inoculate a bed of very slow-growing plants which had received no fertilizer. During the same time other rapidly growing beds in the greenhouse were very readily infected. These experiments are not accurate, but certainly give some strong indications. Also the fact that infection is difficult to secure during the winter months points to the same conclusion. The relation of fertilizers to infection can probably be interpreted by their influence in producing a rapid succulent growth or the reverse. Other investigators of the disease have made similar observations. Clinton and McCormick (2: 390) state that "the use of any fertilizer that favors rapid growth is more likely to help infection * * * than where the fertilization is such that slower or less satisfactory growth takes place." Fromme and Wingard (3: 27) express essentially the same opinion.

Dissemination.

No experiments directly dealing with dissemination were undertaken during the season of 1922, but observations throughout the year confirm the conclusions of 1921 in most respects. There is one notable exception: The experiments and observations in 1921

led us to believe that all field infection originated from plants which were diseased when taken from the beds. The majority and the worst field infections which we have seen in 1922 did come from that source and could be traced without any question to the seed-bed. On the other hand, a number of cases have come to the writer's attention where the beds were free from disease, (if it is possible at all to tell when they are free) but disease developed in the fields set from these same beds. A few cases may be mentioned:

(1) Anderson inspected the beds of a certain Sunderland grower at intervals of three or four days throughout the season and is positive that they were free from disease. Yet parts of the fields set from these beds were very badly diseased. (2) Tobacco fields owned by a grower in S. Deerfield, but located near Brattleboro, Vt., became badly diseased and were visited by A. V. Osmun and Anderson in June. Most of these fields were set from beds near the fields, but some plants were brought from the beds in S. Deerfield. A most searching examination of the beds at both places failed to reveal a single diseased plant; (3) A field of tobacco on a farm in Whately was isolated from all other tobacco fields and surrounded on all sides by woods. Plants were taken from the *beds* on the same farm. During the spring these beds were repeatedly inspected by C. M. Slagg, a wildfire expert, but he failed to find any infection. Yet wildfire became fairly prevalent in the isolated field; (4) The seed-beds of a grower in North Hadley were frequently inspected by Anderson during the spring, and not a trace of wildfire could be found at any time. During August some diseased plants were found in the middle of his field; (5) Wildfire occurred in a field of the Massachusetts Experiment Station farm which was not being used for wildfire work, but not a trace of it had been seen in the beds at the experiment station where the plants were raised; (6) A certain Windsor grower kept his seed-beds covered at all times with copper lime dust, and frequent inspections by Chapman and Slagg showed no infection. He planted two fields about three miles apart from these beds. One of the fields developed a heavy infection during the growing season; on the other, only a trace of wildfire was found.

Many similar cases were reported to the writers by growers but were not checked up by their personal observations. But the evidence is conclusive that all field infection does not come from the seed-bed. We are now confronted with the problem of determining how such infections did start. Rain could not have brought them from other fields because they were too far removed. There is some probability that in the Sunderland field the bacteria were in the soil over winter, since the worst infection occurred in the same place as last year. In the other cases, however, either no tobacco had been planted during the previous year on these fields or no wildfire had been observed there during 1921. Apparently there is some long distance disseminator which we have not yet found. Those that suggest themselves are (1) workmen, (2) insects and (3) wind. Since many isolated infections were discovered within a week or two after the exceptional wind storm of June 12-13 it is possible that the organisms may have been spread

with the dust and sand which was blown in great clouds over the valley at that time. It has been shown above in this report that dry infected soil dusted over healthy plants may produce infection.

All observations of the summer confirm our previous conclusion that the most important short distance disseminator of the disease in the field is the rain, especially when accompanied by wind. It should be noted here, however, that not every rain storm is followed by a new outbreak of wildfire. It was frequently remarked, especially during July, that heavy short rains quickly followed by drying weather resulted in very little spread of the disease. The ideal conditions for spread are (1) long continued rains, (2) rains followed by cloudy weather during which the leaves do not become dry, or (3) periods during which the rains follow each other closely. During June of 1922 we had a long continued combination of all three of the above conditions, which resulted in the worst spread of wildfire which we have ever seen.

CONTROL MEASURES.

Sterilization of Seed.

Seed sterilization has been recommended by the writers because it was thought possible that the bacteria might be carried on or with the seed. Fromme and Wingard (3: 20) of the Virginia Experiment Station, in fact, are of the opinion that a large part of the infection is started from the seed. Although there is no conclusive evidence in the Connecticut Valley or elsewhere that such is the case, nevertheless the practice was recommended as a precautionary measure. In 1921, formaldehyde was recommended as the disinfectant (1: 75), but in 1922, mercuric chloride (corrosive sublimate) was recommended because it was found to be just as efficient, and was less likely to cause injury to the seed. Therefore, the following directions for treating tobacco seed were sent out to tobacco growers before planting time:

"Purchase corrosive sublimate tablets at any drug store. Dissolve one tablet in a pint of water to make a 1-1000 solution. Use a glass jar. Place seed in a cheesecloth bag and soak in the solution for exactly fifteen minutes. Poke or stir occasionally with a stick to insure thorough wetting of all the seed. Remove bag of seed and wash thoroughly in water. Spread out seed in a warm room to dry. Store seed where it will not become contaminated. Germination of the seed will not be affected if directions are followed carefully."

Many of the growers in 1922 used the corrosive sublimate treatment for sterilizing their tobacco seed, and at the Windsor laboratory one hundred and twenty lots of seed were sterilized by this method, and the germination before and after sterilization was tested. In no instance in our laboratory tests was there any injury from such seed treatment.

Some of the growers, however, reported that they injured the seed by the corrosive sublimate treatment. Some said that germination was retarded; others that the percentage of germination was lowered; others said that the seed would not germinate at all. It was at first thought that the failure was due to faulty technique, but laboratory tests showed that even a treatment of thirty minutes was not harmful, and some of the growers omitted the washing of the seed after sterilizing without any bad effect. Some reported lack of germination in seed which was sterilized at the tobacco sub-station by Chapman. It was certain then that the injury could not be attributed to faulty technique in all cases. Inquiry among the growers as to the method by which they sprout the seed revealed one difference between their method and that used at the stations; viz., the custom which many growers have of cracking or sprouting the seed in moist cocoanut fibre or apple punk or between sods for a few days before planting. The seed is kept in a warm room of 70-90° F., and from time to time sufficient water is added to keep the fibre or other material slightly moist. It was thought that possibly the fibre might have something to do with the lack of germination, and some of the seed was taken to the laboratory for test, using both unsterilized and sterilized seed of different lots. It was found that the unsterilized seed sprouted in the fibre, and that the sterilized seed did not show any signs of sprouting even after ten days. Other growers brought in samples of seed which they themselves had sterilized and which had failed to sprout in fibre, and these lots were tested also. We tried varying the conditions under which the seed was kept during the sprouting period, and found that under the conditions ordinarily used, it was almost impossible to sprout the sterilized seed, although the same seed in Petri dishes would germinate satisfactorily. It was found finally that in order to germinate sterilized seed, whether in punk or fibre, the pans should be kept at a lower temperature, and also that the moisture content of fibre or punk must be considerably higher than usual. By close attention to these factors it was possible to sprout the different lots of sterilized seed in either punk or fibre almost as well as before sterilization.

Lack of germination of sterilized seed under usual conditions in punk or fibre appears to be due to the fact that the seed coat is hardened by the washing and drying, and there is a much slower softening of the seed coat than is the case with the unsterilized seed. This was tested in the following way:

Experiment 6. Of two lots of seed, one was sterilized for fifteen minutes with a solution of 1-1000 corrosive sublimate, and the other treated for fifteen minutes in pure water without any chemical added. Both lots were taken from the jars and washed and dried in the usual manner. It was found to our surprise that both lots reacted the same, i. e., when placed in punk or fibre under normal conditions the germination was greatly delayed or lacking. This experiment showed that lack

of germination was not due to the corrosive sublimate treatment but to another cause, probably the hardening of the seed coat by the washing process or possibly by the rapid drying.

The age of the seed or storage conditions may possibly play a role also, as in many cases growers had no difficulty with their seed. A few cases were brought to our attention where the injury was undoubtedly due to incorrect procedure in the corrosive sublimate method.

Data collected from growers who sterilized their seed during 1922 are not conclusive as to the value of the treatment for preventing wildfire.

As a result of our experience this past year, we are of the opinon that in the Connecticut Valley seed is, at most, a minor source of infection. Nevertheless this is a possibility which should not be lightly overlooked, and growers should not save seed from plants which show wildfire infection. But if this is found necessary, we believe the seed should be treated with corrosive sublimate. To avoid the difficulties discussed above, the beds should be sown with the dry seed. We do not know how long the bacteria will remain on the seed, but it is unlikely that there would be any alive on seed two or three years old. By the use of old seed the chance of infection from this source would be eliminated.

Sterilization of Soil in the Seed-bed.

Sterilization of the seed-bed soil with either steam or formaldehyde was recommended by the writers (1: 75) because it was thought possible that the organism could live from one season to the next in the soil. Considerable additional evidence that this is one of the ways in which it may pass the winter has been obtained during 1922, and presented in a previous part of this report. It is a common practice for growers to sterilize their beds to kill weed seeds, prevent root-rot and for other reasons, and many beds were sterilized before the 1922 seed was sowed, a few in the fall but the majority in the spring. Careful records were taken on fourteen beds in Massachusetts which had been sterilized this year. Wildfire occurred in seven of them, and the others remained free. No conclusion can be drawn from these data except that soil sterilization alone cannot be depended on to give a clean seed-bed. It is unquestionable that sterilization of soil by either steam or formaldehyde, if properly done, will kill all the wildfire bacteria in the soil treated, but it may not be so easy to eliminate the possibility of getting it contaminated again from infected soil in the walks, surrounding areas, tools, etc. These chances are perhaps greater where soil is sterilized in the autumn. Most growers use steam and consider it cheaper. If steam is used, it should be applied for thirty minutes at 100 pounds pressure. Those who do not have

boilers which will produce so high a pressure may determine the proper length of exposure by burying a small potato four or five inches below the surface of the soil under the pan and applying the steam until it is cooked through. Only one of the fourteen mentioned above used formaldehyde. Formaldehyde at a dilution of 1-50 in water is applied at the rate of ½-¾ gallons to the square foot of surface. Some preferred to change the location of the beds rather than sterilize the soil. In Massachusetts, accurate records were kept on eight beds, the location of which had been changed to places where no tobacco was planted last year. Four of them had wildfire this year, four did not. The practice of sterilizing the beds should be continued not only to destroy wildfire bacteria but also to kill other disease organisms and weed seeds.

Sterilization of Sash and Plank.

The writers (1: 76) in 1921, recommended that old sash and plank be drenched with a 1-50 formaldehyde solution, and this was practiced by a number of growers. Some painted the sash and used new plank.

Data as to the benefits from this practice during 1922 are not very conclusive because in most cases other sources of introduction were not eliminated, but in a few cases under the writers' constant observation clean plants were raised in 1922 under the same sash and with the same sideboards (after sterilizing both) which had been used for badly diseased beds in 1921. Danger of infection from contaminated sash is well illustrated by the following experience of a Connecticut grower: His seed-beds in 1921 were so heavily infected in June with wildfire that the plants were destroyed. The sideboards were destroyed, the beds plowed up and the sash stored over winter in a tobacco barn. The grower in 1922 decided to take no chance of a wildfire infection and contracted with a farmer who did not raise tobacco to grow sufficient plants for his use. The farm on which the plants were grown was remote from any tobacco fields or beds, new land was plowed and fitted and old seed in which there was no possibility of contamination was used. It might be supposed that these precautions would insure freedom from the trouble, but as the farmer growing the plants had no sash, the sash used on the beds in 1921 were taken from the first farm and used on the beds. They were not sterilized, and shortly after the plants were up a very heavy infection occurred on all the beds on which the sash were used. While not absolutely conclusive, the inference is justified that the sash carried the bacteria. Unfortunately no beds without sash were grown on this particular instance, but it might be said that the possibility of contamination from other sources in this case would be slight indeed.

The following laboratory experiment was made with the object of determining how long the bacteria would remain alive on a piece of dry wood such as a side plank or sash:

Experiment 7. Small blocks of pine wood were sterilized and then soaked for eight days in a pure culture of *B. tabacum* in bouillon. Then they were removed to dry sterile tubes where they quickly became dry and were kept so for further tests. The experiment was begun July 1, 1921, and the blocks were kept in the laboratory. At various intervals the blocks were tested for live bacteria by dropping one in sterile bouillon. They were still alive on September 10, but were dead on December 3. Sometime between these dates the last of them died. Apparently, then, they are able to live three month or more on dry wood.

In this laboratory experiment, however, the conditions are not the same as they would be in nature: (1) The wood is dried out more rapidly by the laboratory air than by out-of-doors air. Sash are usually stored in a tobacco shed or barn, while the planks may even be left out in the weather. The conditions in the shed are more favorable than the laboratory for the survival of the pathogene; (2) If sash are kept in the tobacco shed, it is possible for diseased parts of the hanging crop to become lodged on them; (3) If the plank are kept out-of-doors, the moisture conditions would be about the same as for soil. In fact the bacteria might be alive in soil which remains attached to the plank. Since we know that the bacteria can remain alive in the leaves and in the soil over winter, there would seem to be no reason why the sash or plank would not be a source of danger. Wolf and Moss (4: 32), and Fromme and Wingard (3: 22) have presented evidence to show that the germs may be introduced into new beds by the use of old cloth covers which were previously used on infested beds. If such cloth covers or the tent covers used in previous years over wildfire crops are used, they should either be boiled thoroughly in water or soaked in formaldehyde like the sash and planks.

Spraying and Dusting Sed-beds.

Results of the first experiment on the control of tobacco wildfire by spraying or dusting the seed-bed have been published in Bulletin 203 of the Massachusetts Agricultural Experiment Station. Subsequent to the publication of that bulletin the experiment has been repeated at Amherst four times, using a greenhouse bed 4 x 16 feet for each experiment. The plants were pulled and counted when they were large enough for setting in the field, and then the bed immediately seeded for the next experiment. The soil was not sterilized between experiments. The greenhouse bed was used in preference to an out-of-door bed because in this way a longer season could be secured, and the experiment oftener repeated.

Some of the fungicides used in the first experiment were omitted in later experiments because they were found to cause injury to the plants, viz., sulphur dust, lime-sulphur, and the Pickering Bordeaux. NuRexo was used in the second experiment but omitted in the later ones, not because it failed to give control, but because it was thought best to confine the tests to one commercial copper spray. The copper lime dust for Experiment 1 was kindly furnished by the Riches, Piver & Co.; the dust for the later experiments by the Niagara Sprayer Co.; the Pyrox was furnished for all experiments by the Bowker Insecticide Co. In order that all the data may be compared at a glance, the tables of results are first assembled and presented here all together, and then followed by the general discussion.

EXPERIMENT 8.

June 6-July 26, 1921, cloth bed, out-of-doors. Two applications at intervals of 1 week. (Bul. 203).

Fungicide.	Total Number of Plants.	Number of Diseased Plants.	Per Cent. of Diseased Plants	Number of Lesions per 100 Plants.
Bordeaux, 4-4-50 (2 plots	473	6	1.25	2.5
Copper lime dust, 20-80 (2 plots)	534	3	.55	.5
NuRexo (2 plots)	600	3	.48	.5
Pyrox, 10-50 (2 plots)..	570	23	4.1	6.5
No fungicide (4 plots)	1079	527	48.25	178.2

EXPERIMENT 9.

October 10-December 10, 1921. Greenhouse. Three applications at intervals of about a week.

Fungicide.	Total Number of Plants.	Number of Diseased Plants.	Per Cent. of Diseased Plants	Number of Lesions per 100 Plants.
Bordeaux, 4-4-50	848	0	0.0	0.0
Copper lime dust, 20-80	771	3	.38	1.2
NuRexo	747	6	.8	1.2
Pyrox, 12-40	863	5	.58	1.1
No fungicide	1092	221	20.2	37.5

EXPERIMENT 10.

March 17-May 10, 1922. Greenhouse. Three applications at intervals of over a week. Some infection started before first application.

Fungicide.	Total Number of Plants.	Number of Diseased Plants.	Per Cent. of Diseased Plants	Number of Lesions per 100 Plants.
Bordeaux 4-4-50	1637	3	.2	.3
Copper lime dust, 20-80	1449	152*	10.2	30.1
Pyrox, 12-50	1375	140*	10.0	25.8
No fungicide	1714	1322	77.0	484.0

* The explanation of the high percentage of infection in this experiment is presented on page .

EXPERIMENT 11.

May 17-June 22, 1922. Greenhouse. Five applications at intervals of 3 or 4 days.

Fungicide.	Total Number of Plants.	Number of Diseased Plants.	Per Cent. of Diseased Plants	Number of Lesions per 100 Plants.
Bordeaux, 4-4-50	1176	2	.1	.1
Copper lime dust, 20-80	821	0	0.0	0.0
Pyrox, 12-50	1005	3	.3	.5
No fungicide	883	499	57.0	208.0

EXPERIMENT 12.

July 14-August 26, 1922. Greenhouse. Five applications at intervals of 3-5 days.

Fungicide.	Total Number of Plants.	Number of Diseased Plants.	Per Cent. of Diseased Plants	Number of Lesions per 100 Plants.
Bordeaux, 4-4-50	1205	12	1.0	1.2
Copper lime dust, 20-80	1056	3	.3	.4
Pyrox, 12-50	1276	12	1.0	1.2
No fungicide	938	860	92.0	487.0

Experiment 13. In similar experiments at Windsor, the beds were on soil which had grown a heavily infected crop of tobacco in 1921. The beds were not artificially inoculated as in the preceding experiments. The fungicides used were Sanders Dust, No. 1, Niagara 20-80 copper-lime dust, Dosch, 15-85, copper-lime dust, Orchard Brand Bordeaux-lead and Bordeaux-zinc. Seven application were made at intervals of 3 to 5 days. A natural infection developed on the untreated plot and in one corner of a plot next to it. No other wildfire developed on the treated plots.

Discussion of the Dusting and Spraying Experiments.

Frequency of application. The writers last year recommended (1: 81) that the fungicide be applied once a week. Later experiments indicate, however, that this is not sufficient under the following conditions:

(1) When the plants are watered very frequently. On some soils it is necessary to water the beds heavily every day. Most of the fungicide is washed off before the end of a week. This factor was tested in Experiment 10, where the plants were watered and inoculated every day or two. The percentage of infection was fairly high on the Pyrox plot and the dust plot. (The plants in the Bordeaux plot of this experiment were very small and in poor condition on account of accidental burning by cyanide gas which was used to fumigate the house. The low percentage of infection on this plot is not significant.) In the next experiment (Exp. 11) the plants were watered and inoculated less frequently, and the fungicide was applied oftener. The infection was thus reduced again to less than one per cent.

(2) When the beds are exposed to frequent rains. The first rains wash off the fungicide, and later rains spread the bacteria.

Even when the beds are covered during rains there is usually considerable drip through the sash between the glass.

(3) When the plants are growing very rapidly, as they usually are just before setting begins. New leaves are produced so rapidly that many of them will be left unprotected for several days if the application is made only once a week.

No definite interval of time between application can be regarded as safe. There are too many influencing factors. The only safe rule is to *keep all leaves covered at all times with the germicide.* During the very rainy season of 1922 no less than eight or ten applications would have been necessary. Growers have also found it a good practice to dust or spray the beds each time they are pulled over for setting.

Amount of material to be applied. In applying the dust or spray the only safe rule for judging whether enough has been applied is to note whether all leaves are covered. The amount of material required to produce a thorough covering will vary somewhat with the type of machine used and the stage of growth of the plant. In the experiments recorded above, in which a small rotary hand duster was used, it was found that no less than a pound of dust for each application was required to cover a square rod of plants when they are of a size suitable for setting. With the compressed air sprayer which was used 1½-2 gallons of spray material were found to be sufficient to cover the same area.

Relative cost of spraying and dusting. At the local stores in Amherst and Windsor, lime cost $4.90 per bbl. of 280 lbs., or, since a little more if in smaller quantities, about 2c a pound; copper sulphate, 11c per lb.; Pyrox, 20c per lb., and copper-lime dust 10c per lb. Using the amounts per square rod which are indicated above, the cost of materials for eight applications would be as follows:

Bordeaux 4-4-50 ..... 12 cents per sq. rd.
Pyrox 12-50 ..... 58 cents per sq. rd.
Copper lime dust ..... 80 cents per sq. rd.

Thus the cost of a commercial fungicide such as Pyrox is nearly five times as great as that of the home-made Bordeaux, while the cost of the dust is nearly seven times as much. A good compressed air sprayer can be secured on the local market for $7.00 to $10.50, while a suitable dust blower costs $12.50 to $18.50. The advantage which the Bordeaux mixture has in cheapness, however, is counterbalanced by the increased time and labor involved in its preparation. The copper-lime dust is immediately ready for application when received, and the Pyrox or NuRexo has only to be dissolved in water.

Dust vs. liquid sprays. The results of the six series of tests detailed above indicate that the percentage of control is about the

same for the liquid spray as for the dust. In beds where very frequent watering is necessary there might be some advantage in the liquid sprays because when once dried on the leaves, they adhere much better than the dust. The dust, however, has the advantage that it comes up and covers the lower side of the leaves better than the liquid. The dust can be applied more quickly, but thorough dusting with a rotary hand duster is very hard work if continued for any length of time. The dust is also irritating to the nose, eyes and throat. Cheapness of materials and machines is in favor of the liquid sprays. Altogether, the choice between liquid and dust seems to be a matter of personal taste.

Home-made vs. commercial copper sprays. In the control obtained there seems to be very little difference between the results secured by the home-made preparation and the commercial sprays such as Pyrox or NuRexo. Home-made Bordeaux has the advantage of cheapness, while the commercial sprays have the advantage of more rapid preparation for application. If a grower has large beds which require frequent application, certainly it would be more satisfactory to prepare his own fungicide. For small beds the commercial sprays might be more satisfactory. Clinton and McCormick (2: 386) after experimenting with Bordeaux mixture, and a number of commercial copper sprays, recommend home-made Bordeaux mixture as being cheaper and more effective than other copper fungicides. They tried dust on only one bed and had no wildfire there on either the treated or untreated plot.

Best time of day for application. Dust should be applied preferably in the early morning when the plants are wet or after watering. When the copper sulphate and lime in the dust come in contact with water they unite to form Bordeaux mixture, which dries on the leaf and adheres with at least a part of the tenacity of the liquid Bordeaux. If, however, the dust is applied to the dry plant and water then applied, even when the Bordeaux is formed it is mostly washed from the leaf before it dries. Liquid sprays should be applied when the plants are dry because the spray is thus not diluted with water already on the plants, and because less of it drips from the leaves at that time.

Absolute vs. partial elimination of wildfire. It will be noted in the tables given above that in almost all of the sprayed and dusted plots a certain amount of wildfire appeared. Only in a few tests has it been possible to eliminate all infection. In the first five series of tests, however, it should be remembered that sprinkling cans full of water teeming with the parasitic bacteria were sprinkled over all the plants every three or four days. Such a method of inoculation is much more drastic than would occur under natural conditions in the beds of the average tobacco grower.

If the treatment here recommended is faithfully carried out by the grower, we believe that in the large majority of cases no wildfire will be found in his beds. Even if there are occasional infected plants in the bed, the treatment is not a failure. The removal of diseased plants from the field will be much easier if there are only a few of them. Even if they are not all removed the amount of final infection may be expected to be less if there are only a few centers from which it can spread.

Will clean beds give clean fields? Clean beds are not an absolute guarantee that no wildfire will appear in the fields planted from such beds. During the season of 1922 in at least six instances, the writers have convinced themselves by thorough and frequent inspection that the seed-beds of certain growers were entirely free from wildfire, but the disease developed later in the fields planted from these same beds. (Read the paragraph above on "Dissemination" for more details). Such cases, however, should not encourage anyone to believe that no benefit is derived from keeping the seed-bed clean. The worst and the most widespread field infections have usually come from the bed. Starting with clean plants in the field is not the whole measure of success, but it is a long start toward it.

Success by practical growers. During the season of 1922, the writers made frequent inspections and kept careful records on the seed-beds of a number of growers. Untreated checks were not left in any case, and for this reason the results are not entirely convincing. They were unable to find wildfire in any of these beds where the plants were kept constantly covered with the fungicide. On the other hand, it did appear in the beds of many who dusted or sprayed a few times or started to treat only after the disease became evident or used only a scant amount of material.

Value of an arsenical in the fungicide. In the first test some of the fungicides, both the dry and the liquid, contained an arsenical. This arsenical not only was found to be of no value for the control of wildfire, but frequently caused injury to the plants. There seems to be no reason for adding an insecticide.

Dust burn and spray injury. Heavy application of dust or copper spray frequently causes some injury to the plants. It has been commonly noted in the experimental beds at Amherst that the plants in the check plots appear healthier (except for the wildfire), and larger than in the treated plots. Growers have frequently called the writers' attention to this condition in their beds. Sometimes it is much more marked than at other times. Frequently it cannot be observed at all. Certain conditions of the plant or its environment must be responsible for this variation, but it is not as yet known just which conditions favor and which prevent such injury.

Dust burn is evidenced on the leaves by small dead spots of one-eighth inch diameter or less, colored white, brown or darker to black, irregular in outline, commonly bordered by indefinite blanching of the immediately surrounding tissue. This border, however, is narrow and inconspicuous and fades away indefinitely into the normal green leaf. It is quite different and easily distinguished from the halo about the wildfire spot. The leaf area about the spot is also commonly distorted or puckered into radiating wrinkles. Where excessive amounts of dust are used, whole leaves or entire plants may exhibit this wrinkled distorted appearance without central dead spots. This results in dwarfing.

Spray injury resulting from the liquid fungicides is indicated by larger dead areas in the leaves on the margins, tips, or other places where the liquid stands in drops.

Injury from either dust or liquid spray has never been serious, and at most has resulted only in slightly slower growth of the plants in the beds. The plants immediately recover after being set in the field. The injury is never of sufficient importance to discourage the application of dust or liquid spray.

Secondary benefits. Practical growers have frequently called attention to the absence of flea beetle in the treated beds. One prominent grower has stated that he would spray whether he had wildfire or not, because the beds were free from these insects. Copper lime fungicides are known to repel flea beetles.

Frequently when the plants are thick in the bed and kept damp, they rot off at the base of the stem. It has been commonly noticed that this condition does not occur when the beds are properly treated with a fungicide.

Conclusion. Any grower who will start when the plants are no larger than a dime, and keep the leaves covered at all times with copper lime dust or any other good copper fungicide, can control wildfire in the seed-bed. We agree with Clinton and McCormick (2: 386) in the following quotation except that we would include dusting as well as spraying: "We are convinced that spraying of tobacco beds should be made one of the routine practices of tobacco growing as long as there is danger from wildfire. * * * We have evidence that plants thoroughly coated with the spray do not become infected anything like unsprayed plants in the same bed. Spraying to be most effective, however, must start before the appearance of wildfire, and be continued until the end of the transplanting season. We would start with the young plants that have just taken root, and whose largest leaves are about the size of a thumb nail. * * * *Spraying, we believe, is the only remedy that prevents spread of the wildfire in a seed-bed, no matter what the source of its introduction.*"

Destroying Diseased Areas in the Bed.

It is characteristic of the disease that when it is first found in the beds it does not occur uniformly over the bed, but is usually found in round spots which may be from a few inches to several feet in diameter, depending on the length of time during which the spot has been spreading. If only one of a few spots are found in a bed, it is sometimes possible by prompt action to keep the rest of the bed clean. This may be done by immediately destroying all the plants by drenching them with a 1-10 formaldehyde solution. Not only the spot, but all the plants within a foot or two beyond it must be killed. This treatment was successful in preventing further spread in one bed in Sunderland, in one at Hatfield, and two in Windsor, all of which were under the writers' constant observation during the summer. Glass should be removed from the bed at this time unless it is desired to kill the whole bed or a covered section of it. Plants should not be hoed out or pulled out before treatment, since this only serves to spread the trouble. Plants around the burned-out areas should be watched carefully for further spread. Spraying or dusting should also be started at once if it has not been practiced previously.

Removing All Plants from a Diseased Field and Resetting with Healthy Plants.

Two fields have been under the careful observation of the writers during 1922 in which this practice was adopted, but in both cases it resulted in failure. In one field in Hadley and one in North Hadley, when the plants were about a foot high, they were found to be practically all infected. All were removed from the field, and after it had been harrowed the field was reset with healthy plants. In both cases before the new plants were ready to harvest they became almost as badly infected as the old ones. Apparently the pathogene remains in the soil and, under favorable conditions, will infect the new crop. The grower can gain by this practice only when the weather changes for the better during the growth of the second crop. The same principle would apply also to the restocking of a field where only a part of the plants were diseased. This was tried on a large scale by a grower of shade tobacco at North Hadley, who removed only the diseased plants (about 10%), and restocked with healthy plants, but he failed to control the disease. The following experiment bearing on this point was tried at the Windsor station:

Experiment 14. In one plot nineteen diseased plants were found ten days after setting. They were all removed and replaced by healthy plants. Eleven out of the nineteen resets developed wildfire later.

During 1921, a number of growers practiced either partial or complete restocking with healthy plants after diseased ones were

removed, and little or no wildfire appeared later in the field. The same was true of some Connecticut fields in 1922. This apparent control may have been due to weather conditions which were not favorable for infection of the plants of the second setting. At any rate, the results were contrary to most of our experience of 1922. In view of the latter it seems questionable whether restocking should be recommended.

Roguing Without Resetting.

When only a few plants in a field are diseased it is probably best to remove them from the field and leave empty the places from which they were taken. This was tried with success by three growers in North Hadley whose fields were under the writers' observation during the present season. Other growers have told the writers that they kept wildfire in check by this method.

Experiment 15. In a plot at the Windsor station where five plants were found to be diseased ten days after setting, they were all removed and the places not filled. The surrounding plants were inspected regularly, and in two cases they became infected later. In a later experiment where the plants were about one and one-half feet high, the diseased ones were removed and not replaced. Before harvesting, however, wildfire had appeared on the adjacent plants and had spread 4-6 plants to the windward and along the row.

It is reasonable to believe that bacteria which came into the soil from the original diseased plant would have less opportunity for further infection if no plant replaced the diseased one which was removed. Certainly the danger of surrounding plants becoming infected is diminished by removal of infected ones from the field. On the whole there is no question but that this practice of roguing will help to a great extent where there is only a light infection in the field, especially if the plants are pulled when small. After plants are half-grown, however, under favorable conditions, the disease may spread in its customary manner and it may be necessary to remove plants or infected leaves from plants for some distance around the original point of infection.

Picking Off Diseased Leaves.

If the plants are large and infection is light, a certain amount of benefit may be derived from removing all diseased leaves and carrying them from the field. The principle of this measure is the elimination of as many as possible of the centers of spread. Then when the rains come the number of bacteria splashed to the healthy leaves will be greatly reduced. This method was tried by Anderson on a four-acre field in Whately.

Experiment 16. Infection in this field started from about 6-8 rows near the east side which had been planted from a diseased bed. At the time when the experiment was started a majority of the plants in these rows were diseased, and it had spread more or less to plants on adjacent rows. There was practically no infection on the west half. On June 30, all diseased leaves were picked from the east half (48 rows). No attention was paid to the west half. On the badly infected rows mentioned above a large basketful of leaves were taken from each row, some of the plants being left almost without leaves. It was picked again four days later, the weather having been very rainy during the last month. Probably as many leaves were removed the second time as during the first picking. It was picked over at short intervals five times afterward, and with each picking the number of diseased leaves decreased until on July 26 hardly a diseased leaf could be found. After the heavy rains of the last few days of July and the first of August, however, wildfire began to appear again on the picked side of the field, but to a greater extent beyond the forty-eighth row where no picking was done. The field was harvested on August 8. On that date the picked and unpicked sides of the field were inspected by Mr. Arthur Hubbard, W. H. Davis, D. Potter, C. M. Slagg, Dr. James Johnson and the writer, and it was the opinion of all that the unpicked showed much more wildfire than the picked side. Mr. Hubbard was of the opinion that the east half would not have been worth harvesting if the disease had been left to take its natural course. The loss in weight from removal of the diseased leaves was not serious. As previously mentioned in this report there was good evidence that when infection began again during the first few days of August, it came from bacteria which were in the soil. This source of infection cannot be eliminated and will probably prevent this method of control from ever being entirely successful. In view of the fact, however, that the season of 1922 was unusually favorable to the spread of wildfire, the results of the experiment are encouraging.

A similar experiment was conducted on a Round Tip plot at the Windsor station, and with similar results. Growers who tried picking off affected leaved are divided as to their opinion of the practical value of the method. The degree of success varied according to the kind of tobacco and method of harvesting. Chances of success are better in primed tobacco because after harvesting starts the leaves are picked so rapidly that the disease does not have an opportunity to get a good start, and it also becomes increasingly difficult for the germ-laden soil to splash to the first leaves. Field observations on the picking of leaves during 1922 lead to the following conclusion:

On the shade Cuban, favorable results were almost uniformly obtained, and the disease was practically eliminated. On Havana and Round Tip, where diseased leaves were removed, there was a considerable variation in the results with a majority of fields showing decided benefit. In Broadleaf there did not seem to be anything gained by picking off the leaves.

For anyone who contemplates this method of control it is recommended that (1) the first inspection be made as soon as the plants are established in the field; (2) the leaves be picked off twice a

week as long as any diseased ones can be found; (3) sand leaves of diseased plants be picked also.

Clinton and McCormick (2: 396) also experimented with removal of diseased leaves, and as a result were somewhat doubtful as to the benefits.

Dusting the Plants in the Field.

The value of dusting the plants in the field with copper-lime dust was tried by two Massachusetts growers under the writers' supervision during the season.

Experiment 17. Twenty-four acres in Hadley were first dusted with a four-row traction duster which was kindly furnished by the Niagara Sprayer Co., on July 6 when the plants were 12-18 inches high. The infection was bad in parts of the field when the experiment was started. Four rows were left without dust. There were very heavy rains on the 8th, and the second application was made on the 13th and 18th. During July there was very little spread of wildfire in any fields, and the palnts grew enormously. By the first of August the plants had grown until the machine could not be drawn through the field without serious damage to the plants and, therefore, no more applications were made. There was considerable spread of the disease during August and up until it was harvested about the middle of the month. A comparison of the treated and unterated rows at that time showed no difference in the amount of the disease. No accurate counts were made but a cursory examination while walking between the rows did not indicate any benefit from the two applications of dust. It was also noticed that there were dust-burn spots on the treated leaves similar to those which have been previously described as occurring in the beds. The owner feared that if the dusting were continued, the spots might affect the market of the crop.

Experiment 18. Another grower in North Hadley dusted two fields with the machine used in Experiment 17, but more frequent applications were made. Wildfire was not controlled, the results being similar to those of Experiment 17.

Experiment 19. On one of the Windsor station plots Round Tip tobacco which showed a heavy mixed infection of wildfire and angular leafspot on the bottom two or three leaves when the plants were from one to one and one-half feet in height, a copper-lime dust was twice applied to four rows, with a five-day interval between the first and second treatments, no rain falling in the interim. Six rows were left untreated for comparison. For about two weeks after treatment, the spread of the disease in the dusted rows was practically nil, while in the undusted rows it spread steadily but very rapidly. After this time three rainy days ensued, but purposely no more dusting was done. After harvest time it was found that the amount of wildfire on the dusted rows was only fifteen per cent. (estimated from partial count on cured tobacco) less than on the rows which had not been dusted.

No doubt if the leaves in the field could be kept covered with dust all the time, the disease could be controlled, but this would require more frequent applications, and when the plants become large it cannot be done without considerable breaking of the leaves. Control by this method is probably possible, but not

economically so. Further experiments, however, are planned. It was found that the dust adhered much better if applied early in the morning while the plants were still wet with dew.

Spraying with Bordeaux Mixture in the Field.

Bordeaux mixture was tried with the idea that it would adhere to the leaves more tenaciously, and hence so many applications would not be necessary as when dust was used.

Experiment 20. A field of twelve acres in North Sunderland was sprayed on July 11 with 4-4-50 Bordeaux. No further applications were made because the owner feared that the material would remain permanently on the leaves and affect its sale. An examination on August 14, when the crop was being harvested, showed that it was present in large enough quantity on many of the leaves to give them a decidedly blue cast. A comparison of the sprayed and unsprayed rows showed no difference in the amount of the disease.

Clinton and McCormick (2: 395) experimented with Bordeaux mixture in a preliminary way, and found that it retarded spread of the disease, but did not consider it practical because of cost and unknown effect of the spray on the quality of the mature leaf.

A few Connecticut growers tried spraying in the field in 1921, and reported good control. This year several growers of sun as well as shade-grown tobacco sprayed plants in the field, from one to six times, until the plants were too large to permit of further treatment, but the results have not been encouraging in the case of sun-grown tobacco. While the treatment seemed to check the disease for a time, later in the season, after the plants had grown too large to continue the treatment, wildfire spread rather rapidly, and at harvesting, little difference could be observed between the sprayed and unsprayed areas in the same field. In the case of one grower who had a rather bad field infection when the plants were small, the use of a Bordeaux mixture applied twice on part of the field when the plants were small checked for a long time any further spread of the disease, and at harvesting time the part of the field sprayed twice showed much less wildfire than the unsprayed part of the field.

Bordeaux mixtures are cheaper and, under field conditions, remain on the leaves a longer time, which is, of course, desirable from the infection standpoint, but a disadvantage when the plants are more than half-grown, as it remains on the leaves, and the blue color would be undesirable after the cure.

Another factor operating against the efficiency of dusts or sprays in the field is that after the plants are about half grown, it is a practical impossibility to operate a duster or sprayer to advantage, and one is obliged to stop the treatment at what might be termed the critical period, as it is well known there is often a heavy wildfire infection just prior to maturity.

It is believed, however, that some benefit might be obtained from dusting or spraying when the plants are small and until they are about a foot high, particularly if spraying or dusting were combined with picking off diseased leaves, and the spraying or dusting repeated at very close intervals, say two or three times a week for a period of two weeks or so.

It is believed that the application of dusts or sprays to tobacco in the field is worthy of further consideration, both by the growers and the station, and next season more detailed experiments along this line will be carried on.

At present, however, the evidence at hand is not very favorable for this method of control.

The Outlook for 1923.

The question now most frequently asked by the grower is: What can we expect from wildfire in 1923 and in the following years? Will it continue as prevalent and troublesome as it has been in 1922? Will it become worse after our land is thoroughly infested with the germ? Or will it gradually disappear? Frequently tobacco growers have told the writers that they would stop raising tobacco if they thought the disease would continue to be as serious as it has been during 1922. No man can predict its future behavior with certainty or anything which approaches certainty, but we can base some judgment on (1) what we know about its relation to weather conditions, and (2) its behavior in states where it has been present longest.

We know that the disease can spread only when the rains are long continued or follow each other in close succession, i. e., when the water remains for long periods on the leaves. The summers of 1921 and 1922 were, for the most part, ideal in this respect for the spread of the disease. They have not been average summers for the Connecticut Valley. The disease will not be as destructive during an average growing season. We do not believe that wildfire will soon disappear from the valley, but during a dry summer it might not cause any damage. After a succession of unfavorable seasons the sources of infection might be so reduced that it would cause little trouble even with the return of a summer favorable for its spread. The above opinion is supported by the course which the disease has taken in the South. Five years ago it was destructive there. In 1921 the season was very dry, and the injury from wildfire was slight. The season of 1922 is said to have been not unusually dry, but the disease has not returned to any extent. Our advice to the Connecticut Valley grower is to plant as usual, take a chance on the weather, but to omit no precaution recommended against wildfire.

Condensed Recommendations for Control.

There is no one measure by the use of which a tobacco grower may be assured of raising a clean crop. As long as wildfire is in the valley, he must start before the seed is planted, be ever on the alert and ready to put into practice any part or all of the season's program which may now be briefly summarized:

1. Select seed only from plants known to be free from the disease. If possible, go a step farther and take only from fields known to be disease-free. Protecting the flower heads with bags may be useful. Old seed is less likely to be contaminated.
2. If there is doubt about the seed being sterile, soak it in a cheesecloth bag for fifteen minutes in 1-1000 corrosive sublimate, wash and spread out to dry.
3. If possible, locate seed-beds only on land where there was no wildfire during the previous year and where there has been no opportunity for contamination.
4. Sterilize soil with steam at 100 pounds pressure for thirty minutes, or with formaldehyde 1-50 at the rate of one-half gallon to the square foot. It is safer to sterilize walks also. Spring sterilization is safer than fall sterilization.
5. Drench boards and sash with formaldehyde 1-50. If cloth is used, it should either be new or should be boiled in water or treated like the boards and sash. If sash and plank are new or have never been used for tobacco beds, they need not be sterilized.
6. Keep the plants covered with copper-lime dust or a copper spray such as Bordeaux mixture, at all times, from the stage when they are as large as the finger nail until setting is completed.
7. Remember that the germs can be carried from one bed to another on the hands, tools, sash, etc., and avoid such chances.
8. Adopt a system of bed management which will keep the leaves moist during the shortest length of time compatible with the production of good plants.
9. If the disease appears in certain spots in the bed, these spots along with a broad margin of plants which appear healthy should be killed by drenching with 1-10 formaldehyde.
10. Pull plants for setting only from disease-free beds.
11. Starting as soon as the plants have recovered and begun to grow in the field, make frequent inspections and remove every diseased plant from the field.
12. Do not work in a field where there is any wildfire while the leaves are wet.
13. Removal of diseased leaves at intervals of three or four days where the infection when first found is light, will reduce the

numbers of centers of spread, and may materially reduce the percentage of wildfire in the crop when harvested.

14. Do not topdress fields on which tobacco is to be planted with stalks or refuse from badly infected crops.

15. Rotate tobacco with other crops if practicable.

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CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN NO. 3 OF THE TOBACCO SUB-STATION

The Connecticut Agricultural Station,
E. H. JENKINS, Director, and
The Connecticut Valley Tobacco Improvement Association,
G. H. CHAPMAN, (Windsor), Research Director, Co-operating

Experiments in the Curing and Fermentation of Connecticut Shade Tobacco

FEBRUARY, 1923

Notice to Growers:

If you wish to receive future bulletins regarding tobacco, please send your correct address to the Station at New Haven or to the Association.

Experiments in the Curing and Fermentation of Connecticut Shade Tobacco, 1922.

G. H. CHAPMAN.

It is a well-established fact that the curing of tobacco is a life process, and that fermentation has to do with the changes taking place after the cells of the leaf are dead. It is readily understood, of course, that under certain conditions the two processes may take place simultaneously, particularly in the later stages of the curing.

As has been pointed out by Dr. W. W. Garner, of the Bureau of Plant Industry, curing involves principally the two somewhat similar physiological processes of respiration and translocation of mobile nutrients. The course of these processes, especially respiration, is greatly influenced by the prevailing temperature and humidity. These factors largely determine the character of the cured leaf.

Except in a rough way it is impossible to control temperature or humidity in ordinary shed curing of shade or stalk tobacco, and consequently in our climate, where rapid changes in temperature and humidity are prevalent, there usually is found, even in a crop of good growth, a wide variation in color and leaf quality in different seasons, and sometimes in the same season.

Many attempts have been made to perfect an artificial or controlled method of curing tobacco, but until automatic control apparatus was devised, little progress was recorded, which would tend to make the grower independent of weather.

The Carrier Engineering Co. of New York, and particularly Mr. A. C. Buensod of that company, have spent a number of years working on the application of control methods to the curing of tobacco, and to a certain degree they have been successful in devising satisfactory equipment for the control curing of cigar leaf tobacco. It was the writer's good fortune to have assisted for two seasons in the development of this process on a commercial scale in Porto Rico, and it was believed it would be possible to obtain satisfactory results on Connecticut tobacco. Some work along this

line had already been done by Mr. W. S. Pinney of Suffield, and Mr. Buensod. It was hoped that very interesting data could be secured without going to the expense of erecting a plant at the station this year, by using a cabinet of small dimensions holding a dozen or more sticks of tobacco, and on which cabinet the same control apparatus as employed in commercial plants was attached. A description of the cabinet used in these experiments is given below:

Description of Cabinet.

The cabinet is built of two galvanized iron casings with a two-inch layer of magnesia between to provide for sufficient insulation to protect the interior from being affected by any external changes

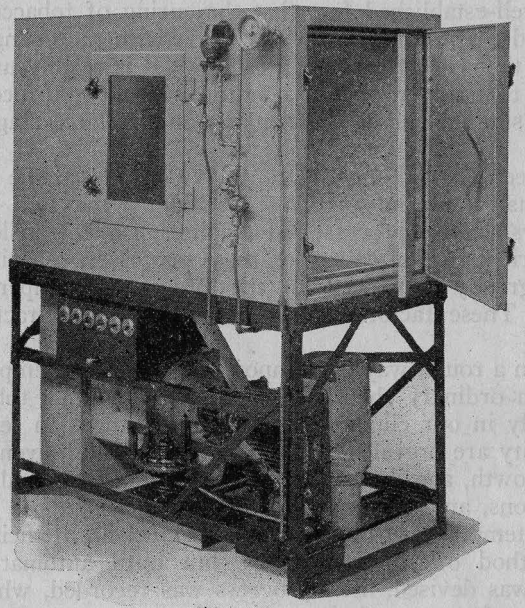

Figure 1. Carrier Ejector Processing Cabinet, showing arrangement of controls.

of temperature. Fig. (1) shows the general arrangement of the experimental cabinet with control apparatus in place. The air circulation within the cabinet is accomplished by the Carrier ejector system. Air from the fan is blown through a series of cone-shaped nozzles located across the end of the cabinet near the ceiling. The entire volume of air within the chamber is kept in con-

stant motion following a circuit beginning with a rapid movement across the top of the chamber and completed by a slower movement in the opposite direction across the remainder of the chamber. Dampers control the relative amounts of fresh air or return air

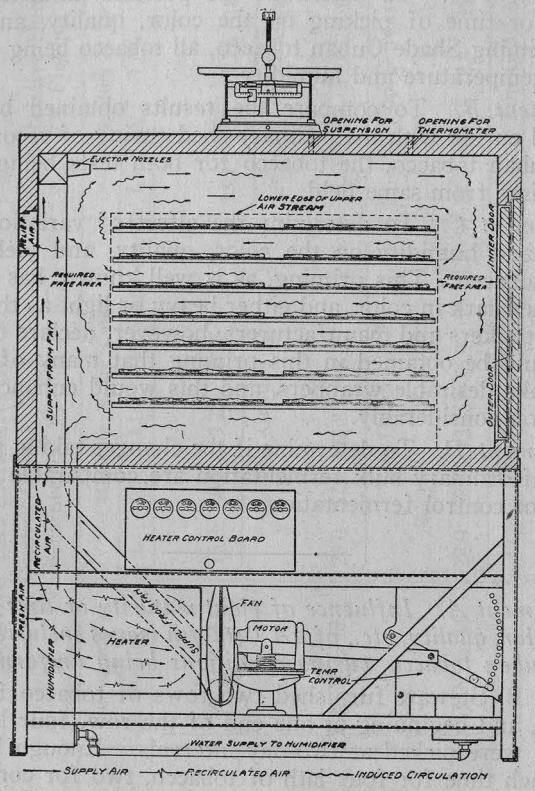

Figure 2. Cut showing air circulation in cabinet. Note particularly induced circulation.

used. Fig. (2) shows the movements of air currents in the chamber.

Humidification is brought about by atomizing spray nozzles operated by compressed air. Almost any humidity can be obtained at will. The humidity is controlled by a hygrostat which may be set at any desired point. The temperature is controlled by a thermostat which also may be set wherever desired. Once adjusted, uniform conditions of temperature and humidity may be maintained indefinitely, as the controls operate the heaters and sprays automatically.

Object of Experiments.

The several experiments which were carried on during the season are here outlined:

Experiment A. To determine the possible influence of plant maturity or time of picking on the color, quality, and yield of second priming Shade Cuban tobacco, all tobacco being cured with uniform temperature and humidity.

Experiment B. To compare the results obtained by artificial or control curing with the ordinary shed curing of second priming Shade Cuban tobacco, the tobacco for both tests being harvested at same time from same field.

Experiment C. To determine the effect of variations in temperature and humidity on the color, quality, and yield of third priming tobacco. This priming, as is well known, has a tendency to be rather dark in color, and either heavy or light as the case may be. The packers and manufacturers, however, declare that if light colors could be obtained in this priming that many of the leaves would make desirable wrappers, and this would enhance the value of the crop considerably.

Experiment D. To determine if the changes taking place in the process of ordinary bulk fermentation are comparable to those of artificial or control fermentation.

Experiment A. Influence of plant maturity or time of harvesting on color, quality, etc., of 2A (4th-7th leaves inclusive) priming Shade Cuban tobacco, curing conditions being uniform.

Mr. J. B. Stewart furnished two rows of tobacco for this experiment, and beginning at one end of the row, four leaves (4th-7th inc.) were picked at two-day intervals. Enough leaves were picked each time for four lath of tobacco, two for control curing and two for barn curing. The leaves were picked "running", no attempt being made to reject undesirable leaves or plants. This tobacco was set the 19th of June, and the first lot of 2A priming leaves was taken August 3d, forty-five days from time of setting. The last lot was taken August 28th, sixty-seven days from time of planting. The first lot would be classed by growers as too green, and the last lot as over-ripe. In this experiment the curing was carried on at a temperature of 95° F., and a relative humidity of 81-82%. Table (1) gives the data on the various pickings and the per cent of grades produced. For grading purposes, lots A, B, C, D (very immature to slightly immature) were grouped together as were E, F, G, H, I (slightly immature to mature) and J, K, L, M (mature to over-ripe).

TABLE I.

CURING EXPERIMENT A.

Control Cure.

Tobacco Set June 19, 1922.
Tobacco from J. B. Stewart.

Temperature 95° F.

Relative Humidity 81-82%
2A Picking (4th-7th inc.)

Lot.	Date of Picking.	Days in Field.	*Days in Cure.	Grouping of Lots for Grading.	†Grading % by Count.					†Grading % by Weight.				
					L	LV	LL	V	All Others.	L	LV	LL	V	All Others.
A-1	Aug. 3	45	8											
B-1	" 5	47	8											
C-1	" 7	49	8	A B C D	13.8	40.7	19.75	19.35	6.4	13.1	41.0	21.25	18.05	6.6
D-1	" 9	51	8				Top Grades 93.6					Top Grades 93.4		
E-1	" 11	53	10											
F-1	" 13	55	8											
G-1	" 15	57	8	E F G H I	25.0	52.0	11.8	8.95	2.3	16.65	60.0	11.65	8.35	3.35
H-1	" 17	59	9				Top Grades 97.75					Top Grades 96.65		
I-1	" 19	61	9											
J-1	" 21	63	7											
K-1	" 23	65	7											
L-1	" 25	67	7	J K L M	28.0	32.85	13.75	16.9	8.50	28.2	33.55	12.8	18.25	7.2
M-1	" 28	70	7				Top Grades 91.5					Top Grades 92.8		

* Leaf web all cured. Removed to shed to let stems cure out.
† Grading done after fermentation.

Control Curing. A study of the above table brings out some rather significant data on effect of maturity as related to the cure of tobacco, at least in so far as the season is concerned. While the actual number of days in the field would probably vary from season to season, the results on maturity effects would be the same. It will be observed that grading percentages are given not only by weight, which is the customary method of stating the yield of different grades, but also by count of leaves in the different grades.

It will be observed that in all three groups the percentage of the four top grades was higher than is obtained by the ordinary method of barn curing.

Lot A-D inclusive, green tobacco, yielded of L's and LV's 54.1 per cent, while lot E-I inclusive, slightly green, yielded 76.65 per cent, and the ripe to overripe tobacco in lot J-M inclusive, yielded 61.75 per cent of these grades. There can be no question but that lot E-I, picked from fifty-three to sixty-one days after setting in the field, yielded the largest amount of fancy tobacco, followed by lot J-M, consisting of ripe to overripe tobacco picked from sixty-three to seventy days after planting. The immature or very green tobacco, lot A-D, picked from forty-five to fifty-one days after setting, yielded the lowest percentage of L's and LV's. It is to be noted that in this grading the percentage of LV's is considerably larger than of the L's. The difference between these two grades was very little and, under ordinary sorting conditions, most of the LV's would be classed as L's. In fact, in lot E-I, after the sorting was completed one packer was unable to differentiate when the lots were mixed, between the L's and the LV's, and stated that they should all be put into one grade, L's.

It is also worthy of note that while in lot J-M, the percentage of L's by weight is greater than in either of the other lots, the drop in LV's is also much greater. It is also to be noted that on the very green tobacco the percentage of LL's is almost double what is found in either of the other lots. Another fact worthy of note is that in lot E-I, the percentage of the V grade is less than half that found in either lot, A-D or J-M.

The quality of the tobacco in lot E-I also was much better than in either of the other two lots.

The percentage of grades in all the lots, however, is very satisfactory, but this high percentage, of course, is due to the control of temperatures and humidities during the cure.

We are led to conclude from this experiment that Cuban Shade tobacco harvested slightly on the green side will yield a higher percentage of top grades than tobacco picked very green or ripe to overripe, and that with growing conditions approximating those of last season the second picking should be taken from fifty-one to sixty-one days after setting in the field.

Of course in a different season or under different growth conditions the yields might, and probably would, vary somewhat from those obtained this past season. It would seem questionable if we can ever get a definite time limit in which to pick tobacco in varying seasons, but possibly after further study it may be found that for a given set of growing conditions we may be able to closely approximate the period for taking the different pickings. Any data that would give us information on this point would be better than the haphazard way in which tobacco is picked at present. All observations to date indicate that much of the tobacco is harvested too late to give a maximum percentage of top grades.

With control methods of curing, however, it can be seen from the above that it is possible to extend the picking period over a considerable length of time and still produce a high yield of desirable tobacco. This can not be done in barn curing. This is brought out forcibly as a study of the results obtained in Experiment *B,* which is described as follows:

Experiment B. A comparison of artificial or control curing with ordinary barn curing of second priming Shade Cuban tobacco, the tobacco being taken from the same field and harvested on the same date.

The tobacco used in this experiment was from the same field as that used in Experiment *A,* and, as stated in the description of that experiment, double the number of leaves needed were harvested each time, one-half of each lot being used in Experiment *A,* and the others in Experiment *B.* The data as to setting and harvesting is the same as in Experiment *A.* The only difference between *A* and *B* is that *A* was cured under control conditions, and *B* was cured in the shed.

In Table (II) will be found the data together with the per cent of grades obtained from barn curing. As in Experiment *A,* lots A-D inclusive, very immature to slightly green, were grouped together, as were lots E-I inclusive, slightly green to mature, and lots J-M inclusive, consisting principally of overripe tobacco. As in the previous experiment the grading per cent is given by weight and count as well.

TABLE II.

CURING EXPERIMENT B.

Barn Cure.

Temperature Variable. Relative Humidity Variable.
2A Picking (4th-7th inc.)

Tobacco Set June 19, 1922.
Tobacco from J. B. Stewart.

Lot.	Date of Picking.	Days in Field.	Days in Cure.	Grouping of Lots for Grading.	†Grading, % by Count. L	LV	LL	V	All Others.	†Grading % by Weight. L	LV	LL	V	All Others.
A	Aug. 3	45	Until Cured	A B C D	0.0	13.05	10.55	23.6	57.8	0.0	10.3	11.95	24.05	53.7
B	" 5	47			Top Grades 47.2					Top Grades 46.3				
C	" 7	49												
D	" 9	51												
E	" 11	53		E F G H I	12.85	19.5	16.5	22.15	29.0	15.05	19.45	15.65	27.1	22.75
F	" 13	55			Top Grades 71.0					Top Grades 77.25				
G	" 15	57												
H	" 17	59												
I	" 19	61												
J	" 21	63		J K L M	3.0	13.4	19.0	31.3	33.2	2.15	18.85	21.45	34.0	28.55
K	" 23	65			Top Grades 66.7					Top Grades 76.45				
L	" 25	67												
M	" 28	70												

† Grading done after fermentation.

Before making a comparison between the barn curing and control curing, a discussion of the per cent of the various grades produced in the different lots of the barn-cured tobacco is given, as this shows even more clearly than Experiment *A* the influence of maturity on percentage of high grades obtained. Lots A-D inclusive yielded only 46.3 per cent of top grades, of which only 10.3 per cent were L's and LV's. Lots E-I inclusive yielded 77.25 per cent of the four top grades, of which 34.5 per cent were L's and LV's. Lots J-M inclusive yielded 76.4 per cent of the four top grades of which only 21 per cent were L's and LV's.

Here is clearly indicated again that under growth conditions existing this past season, second priming tobacco harvested fifty-one to sixty-one days after setting in the field yielded by far the best tobacco. That which was picked too green produced only a comparatively small per cent of high grades, while the tobacco picked in the middle period as compared with the later period yielded totals of the four top grades nearly alike. It is significant to note in the overripe tobacco a considerably larger per cent of LL's and V's, which, of course, are less valuable, than in the tobacco picked in the middle period.

It is worthy of note that although in our barn curing of the tobacco we obtained for leaves picked in the middle period 77.25 per cent of the four top grades, Mr. Stewart, harvesting the same picking on the same field on August 13th (early in this period), obtained a yield of 90 per cent top grades in barn curing, which is rather phenomenal for this past season. It may be said that the run of top grades this year in Shade Cuban tobacco for this particular picking does not appear to run over 75 per cent, and on many plantations is much lower than this.

It is obvious that the time of picking is an even more important factor in barn curing than it is in control curing. We should particularly guard against picking the tobacco too green, but on the other hand, if it is allowed to mature, as it often is, the percentage of L's and LV's is reduced. It is sometimes very difficult to judge when the tobacco is ready to be harvested, but it is one of the most important factors in the production of desirable leaf, and in case of doubt the picking should be on the green or immature side, rather than wait for full maturity of the tobacco.

A direct comparison of the results obtained in control cured vs. barn cured 2A priming of Shade Cuban tobacco is given in the following table in tabular form. Duplicate lots of tobacco as shown in Tables (I) and (II) are compared:

TABLE III.

COMPARISON OF BARN CURE WITH CONTROL CURE.

Duplicate Lots Cured.

Lot.		Grading % by Weight.				
		L	LV	LL	V	All Others.
A-D (very immature)	Control Cure	13.1	41.0	21.25	18.05	6.6
	Barn Cure	0.0	10.3	11.95	24.05	53.7
E-I* (slightly immature)	Control Cure	16.65	60.0	11.65	8.35	3.35
	Barn Cure	15.05	19.45	15.65	27.1	22.75
J-M (mature-overripe)	Control Cure	28.2	33.55	12.8	18.25	7.2
	Barn Cure	2.15	18.85	21.45	34.0	28.55

* In Mr. Stewart's 2A priming from this field picked with lot *F*, barn cured, which has been stated as sorting 90 per cent. four top grades, the grading was as follows: L's and LV's 73 per cent., LL's 17.3 per cent., V's 0.0 per cent., all others 10 per cent. This is closely comparable with results here.

It is unnecessary to go into further discussion of the results obtained by the two methods of curing. The conclusion is obvious. One point, however, is worthy of repetition; with control curing, aside from production of a higher per cent of desirable grades as compared with barn curing, the time during which tobacco *can be picked* and still yield very large quantities of top grades is at least three times as long as when the tobacco is barn cured.

If this or a similar process of control curing can be economically installed for Connecticut Valley tobacco, many of the losses now met with will be avoided and profit assured.

Experiment C. To determine the effect of variations in temperature and humidity on the cure, particularly as regards color of third priming tobacco.

The production of more light tobacco in third priming Shade Cuban would raise the value of the crop considerably, and in this experiment an attempt to secure data as to the temperature and humidity conditions necessary to bring about this improvement in the color of the third priming was made.

Owing to the fact that only one curing cabinet was available, it was impossible to secure data on tobacco picked on any one date, subjected to variable temperatures and humidities. It was necessary to proceed as in our other experiments, picking the tobacco at intervals, and varying the temperature and humidity conditions at different times. This, of course, necessitated the later picked lots of tobacco being cured under different conditions than the earlier, but it was not believed this would operate against the value of the experiment, as it is almost axiomatic that the riper tobacco gets, the lighter will be the *general* color, although as it ripens there is a great tendency to spotting and double colors. The tobacco used in this experiment was a third priming from the plantations of Messrs. Ransom and A. A. Clark. In the table given below is shown the date of picking, the length of time in cure, and the results obtained.

TABLE IV.

CURING EXPERIMENT C.

Control Cure.

Tobacco from { J. Ransom. / A. A. Clark. } Third Priming (13th-16th leaves inc.)

Lot	Date of Picking.	Days in Cure.	Temperature of Cure	Relative Humidity	Character of Tobacco Colors.
A-1	Aug. 23	13	95° F.	81%	Fair (Light brown—dark muddy)
B-1	" 27	11	" "	"	Fair (Light brown—Red)
C-1	" 30	10	" "	"	Fair (Light brown—Red)
D-1	Sept. 1	10	" "	81-83%	Fair (Light brown—Red)
E-1	" 4	10	95-100° F.	83%	Poor (red—dark muddy)
F-1	" 5	9	" "	"	Poor (red—dark muddy)
G-1	" 7	11	100° F.	"	Fair (Light brown—dark muddy)
H-1	" 9	10	" "	"	Very poor (blue black)
I-1	" 11	9	" "	"	Very poor (blue black)

The conditions carried on lots A-D inclusive were 95° Fahrenheit and 81 per cent relative humidity. The relative humidity was then raised to 83 per cent, and the temperature to 100° Fahrenheit, lots *E* and *F* being subjected to this rising temperature and humidity, while lots *G* to *I* inclusive were cured uniformly at a temperature of 100° Fahrenheit and 83 per cent relative humidity.

We had no data to indicate the probable optimum temperature and humidity to use as in the case of the second priming tobacco. Examination of the different lots after curing would indicate that the curing of this third picking was much too fast, and that possibly lower temperatures should have been used. It will be noted that lots A-D inclusive, which were more immature tobacco and cured at a temperature of 95° Fahrenheit and 81 per cent relative humidity, are reported as fair in color, while the lots E-I inclusive, cured at temperatures from 95-100° Fahrenheit and relative humidity of 83 per cent, are very dark in color, muddy, and less desirable than barn cured third picking from the same field. Lots A-D inclusive, however, compare very favorably with the average run of third picking this past season, but there is not sufficient increase in light-colored grades of tobacco, and the results obtained in these experiments are negative. It is believed that with lower temperatures, keeping the tobacco alive for a longer period, more favorable results would be obtained.

It would seem that if we can subject third priming Shade Cuban tobacco to proper temperatures and humidities in a correct relation in control curing, it ought to be possible to produce light-

colored tobacco, and more work along this line is planned. It is known that under favorable conditions in barn curing, we occasionally get very nice third priming tobacco.

We know that late fertilization and other factors influence the character and composition of tobacco to a great extent, particularly the body and color; but as the development of color in curing is so dependent on temperature and humidity, it would seem that unless the leaf composition of the upper leaves of Shade Cuban tobacco is such as to preclude the control of the various changes, favorable results ought to be obtained.

Experiment D. To compare the changes taking place in bulk fermentation and in "open" or control fermentation of tobacco.

Mr. Buensod has been very much interested in the possibility of the control method being applied to the fermentation of tobacco as well as to the curing, and has done considerable work in Porto Rico along this line. Some of the tobacco, both barn cured and control cured, was in part bulk fermented at the warehouses of the American Cigar Co., and duplicate samples were fermented by the open method (so-called) in the experimental cabinet.

In this method the hands are pinned as closely as possible on the lath and hung in the cabinet and there subjected to the desired temperature and humidity. Some of the lots were fermented in the cabinet for a longer period than others, the temperature carried ranging from 114-115°, and the relative humidity 81-85%. The time of treatment varied from 5½ to 17½ days.

The results obtained were not encouraging although the tobacco *looked* to be fermented sufficiently, and the colors were set satisfactorily. A comparison of bulk fermented with control fermented tobacco in the duplicate lots indicated that the same changes had not taken place in the control fermented tobacco as had taken place in bulk fermentation. The evening and setting of the colors by both methods was satisfactory, but the elasticity and water retaining capacity of the bulk fermented tobacco was far superior to that of the control fermented lots. The taste of the control fermented tobacco was bitter while that of the bulk fermented was sweet and wholesome. Color comparisons between bulk fermented and control fermented tobacco as determined by alcohol, cold and hot water, and benzol extractions, showed that while residual green coloring matter was present in comparatively large amounts in the control fermented tobacco, it had almost disappeared from the bulk fermented tobacco; also the amount of brown coloring matter was much less in the control fermented than in the bulk fermented. The control fermentation in the cabinet seemed to affect more the surface of the leaf, and so far as could be judged, did not extend to the body of the leaf to any great extent. An analysis of duplicate lots of leaves after fermentation also showed that the reduction of protein content was not more than half as much as in the control fermented as in the bulk fermented tobacco.

On the whole it may be stated that so far as can be judged from this experiment, the fermentation of tobacco by the open or control method is not satisfactory. It may be that a variation of conditions would produce better results.

This same result has been observed in Porto Rican tobacco fermented by the control method, but there it developed that after ageing in the bale for some months, no difference between the bulk fermented tobacco and the control fermented could be noted. This would indicate that in bulk fermentation the tobacco is practically *finished* during the fermentation, but that in control fermentation the process is incomplete, and a considerable amount of *natural* after-fermentation occurs in the bale. There is one significant difference between the two methods which may be responsible for some of the varying results; that is, in bulk fermentation the tobacco is tightly packed together, and the quantity of air around the leaves is very small, and oxidation or other chemical changes probably differ from those in the control fermentation where the constant circulation brings large amounts of air in contact with the leaves. Complete analytical data on the different duplicate lots of bulk fermented and control fermented tobacco cured under the same conditions at the same time is not yet available, but this will be presented in a later report.

In conclusion, it is desired to acknowledge the co-operation of the Carrier Engineering Corporation in conducting these experiments. They not only loaned the experimental cabinet but defrayed a third of the cost of the experiment. Mr. A. C. Buensod, of the Corporation, also spent several weeks in Windsor, supervising the details of operating the cabinet.