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DEPARTMENT OF ZOOLOGY

THIRD ANNUAL REPORT

OF THE

SUPERINTENDENT

FOR

SUPPRESSING THE GYPSY AND BROWN-TAIL MOTHS.

JANUARY, 1908.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1908.

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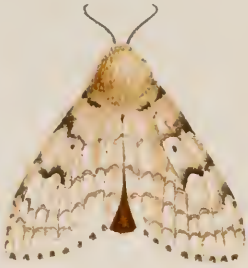

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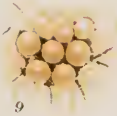

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GYPSY MOTH

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ORGANIZATION.

A. H. Kirkland, M.S.,	*Superintendent.*
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Frank A. Bates,	*Field Agent, Western Division.*
John W. Enwright,	*Field Agent, Northern Division.*
John A. Farley,	*Field Agent, Southern Division.*
Charles W. Minott,	*Field Agent, Central Division.*
George A. Smith,	*Field Agent, Eastern Division.*

SCIENTIFIC STAFF.

C. H. Fernald, Ph.D.,	*Consulting Entomologist.*
Franklin H. Mosher,	*Entomologist in Charge of Laboratory.*
Herbert P. Johnson, Ph.D.,	*Bacteriologist.*
H. D. Haskins, B.S.,	*Consulting Chemist.*
C. G. Barnum, M.S.,	*Chemist.*

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Commonwealth of Massachusetts.

THE GYPSY AND BROWN-TAIL MOTHS.

During the year 1907 work against the gypsy and brown-tail moths was vigorously prosecuted along the general lines found to be desirable and effective in previous years, it being practically a continuance of the policy outlined in the report for 1905. In brief, it has been a continuation of the effort to reduce the numbers and check the spread of the moths: first, by keeping the trees overhanging streets, boulevards, railroads or other lines of travel free from these pests; and second, by following up the work previously done in destroying the moths in the principal residential sections, where in past years so much damage and annoyance have been caused by these pests. Added to this, a beginning has been made on the problem of dealing with the insects in the badly infested woodland sections. The work of importing parasites has been continued on even a larger scale than heretofore, and with better prospects of ultimate success in securing the establishment of effective natural checks on the increase of the moths. During the late fall and early winter scouting operations — a thorough inspection by trained employees — have been carried on along the western border of the infested region, particularly in Worcester and Middlesex counties, with the result that a considerable number of small gypsy moth colonies have been found in towns which we have previously been unable to thoroughly examine. The importance of locating and stamping out these incipient colonies cannot be too highly emphasized.

Of the recommendations made by the superintendent in his last report, practically all were adopted by the Legislature as

amendments to the gypsy moth law, in chapter 521, Acts of 1907. By this additional legislation the superintendent has been able, subject to the approval of the Governor, to initiate or carry on necessary work against the moths in cities or towns failing to provide sufficient funds in season for the necessary work, or failing to perform it in a satisfactory manner, the cost of the same being charged to the delinquent city or town in the form of a special tax. We have also been able to give special assistance, where conditions warranted it, in the work of stamping out the gypsy moth pest in certain parks, woodlands or other places of general public resort, where there was great danger of the moths spreading and dropping on persons or vehicles. The amendment permitting the reimbursement of all cities and towns alike every sixty days has been of particular assistance in the effective prosecution of the work, and has not required any increase in the clerical force of the central office; in fact, that provision has made a notable decrease in the amount of work formerly required of our clerical force at the close of the year, when reimbursements were made to a large number of cities and towns annually, only, as required by previous legislation.

The financial statement presented Jan. 1, 1907, showed a balance on hand of $20,884.49, nearly all of which was paid out in reimbursements to cities and towns which had delayed submitting the necessary vouchers and pay rolls for the 1906 work before the closing of our books for that year. An appropriation of $300,000 was provided by the Legislature for the 1907 operations, and this has enabled us to prosecute the work more vigorously and on a larger scale than attempted heretofore, and the results obtained show that this large outlay at this time was well warranted by existing conditions, and was in the line of good business policy.

The maximum number of employees engaged in the work against the moth pests in the infested cities and towns during 1907 was slightly over 1,800, their work being directed and inspected by a force of about 40 trained employees of the central office. One most excellent result of the work against the gypsy and brown-tail moths has been the development in each city and town of local trained gangs, whose efficiency and consequent value to the community, as well as to the State, constantly in-

creases as time goes on. Furthermore, by the constant campaign of education kept up by the central office and by the local authorities in charge of the moth work, property owners are becoming more and more familiar with these insect pests, and are giving an amount of assistance the value of which can hardly be computed. For the benefit of those who cannot find time to read all the details given in this report, the following summary is presented.

Synopsis of the Report.

1. The suppression of the moths on street trees and those overhanging railroads and other lines of travel has been vigorously prosecuted. This has minimized the danger of the scattering of the caterpillars on vehicles.

2. In the badly infested residential sections the moths are now thoroughly under control, and in them practically no damage was done by either of the pests during the past season. Scouting operations in outlying territory adjoining the known infested district have resulted in the finding of numerous small colonies, which are now being thoroughly treated.

3. While there have been a few particularly annoying cases of apathy or interference in the work on the part of local officials, there has been less than in previous years.

4. The co-operation of local officials and citizens as a whole has been hearty, although there has been an increasing tendency to leave the clearing of private estates to the local authorities, — a fact which of itself is a tribute to the growing efficiency of local work.

5. A larger number and greater variety of parasites of the moths were secured during 1907 than any year heretofore, while those engaged in handling these natural checks on these caterpillar pests have acquired by experience increased skill which cannot result other than beneficially.

Recommendations are: —

(*a*) To carry on the work against the moth pests to the best advantage during 1908, an appropriation of $150,000, in addition to that made by chapter 434, Acts of 1907, will be necessary.

(*b*) To meet the expenses in connection with importing para-

sites and other natural enemies of the gypsy and brown-tail moths during 1908, the sum of $15,000 should be made available.

(*c*) City or town employees should be given authority to enter private property at any time for the purpose of making an examination to determine if the moth pests occur on the same.

Financial Statement.

Since the work of suppressing both the gypsy and brown-tail moths usually is in progress at the same time, and by the same gang of men, it is impossible for the superintendent to comply with the requirements of the original "gypsy moth act," so called, which directs him to "separate, so far as practicable, the expenditures on work against the gypsy moth from those on work against the brown-tail moth."

In the winter season, for example, the men engaged in creosoting gypsy moth egg clusters on street trees also at the same time remove and destroy the webs of the brown-tail moth; while later in the season orchards are sometimes found infested by both these insects, and the spraying operations necessary to kill one species also destroy the other.

The superintendent has endeavored to secure complete returns from all cities and towns for their expenses in connection with this work up to the close of the fiscal year, Nov. 30, 1907. Notwithstanding the earnest efforts put forth to obtain this information, a number of cities and towns have at this writing failed to submit the necessary pay rolls and schedules of bills, although a sufficient balance is on hand to provide for the required reimbursement on the part of the State.

The balance carried forward from last year, viz., $20,844.49, was practically all disbursed during the month of January, 1907, in reimbursements to dilatory municipalities. For the same reason, the balance carried forward to the credit of 1908 operations is apparent rather than real, and will be largely disbursed during the present month.

Balance from 1906,	$20,844 49	
Appropriation of May 8, 1905,	75,000 00	
Appropriation of May 17, 1907,	220,000 00	
		$315,844 49

Office expenses: —		
Management,	$4,583 33	
Salaries of clerks,	2,392 42	
Rent,	1,302 35	
Stationery and postage,	739 45	
Printing,	1,410 52	
Experts,	384 51	
Supplies and furniture,	338 00	
Sundries,	772 81	
Educational work,	51 20	
Field expenses: —		
Wages of employees,	35,451 03	
Travelling expenses of employees,	8,005 69	
Supplies,	134 76	
Contract work,	105 13	
Special expense for care of local parks, etc.,	7,253 08	
Supplies for experiments,	133 59	
Emergency operations,	1,498 91	
Reimbursements to cities and towns,	175,552 88	
		$240,109 66
Balance Nov. 30, 1907,		$75,734 83

To the credit of the above should be placed the cost of emergency work in the city of Woburn, $1,498.91, where the local authorities failed to act, which has been certified as a special State tax, to be collected in the usual way, leaving the net actual expense $238,610.75.

Parasite Appropriation.

It was necessary to increase greatly the number of trained assistants employed at the parasite laboratory during the summer season of 1907, in order properly to care for the large shipments of the beneficial insects obtained from abroad. An increased force of European collectors were also employed, while the expenses of Dr. L. O. Howard's European trip were also met by this office. The total expenses incurred in this work during the year 1906 are given below: —

Balance Jan. 1, 1907,	$7,131 52	
Appropriation May 8, 1905,	10,000 00	
Appropriation May 17, 1907,	15,000 00	
		$32,131 52

Expended in 1907: —		
Wages of employees,	$5,395 63	
Travelling expenses,	2,933 98	
Rent,	481 00	
Supplies,	1,428 51	
Stationery and postage,	37 34	
Experts,	2,010 36	
Sundries,	451 87	
Importation of parasites,	9,066 95	
		$21,805 64
Balance Nov. 30, 1907,		$10,325 88

Expert Investigation of Parasite Work.

Of the special appropriation of $15,000, May 17, 1907, for the purpose of further experiments in introducing parasitic enemies of the gypsy and brown-tail moths, the superintendent was authorized to spend an amount not exceeding $10,000 in securing the opinion of experts relative to our methods of work in this connection, this investigation to be made by competent entomologists of national or international reputation. The details of this investigation are given elsewhere in this report. The expenses in this connection were as follows: —

Expenditure allowed,	$10,000 00
Fees and expenses paid experts,	2,690 16
Unexpended balance,	$7,309 84

Analysis of Town Expenses.

The operations of 1907, being on a larger scale than heretofore attempted, necessitated the purchase on the part of cities and towns of an increased amount of supplies, particularly spraying outfits, insecticides and tools. These are still in a serviceable condition, and, aside from spraying outfits, the purchase of which the superintendent shall continue to urge, there should be a reduction in this class of items the coming year.

The total amount spent in the 81 towns and cities receiving reimbursement from the State to the amount of $170,773.72 may be distributed as follows: —

Total amount spent,		$481,738 12
Deduct for private work,		143,501 08
Net amount spent,		$338,237 04
Pay roll,	$274,561 80	
Travel,	574 17	
Rent,	563 08	
Supplies,	57,837 84	
Sundries,	2,664 43	
Stationery and postage,	1,271 83	
Printing,	763 89	
		$338,237 04

Financial Summary by Towns.

The following table shows the expenditures required of cities and towns before receiving reimbursement, and the total expenditure and reimbursement of each city and town of the infested district during 1906 and 1907. The statement for 1906 includes all reimbursements on account of work done during that year, some of which had not been made at the time of sending the last report to press.

	1906.			1907.		
	Required Expenditure.	Total Expenditure.	Reimbursement.	Required Expenditure.	Total Expenditure.	Reimbursement.
Abington,	$1,016 16	–	–	$1,043 29	–	–
Acton,	679 17	$108 23	–	702 95	$2,960 67	$2,257 82
Amesbury,	2,118 97	902 75	–	2,092 90	1,086 52	–
Andover,	2,443 24	2,075 49	–	2,410 05	3,685 76	1,020 57
Arlington,	3,956 49	14,983 35	$8,821 49	4,046 34	11,450 02	5,993 94
Ashland,	406 65	121 90	–	414 44	740 59	326 15
Avon,	362 96	–	–	363 40	–	–
Ayer,	667 87	–	–	717 22	–	–
Barnstable,	1,938 62	150 00	–	2,002 04	–	–
Bedford,	484 08	2,390 50	1,906 42	492 97	6,533 22	6,040 25
Belmont,	2,210 42	5,203 53	2,993 11	2,249 64	5,411 51	3,161 87
Berlin,	–	–	–	216 08	280 95	64 87
Beverly,	5,000 00	6,718 94	859 47	5,000 00	8,244 88	1,622 45
Billerica,	878 94	1,984 39	1,105 45	878 28	4,189 78	3,311 50
Bolton,	–	–	–	195 16	417 54	222 38

	1906.			1907.		
	Required Expenditure.	Total Expenditure.	Reimbursement.	Required Expenditure.	Total Expenditure.	Reimbursement.
Boston,[1]	$5,000 00	$15,613 96	$5,306 98	$5,000 00	–	–
Bourne,	1,015 09	132 34	–	1,081 86	–	–
Boxborough,	98 75	11 50	–	97 09	$1,013 37	$916 28
Boxford,	407 19	1,088 19	681 00	438 84	1,800 75	1,361 91
Braintree,[1]	1,963 09	1,873 16	–	1,989 47	–	–
Bridgewater,	1,228 32	272 53	–	1,257 56	–	–
Brockton,	5,000 00	–	–	5,000 00	–	–
Brookline,	5,000 00	–	–	5,000 00	–	–
Burlington,[1]	228 98	5,147 05	4,918 07	232 50	–	–
Cambridge,[2]	5,000 00	7,957 07	1,478 54	5,000 00	3,260 99 983 56	380 50 –
Canton,	1,480 24	–	–	1,541 40	–	–
Carlisle,	161 41	1,551 04	1,389 63	164 96	3,276 29	3,111 33
Carver,	606 84	–	–	549 31	645 78	96 47
Chelmsford,	1,235 09	2,207 73	972 64	1,248 16	4,265 09	3,016 93
Chelsea,	5,000 00	–	–	5,000 00	–	–
Clinton,	–	–	–	3,211 14	–	–
Cohasset,	2,562 89	2,058 00	–	2,601 07	2,883 59	226 02
Concord,	2,196 01	4,190 94	1,994 93	2,233 87	5,755 78	3,521 91
Danvers,	2,139 51	6,145 45	4,275 94	2,183 64	7,630 23	5,446 59
Dedham,	4,319 29	638 28	–	4,461 35	–	–
Dover,	371 21	823 00	451 79	393 63	2,030 42	1,636 79
Dracut,	853 14	–	–	862 81	1,260 03	397 22
Dunstable,	–	–	–	116 03	814 43	698 40
Duxbury,	748 20	–	–	772 63	1,680 63	908 00
East Bridgewater,	652 37	615 21	–	664 79	1,417 46	752 67
Easton,	1,928 36	132 69	–	1,947 96	–	–
Essex,	419 61	1,921 63	1,505 02	422 27	2,198 84	1,776 57
Everett,	5,000 00	5,000 98	–	5,000 00	2,542 22	–
Falmouth,	–	–	–	3,128 51	–	–
Framingham,	3,687 44	3,148 58	–	3,800 82	5,252 12	1,161 04
Georgetown,	391 72	657 79	266 07	394 98	1,033 92	638 94
Gloucester,	5,000 00	4,721 35	–	5,000 00	6,506 28	753 14
Groton,	–	–	–	1,205 98	–	–
Groveland,	419 03	644 46	225 43	441 45	1,345 15	903 70
Halifax,	126 21	34 50	–	134 03	735 18	601 15
Hamilton,	1,120 77	2,472 01	1,351 24	1,186 10	3,432 79	2,246 69

[1] These towns had not made complete returns for the year at the time of printing.
[2] Expenditure and reimbursement for 1907 is for first half-year, to May 1.

	1906.			1907.		
	Required Expenditure.	Total Expenditure.	Reimbursement.	Required Expenditure.	Total Expenditure.	Reimbursement.
Hanover,[1]	$548 32	$605 54	$57 22	$551 55	–	–
Hanson,	298 60	–	–	366 28	$796 46	$430 18
Harvard,	–	–	–	437 53	139 32	–
Haverhill,	5,000 00	3,886 39	–	5,000 00	2,618 23	–
Hingham,	1,745 38	3,863 95	2,118 57	1,778 16	3,773 46	1,994 80
Holbrook,	507 27	104 14	–	511 06	215 76	–
Holliston,	620 45	–	–	618 46	–	–
Hopkinton,	655 71	67 40	–	649 77	816 60	166 83
Hudson,	1,252 82	349 83	–	1,276 38	2,536 01	1,259 63
Hull,	1,818 45	–	–	1,860 36	–	–
Hyde Park,	5,000 00	2,876 52	–	5,000 00	–	–
Ipswich,	1,486 38	3,527 33	2,040 95	1,545 93	3,309 01	1,763 08
Kingston,	566 57	–	–	583 56	287 77	–
Lakeville,	249 71	–	–	252 84	–	–
Lawrence,	5,000 00	–	–	5,000 00	–	–
Leominster,	–	–	–	3,769 99	252 00	–
Lexington,	2,330 92	10,217 11	7,886 19	2,390 50	15,109 67	10,796 87
Lincoln,	914 06	2,276 17	1,362 11	1,019 01	3,804 70	2,785 69
Littleton,	395 05	49 25	–	396 95	684 39	287 44
Lowell,	5,000 00	1,076 21	–	5,000 00	–	–
Lunenburg,	–	–	–	400 47	–	–
Lynn,[2]	5,000 00	24,319 24	9,351 10	5,000 00 2,500 00	12,695 42 6,400 58	3,847 72 3,900 58
Lynnfield,	294 55	3,795 36	3,500 81	295 30	3,569 68	3,274 38
Malden,	5,000 00	13,298 00	4,149 00	5,000 00	10,367 13	2,683 57
Manchester,	4,060 10	2,619 86	–	4,302 18	–	–
Marblehead,	2,840 52	3,055 27	171 80	2,891 82	2,450 91	–
Marlborough,[3]	3,791 60	2,239 43	–	3,856 47	2,965 10 469 67	855 44 –
Marshfield,	660 70	150 00	–	673 59	843 96	170 37
Maynard,	1,409 87	–	–	1,426 30	2,498 36	1,072 06
Medfield,	–	–	–	613 01	–	–
Medford,[1]	5,000 00	18,285 17	6,642 59	5,000 00	–	–
Melrose,	5,000 00	13,555 12	4,481 06	5,000 00	7,771 21	1,416 26
Merrimac,	506 68	667 05	160 37	495 08	426 62	–
Methuen,	2,060 16	3,291 90	1,231 74	2,073 56	3,844 35	1,770 79
Middleborough,	1,652 57	–	–	1,696 37	–	–
Middleton,	258 37	1,336 11	1,077 74	276 30	1,746 63	1,470 33

[1] These towns had not made complete returns for the year at the time of printing.
[2] Required expenditure of $2,500 was to be spent in Lynn woods, and reimbursement made on all above that sum was 100 per cent.
[3] Expenditure and reimbursement for 1907 is for first half-year, to May 1.

	1906.			1907.		
	Required Expenditure.	Total Expenditure.	Reimbursement.	Required Expenditure.	Total Expenditure.	Reimbursement.
Milford,	–	–	–	$2,567 49	–	–
Millis,	$286 79	$128 98	–	291 71	–	–
Milton,	5,000 00	–	–	5,000 00	–	–
Nahant,	2,128 30	–	–	2,182 80	–	–
Natick,	2,651 45	–	–	2,652 69	$6,313 48	$2,928 64
Needham,	1,616 48	1,383 48	–	1,709 15	2,073 93	364 78
Newbury,	478 72	2,500 04	$2,021 32	488 56	2,390 90	1,902 35
Newburyport,	4,324 35	3,876 55	–	4,394 09	3,284 53	–
Newton,	5,000 00	8,277 49	1,638 75	5,000 00	6,522 72	761 36
North Andover,[1]	1,783 29	965 45	–	1,803 34	1,517 19	–
North Reading,	267 47	1,077 17	809 70	267 68	2,183 49	1,915 81
Norwell,	334 91	–	–	332 95	–	–
Norwood,	2,051 09	–	–	2,153 65	–	–
Orleans,	233 44	90 00	–	236 63	–	–
Peabody,	3,497 94	8,551 41	4,042 78	3,576 56	8,573 33	3,997 42
Pembroke,	379 56	–	–	374 78	483 23	108 45
Pepperell,	–	–	–	884 80	–	–
Plymouth,	3,739 47	600 00	–	3,829 92	–	–
Plympton,	132 48	–	–	131 09	791 16	660 07
Quincy,	5,000 00	6,129 25	564 63	5,000 00	4,781 38	–
Randolph,	798 10	–	–	799 00	–	–
Raynham,	296 33	88 55	–	293 70	83 57	–
Reading,	1,845 37	4,895 13	3,049 76	1,886 39	7,846 05	5,959 66
Revere,[1]	4,878 89	3,505 39	–	4,939 44	–	–
Rockland,	1,318 18	575 45	–	1,363 81	–	–
Rockport,	1,229 08	1,234 79	5 71	1,227 31	2,070 11	842 80
Rowley,	297 56	1,064 66	767 10	295 72	988 17	692 45
Salem,	5,000 00	11,453 52	3,226 76	5,000 00	12,828 02	3,914 01
Salisbury,	340 99	1,978 20	1,637 21	332 53	2,141 61	1,809 08
Sandwich,	–	–	–	390 92	–	–
Saugus,	1,733 54	15,530 85	13,797 31	1,814 66	14,909 27	13,094 61
Scituate,	1,403 93	280 75	–	1,500 63	–	–
Sherborn,	357 80	1,064 88	707 08	441 09	1,240 14	799 05
Shirley,	–	–	–	378 12	–	–
Somerville,	5,000 00	5,855 04	427 52	5,000 00	4,257 79	–
Southborough,	567 84	337 61	–	587 06	2,083 01	1,495 95
Stoneham,	1,961 68	7,936 22	5,974 54	1,951 61	9,947 90	7,996 29

[1] These towns had not made complete returns for the year at the time of printing.

	1906.			1907.		
	Required Expenditure.	Total Expenditure.	Reimbursement.	Required Expenditure.	Total Expenditure.	Reimbursement.
Stoughton,	$1,272 92	–	–	$1,319 37	$187 41	–
Stow,	323 02	$236 33	–	332 73	798 20	$465 47
Sudbury,	473 04	397 89	–	482 93	1,015 87	532 94
Swampscott,	3,078 12	7,510 22	$3,545 68	3,218 55	4,444 58	980 82
Tewksbury,	708 06	1,200 27	492 21	551 08	1,737 84	1,186 76
Topsfield,	380 47	1,258 44	877 97	397 69	2,426 19	2,028 50
Tyngsborough,	175 47	102 00	–	186 05	1,300 79	1,114 74
Wakefield,	3,338 24	4,945 01	1,285 42	3,340 26	6,176 49	2,268 99
Walpole,	–	–	–	1,422 07	–	–
Waltham,[1]	5,000 00	7,709 81	1,354 91	5,000 00	–	–
Wareham,	1,316 62	–	–	1,361 91	–	–
Watertown,	4,863 82	7,703 99	2,272 14	4,931 91	6,997 11	1,264 66
Wayland,	765 08	944 45	179 37	776 73	1,510 75	734 02
Wellesley,	4,442 85	2,469 34	–	4,721 43	3,188 79	–
Wenham,	840 80	2,818 13	1,977 33	848 86	2,900 65	2,051 79
West Bridgewater,	446 48	–	–	448 07	551 36	103 29
West Newbury,	417 04	1,302 87	885 83	414 60	1,573 12	1,158 52
Westborough,	1,193 07	–	–	1,229 45	–	–
Westford,	639 19	–	–	649 21	2,350 70	1,701 49
Weston,	2,199 00	5,225 29	3,026 29	2,231 64	5,169 97	2,938 33
Westwood,	831 93	7 62	–	833 40	–	–
Weymouth,	2,826 15	3,745 61	735 57	2,803 52	4,129 56	1,060 83
Whitman,	1,574 32	–	–	1,639 90	–	–
Wilmington,	491 00	2,785 28	2,294 28	495 26	2,393 20	1,897 94
Winchester,	4,117 46	14,056 96	7,951 60	4,202 25	10,526 11	5,059 09
Winthrop,	3,568 74	1,655 17	–	3,698 65	–	–
Woburn,	4,335 34	6,483 12	1,718 22	4,307 33	9,632 01	4,252 45
Worcester,	5,000 00	–	–	5,000 00	–	–
Yarmouth,	726 40	100 00	–	732 80	–	–

[1] These towns had not made complete returns for the year at the time of printing.

Allotments of Appropriations.

In making allotments of the funds available for the 1907 gypsy moth work we have been governed almost entirely by the local needs of each municipality. The relative abundance or scarcity of the moths in each city and town was carefully determined by inspections, and the amount needed to deal with

the situation thoroughly, were unlimited funds available, was determined.

From the total sum available for work in 1907, including appropriations, balance from 1906, and the initial liabilities of the cities and towns required by law, the items of central office and field expenses, emergency and special park work and reserve balance were deducted. This gave the net sum available for the year's work. The ratio between this sum and that estimated to be required, based solely on existing conditions, gives the factor used in scaling down the latter estimates to correspond with the amount which could be used in prosecuting the work. In other words, we have in each case considered, first, the needs of the work; and next, the cost of what we could do with the funds at our disposal, taking due care that the total allotments should not exceed the amounts available for reimbursement. At the beginning of the year the appropriation of $75,000 (chapter 381, Acts of 1905), together with the unexpended balance from 1906, was so allotted; and when the later appropriation of $220,000 (chapter 434, Acts of 1907) became available, a supplementary allotment was made. Later in the fall months, when it became apparent that several municipalities would not expend the entire amount allotted them, a part of the funds held in reserve for them was transferred to others which needed additional assistance on the part of the State. All allotments, whether original or by transfer, were first submitted to His Excellency the Governor for approval, as required by law.

This problem of adjusting the allotments to various cities and towns has formed an important part of the work of the central office. Dealing as we do with over 150 municipalities, each having its own system — or lack of system — of accounting, it has often been impossible to obtain a correct balancing of accounts. Even at this writing, after continued and most persistent solicitation, several of our municipalities have not submitted correct and complete records of their 1907 expenses, although notified seasonably that the fiscal year of the Commonwealth closed on November 30. In common with certain other State boards, we have indeed found that the *vis inertiæ* of many town and city officials is a most difficult obstacle to overcome.

Much help in lightening the labors of the central office has been gained by the amendment permitting reimbursement to all municipalities every sixty days. While it has directly benefited towns by returning to them promptly for future use the reimbursement due from the State, it has enabled our clerical force to keep more nearly abreast of its work, and has lessened the congestion in the accounting department which formerly occurred at the close of each year. In the case of the towns receiving 100 per cent. reimbursement after spending their liability, the refunds due have been turned over repeatedly in financing operations against the moths; while with those receiving but 80 per cent. or even 50 per cent. reimbursement, the return of the amount due from the State every sixty days has often been of great advantage at critical times, particularly in the summer campaign; furthermore, it has eliminated an annoying factor, — that of the opposition of one local administration towards providing a substantial refund for the succeeding one. Such a consideration seems petty compared to the importance of suppressing the moth pests for the benefit of all. We are glad to say it has been noticed in only a small number of cases, but we regret to say that where it has occurred it has seriously delayed the necessary work and increased the cost of subsequent operations.

History of the Year's Work.

We have continued, with a large measure of success, the general policies adopted at the beginning of the work against the gypsy and brown-tail moths: *i.e.,* first clearing roadside trees from the pests, in order to prevent the scattering which inevitably takes place by the dropping of caterpillars on passing vehicles; and second, controlling the increasing of the insects in thickly settled sections, where the great majority of our people are domiciled, and where the annoyance and damage has been most severely felt in the past. We have also paid special attention to the care of trees and shrubs in public squares and parks, and have made a beginning on the great problem of dealing with the moths in woodlands.

In caring for street trees about 9,000 miles of roads and streets have been worked over, the trees cleared of nests and

egg clusters, burlapped, banded or sprayed, as conditions required. It should be borne in mind that street trees once clear of the moth do not necessarily remain so. They are particularly exposed to infestation from straggling caterpillars dropped by carriages, automobiles, etc., as well as from the insects which come from stone walls and the occasionally neglected estates. The work of cutting and burning roadside brush and worthless trees, although often severely criticized by those who do not fully appreciate the extent to which neglected roadsides harbor the moths, has been of great help in forcing the insects to the remaining shade trees, there to be killed by spraying or intercepted at the burlap bands. Where badly infested woodlands border the roadsides, and the street trees are in fact but a part of the woods, protective belts from 50 to 100 feet wide have been thinned out, leaving the trees at such distances apart as shall insure their best growth. In such cases the trees to be left have been carefully selected and later banded and sprayed, in order to prevent the caterpillar swarms from reaching the roadside. The importance of this roadside work, which probably represents at least one-half our efforts the past year, cannot be overestimated. If the spread of the moth throughout the State, now greatly favored by the constantly increasing number of automobiles in use, is to be prevented, the roadside trees must be kept free from the insects.

During the winter and early spring months the work of destroying gypsy moth egg clusters and the brown-tail moth webs on street trees and private estates was diligently continued, and the enforcement of the provisions of the law on private estates where no work had been done against the pests was vigorously prosecuted. Obliged by necessity in 1906 to give first attention to the worst-infested residential sections, even to the neglect of outlying districts, we were able in 1907 to extend these operations so far as to cover a large part of the more scattered farming districts as well; so that with the opening of the caterpillar season practically the entire district, aside from the woodlands, had been worked over. Cities and towns were also directed early in the season to place their orders for spraying outfits, burlap and insecticides, so that adequate supplies should be on hand in season for the spring work. During the latter part of

April and throughout May burlapping and banding operations on street trees and badly infested residential sections were carried on; while in the latter part of May and throughout June and July spraying operations were prosecuted vigorously and with great success. Throughout the month of May millions of the small caterpillars, intercepted by the sticky bands used in sections where the gypsy moth was most prevalent, were destroyed by hand by means of steel wire brushes. Beginning with the latter part of June and continuing throughout July and August, the burlaps were well attended, with the usual satisfactory results, this work being followed by the crushing of pupæ and the creosoting of female moths and egg clusters in many localities where their numbers warranted such action. After the egg clusters had been deposited, the most efficient men in each town gang were continued at work creosoting the clusters from the ground upward to a point above the probable snow line. With the "ground work," so called, well done in this way, it is possible, no matter how deep the snow may be, for local gangs to do effective work against the gypsy moth throughout the entire winter. During the fall months, and continuing to the time of the present writing, a great deal of scouting work has been done both by the local gangs and by employees of the central office. This scouting work involves a thorough examination of street, shade and fruit trees, shrubbery, fences, walls, etc., the moth colonies so found being recorded and thoroughly treated. In this way the local organizations are able to obtain an adequate idea of the success of the season's work, and a knowledge of the danger spots to which special attention must be given the following year.

An important part of the fall and early winter work has been the cutting and burning of worthless, hollow or diseased fruit trees, and the cementing or preferably tinning over of cavities in the trees remaining, thereby doing away with notable nesting places of the gypsy moth. Both in the winter and spring work against the gypsy moth all brown-tail moth webs found were removed and burned. The work against the latter insect can be done to the best advantage after the snow has fallen. The webs cut from the trees contrast strongly with the snow, and make it possible for the "ground man" to gather and

destroy all of them. While much of this work must of necessity be done when the ground is bare, there is greater danger that a few fallen webs may be overlooked than when the snow is on the ground. Experiments made by the superintendent many years ago showed that brown-tail moth webs exposed on the ground to the free action of the elements would still yield in the following spring a considerable percentage of caterpillars,[1] which would find their way to the nearest trees or shrubbery, there to feed and develop in a normal manner, and thus continue the infestation.

In this connection, the plan of work against the brown-tail moth adopted by Local Superintendent W. D. Corliss, Gloucester, Mass., is worthy of commendation. Mr. Corliss first sends through the infested district a crew of skilled climbers to cut off the webs, and these are immediately followed by a suitable number of ground men to gather and destroy them. Finally, a trained inspector goes over the work to make sure that all webs have been removed and properly collected and burned. This plan of work has given most excellent results, and has been adopted by many local superintendents.

During the early part of the year it became apparent that field agents were not able, because of the increased area of their divisions to give all the time desirable to those portions of the badly infested central district under their charge. In this central district, within a radius of 15 miles of Boston, the bulk of the work has been required, and here the largest expenditures have been made. Becoming convinced that the best results could be obtained by placing the entire central district in charge of a single agent, a rearrangement of the divisions was made early in the summer, Mr. C. W. Minott being placed in charge of the central division, and a readjustment made of the towns included in the other divisions. In the southern division, embracing practically all of Plymouth and Barnstable counties and a small part of Bristol County, the moths were known to be widely scattered; but to determine the actual conditions prevailing in this far-reaching, thinly settled territory, a great deal

[1] The Brown-tail Moth, Fernald-Kirkland, Massachusetts Board of Agriculture, 1903, p. 60.

of scouting or inspection work was required. To carry on the work already inaugurated in this division, as well as to make a thorough examination of the territory, the secretary to the superintendent, Mr. John A. Farley, was transferred from the office to the field force as agent in charge. Mr. Farley's extensive experience in the work against the moth, particularly in the directing of scouting operations, has made his services in the southern division of special value. The vacancy in the office staff thus caused has been filled by the appointment of Mr. C. O. Bailey to the office of secretary to the superintendent, where his tact, fidelity and excellent knowledge of local conditions have made his services specially valuable.

Acknowledgments.

It is always a pleasure to acknowledge the assistance of others who have contributed in so great a measure to make successful the work against the moth pests. The superintendent has freely sought the advice of the Honorable Attorney-General, the Auditor of the Commonwealth and the secretary of the Board of Agriculture, as well as that of the officials and several members of the Massachusetts Association for the Suppression of the Gypsy and Brown-tail Moths, and in each case the help so sought has been as freely given. Particularly helpful have been the suggestions and counsel given by the consulting entomologist, Prof. C. H. Fernald, Gen. S. C. Lawrence and Messrs. Allen Chamberlain and A. W. Elson; and, finally, the superintendent gladly acknowledges his deep sense of obligation to the assistant superintendent, Mr. L. H. Worthley, Secretary C. O. Bailey and Field Agents F. A. Bates, J. W. Enwright, J. A. Farley, C. W. Minott and G. A. Smith. During the long and serious illness of the superintendent in the early part of the year the management of the work devolved almost entirely upon these gentlemen, and the fidelity and skill with which they have discharged their important duties is worthy of all praise. The superintendent's thanks are also due to the officials of the various cities and towns, and to the inspectors and other employees of the central office, for continued hearty co-operation and faithful service.

Scouting Work.

During the fall it became possible for the first time since the beginning of the work under the present legislation to secure the services of a considerable number of trained employees for scouting operations. A combination of circumstances placed in the labor market a large number of men familiar with the moth and the best means for destroying it. The reduction in the numbers of the gypsy moth in the Fells Reservation of the metropolitan park system released many competent employees; while, as an indirect result of the financial depression, contractors who have made a specialty of clearing large private estates of the moth pest found a lessening demand for their services, and consequently were obliged to discharge a considerable number of their employees. With the approval of His Excellency the Governor, the superintendent has employed some 70 scouts in making a thorough examination of the territory extending westward from the border of the known infested district, work which heretofore it has been impossible to undertake. This force was divided into gangs of from 5 to 8 men, each working under the direction of an inspector; the whole scouting operations being directly in charge of Messrs. Harry Ramsey and Saul Phillips, of the central field force. A thorough scouting is also under way in the heavily wooded section of the North Shore district, including parts of Beverly, Wenham, Hamilton, Essex, Manchester and Gloucester. This section, containing, as it does, a large number of magnificent summer estates and many miles of most beautiful drives, has been known to be generally infested, but until this fall no complete inspection of the woodland areas here has been possible. Through an arrangement with Col. Wm. D. Sohier, whose energetic and effective cooperation has been most valuable, the superintendent agreed to have a thorough scouting made of the entire district, and, with this as a basis, to present an estimate of the probable cost of clearing it from the moth pests. We are assured that, as soon as such an estimate can be made and a plan of the necessary work formulated, we may count upon the liberal financial cooperation of the North Shore towns and their residents in a general campaign against the moths over the entire district.

This section cannot be longer neglected without serious injury to its forests and consequent depreciation of property values, not to mention the unspeakable annoyance caused by the caterpillar swarms which will soon be in evidence if their development is not checked. In the scouting work in Worcester and Middlesex counties, the roadsides, orchards and private estates, as well as suspected woodlands, have been looked over by trained men, with the anticipated although somewhat discouraging result that the gypsy moth has been found established in a considerable number of the towns examined.

In his report of January, 1907, the superintendent said (page 24): "It may be well to state at the outset that the actual limits of the district infested by the gypsy moth in Massachusetts are not yet known, and will not be determined until such time as funds for a thorough examination of the outlying towns by trained men are available. To correctly delimit the infested district, a force of at least 100 trained men might well be employed throughout the greater part of an entire year." Our experience during the year 1907 has simply confirmed the opinion expressed above. Since the advent of the automobile, the scattering of the gypsy moth caterpillars has gone on apace. Our scouting plans for the winter also include a thorough examination of the main automobile route from Boston to Springfield, with probabilities strongly in favor of finding moths in such centers of population as Brookfield, Warren, Palmer and Springfield. Should the moths be found in the latter city, it will be desirable to continue the inspection southerly along the line of travel toward New York as far as the Connecticut border, and westerly to Westfield, Pittsfield and possibly down the Housatonic valley. It is quite probable that scattering infestations will ultimately be found along the main lines of automobile travel throughout the State. Thus it may be found that the splendid system of State highways which the liberal policy of our Commonwealth has provided, by increasing the general use of the automobile, has contributed indirectly to the scattering of the gypsy moth.

The scouting operations of the year 1907 have developed the presence of the gypsy moth at Ashby, Berlin, Bolton, Clinton, Dunstable, Falmouth, Fitchburg, Franklin, Grafton, Leicester,

Leominster, Lunenburg, Medfield, Medway, Milford, Millbury, Northbridge, Pepperell, Sharon, Shirley, Shrewsbury, Townsend, Upton, Walpole and Worcester. The entire gypsy moth territory in Massachusetts now includes 165 cities and towns, with an area of 3,148 square miles.

A complete list of cities and towns known to be infested by the gypsy moth Jan. 1, 1908, is appended: —

Abington.
Acton.
Amesbury.
Andover.
Arlington.
Ashby.
Ashland.
Avon.
Ayer.
Barnstable.
Bedford.
Belmont.
Berlin.
Beverly.
Billerica.
Bolton.
Boston.
Bourne.
Boxborough.
Boxford.
Braintree.
Bridgewater.
Brockton.
Brookline.
Burlington.
Cambridge.
Canton.
Carlisle.
Carver.
Chelmsford.
Chelsea.
Clinton.
Cohasset.
Concord.
Danvers.
Dedham.
Dover.
Dracut.
Dunstable.
Duxbury.
East Bridgewater.
Easton.
Essex.
Everett.
Falmouth.
Fitchburg.
Framingham.
Franklin.
Georgetown.
Gloucester.
Grafton.
Groton.
Groveland.
Halifax.
Hamilton.
Hanover.
Hanson.
Harvard.
Haverhill.
Hingham.
Holbrook.
Holliston.
Hopkinton.
Hudson.
Hull.
Hyde Park.
Ipswich.
Kingston.
Lakeville.
Lawrence.
Leicester.
Leominster.
Lexington.
Lincoln.
Littleton.
Lowell.
Lunenburg.
Lynn.
Lynnfield.
Malden.
Manchester.
Marblehead.
Marlborough.
Marshfield.
Maynard.
Medfield.
Medford.
Medway.
Melrose.
Merrimac.
Methuen.
Middleborough.
Middleton.
Milford.
Millbury.
Millis.
Milton.
Nahant.
Natick.
Needham.
Newbury.
Newburyport.
Newton.
North Andover.
North Reading.
Northbridge.
Norwell.
Norwood.

Orleans.
Peabody.
Pembroke.
Pepperell.
Plymouth.
Plympton.
Quincy.
Randolph.
Raynham.
Reading.
Revere.
Rockland.
Rockport.
Rowley.
Salem.
Salisbury.
Sandwich.
Saugus.
Scituate.
Sharon.
Sherborn.
Shirley.
Shrewsbury.
Somerville.
Southborough.
Stoneham.
Stoughton.
Stow.
Sudbury.
Swampscott.
Tewksbury.
Topsfield.
Townsend.
Tyngsborough.
Upton.
Wakefield.
Walpole.
Waltham.
Wareham.
Watertown.
Wayland.
Wellesley.
Wenham.
Westborough.
West Bridgewater.
West Newbury.
Westford.
Weston.
Westwood.
Weymouth.
Whitman.
Wilmington.
Winchester.
Winthrop.
Woburn.
Worcester.
Yarmouth.

Special Work in Parks.

By the amendment to the original gypsy moth act, adopted by the Legislature in 1907, the superintendent was authorized, subject to the approval of the Governor, to give special assistance in caring for the moth pests in parks, cemeteries, woodlands and other places of public resort, where there was special danger of the spread of the caterpillars upon persons or teams. This provision has enabled us to arrange for co-operative work for the preservation of several of our most beautiful parks which have been devastated by the swarming gypsy moth caterpillars. Co-operative work of this kind has been arranged in the case of the Lynn Woods Reservation, particularly for the protection of the trees along the main drives, and of certain valuable pines and hemlocks at Pine Banks Park in Malden and Melrose, where a large number of beautiful pines had already been killed by the moth; in clearing up and putting in condition for effective spraying operations Sewall's Woods Park and Ell Pond Park at Melrose; the protection of the fine hemlocks and other trees in "Shaker Glen," so called, in Woburn; and in making an important beginning in wiping out the large gypsy moth colony which now threatens Prospect Hill Park, Waltham.

We are obliged, and rightly, to keep constantly in view the economic side of the gypsy moth problem. Our fruit trees, shade trees and shrubbery must be amply protected; otherwise, depreciation of property values is bound to occur, not to mention the discomfort and annoyance caused in so many ways by the caterpillar swarms.

There is also another phase of the problem, which appeals strongly not only to tree lovers but to the population of our badly infested cities and their suburbs. In addition to the magnificent system of metropolitan parks, there are in the badly infested moth district hundreds of small parks and squares whose beauties are as keenly enjoyed by the great working class as by their neighbors to whom fortune has given greater opportunities for leisure; furthermore, not all the beauty spots in the woodlands have as yet been acquired for public uses, yet many of them are freely thrown open to the public by their owners. It has been our constant purpose to have all these places of public resort protected as thoroughly as possible from the inroads of the moth pests, and to this end we have repeatedly urged that they receive proper care at the hands of local authorities. There have been cases, however, as previously mentioned, where a little judicious, direct help on the part of this department has been a great benefit not only to the people of the city or town in which the park was located, but to the greater public at large. The amount so expended has been small, but the results obtained, we believe, will prove to be far reaching and of permanent value.

The amount expended on this feature of the work against the moths is tabulated below: —

Lynn Woods Reservation, ...	$5,000 00
Contingent upon the city of Lynn expending a like sum.	
Pine Banks Park, Malden and Melrose, ...	1,957 00
Contingent upon the cities of Malden and Melrose properly spraying the park in the summer of 1908.	
Ell Pond and Sewall's Woods parks, Melrose, . . .	1,500 00
Cutting and thinning operations. The city of Melrose to follow up this work by spraying.	

Pines, Hemlocks and Other Trees defoliated by Gypsy Moth Caterpillars. — Lynn Woods, July, 1907.

Shaker Glen, Woburn, ...	$1,498 91
Land held by private owners, but much frequented by the public. Spraying operations necessary to preserve the fine hemlocks from destruction.	
Prospect Hill Park, Waltham, ...	435 00
Contingent upon the city of Waltham thinning and spraying belts of woodland to protect the work done by the State.	

In the case of the work at Prospect Hill Park, Waltham, competitive bids were secured from a number of responsible contractors, the contract being awarded to the lowest bidder. In the case of the other parks mentioned, the work has been done by day labor.

Emergency Work.

By chapter 521, Acts of 1907, amending chapter 381, Acts of 1905, the superintendent, subject to the approval of the Governor, is authorized in case of emergency, or where there is great or immediate danger of the increase or spread of the moths, due to the neglect of any city or town to comply with the terms of this act, to initiate or continue the work of suppressing the moths, the cost of the same to be collected as a special State tax upon the negligent municipality. Previous to the passage of this amendatory act, the only method to secure action on the part of negligent cities or towns was to issue an order directing the expenditure of the necessary sum within a certain specified time, with a heavy penalty for failing to comply with such directions. To enforce this section of the law recourse must be had to the courts, with the unavoidable delays attending such action; while in the mean time the caterpillar swarms might easily destroy the foliage of the trees and inflict irreparable damage. As the law now stands, the superintendent has a means for prompt action in such cases of emergency. It has not been necessary to make use of this feature of the law except in the case of a single city, where, through unfortunate local complications, the work was badly neglected at the time when the caterpillars were swarming. The cost of this emergency work has been charged back to the city, and will later be collected as a special State tax.

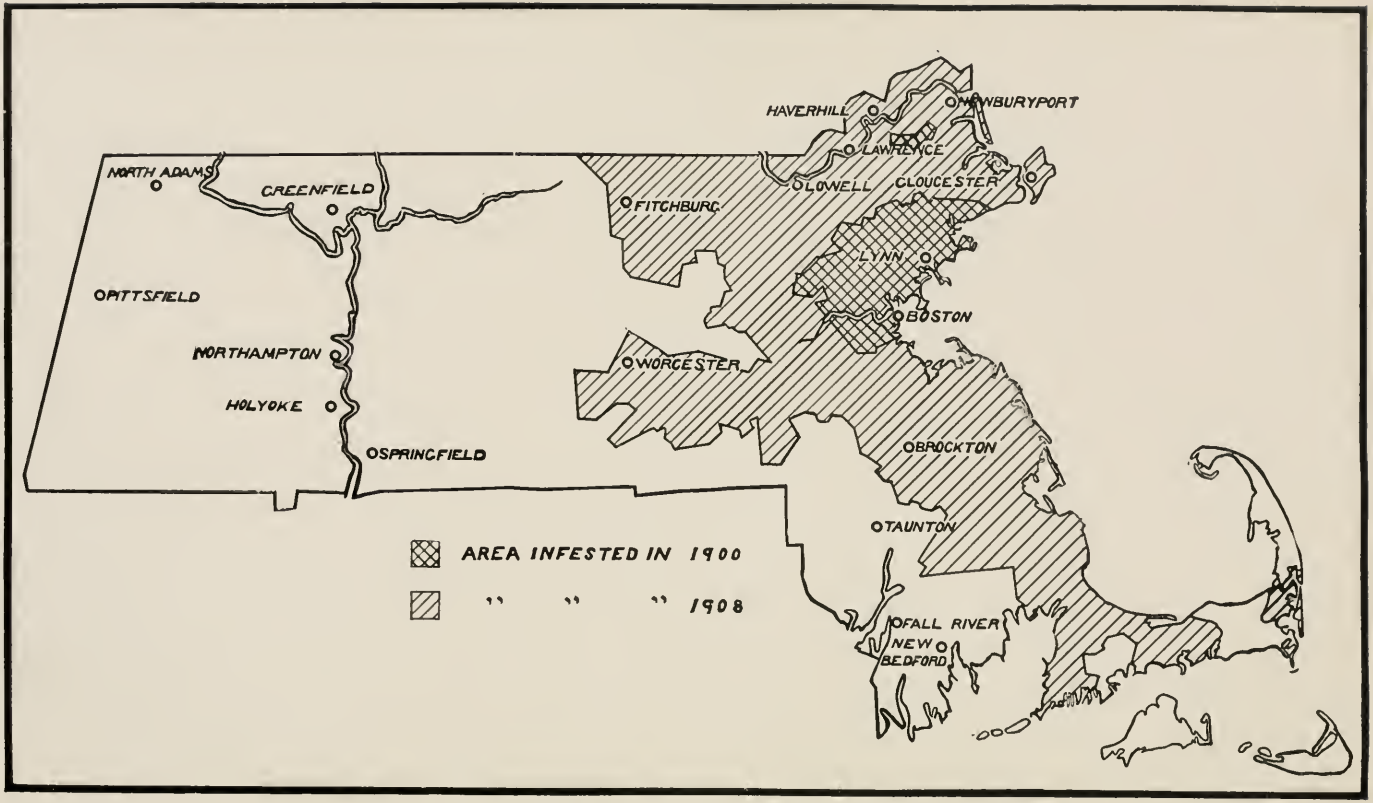
Condition of Infested District.

So successful have been the efforts made during the past two and one-half years to bring the gypsy and brown-tail moths under control, that the residential district and roadside problems are now in a sense of minor importance. It has taken much of hard, persistent, intensive work to bring about this state of affairs, but it has been accomplished. No longer are travellers on our roads and streets annoyed by swarms of caterpillars spinning down from overhanging shade trees; no longer are the inhabitants of the congested districts poisoned and made sick by swarming brown-tail moth caterpillars, whose irritating hairs produce indescribable suffering; no longer are the fruit and shade trees in village, house lot or orchard defoliated and left bare to the scorching rays of the sun. True, there have been many isolated cases of such annoyance and injury in a large number of towns during the year; but, viewing the condition of the whole district in midsummer, 1907, in comparison with the conditions prevailing in 1905, the gain made in the control of the moth is as remarkable as it is gratifying. The superintendent feels that this statement can be made in all propriety, since the actual field work has been done by local organizations, intelligently directed and properly supported by municipal authorities and the co-operative efforts of thousands of good citizens.

How general is the confidence in the efficacy of the present system of work is well shown by the increasing tendency to rely wholly on the local organizations to clear the trees on private estates, — a condition of affairs exceedingly gratifying from one point of view, but from another not wholly commendable, since the local forces cannot have too much assistance from property owners.

The problem of controlling the gypsy moth has now resolved itself into the great question of dealing with the infested woodlands. Of minor rank, but still highly important, is the continued control of the moth where the mastery has been gained, and the extermination of the incipient colonies in the outlying sparsely infested towns.

In the "central district," as it may well be called, including



Map showing the Area infested by the Gypsy Moth Jan. 1, 1908.

as it does the most seriously infested towns, such headway has been gained that it will be possible in several cases to reduce the allotments of expense for 1908. In other words, in some of the central towns the crisis has been met and has safely passed. In others, where the problem still involves the care of large areas of infested woodlands, or where suitable expenditures have not been made in the recent past, the fight must be still kept up with unabated vigor.

In the "outer districts," as we have arbitrarily delimited it, are found towns and cities of all degrees of infestation by the gypsy moth, from that of Hyde Park or Bedford, where large numbers of the moth are still in evidence, to that of Leicester or Townsend, where but single small colonies exist. The condition of each city and town is briefly summarized in the pages that follow.

Central District.

Arlington.

W. H. Bradley, *Local Superintendent.*

The work in this town has been carried forward this year with unabated interest on the part of the local officials, and excellent systematic work has been done in combating the moth pests throughout the year. Fall and winter cleaning, tanglefooting, burlapping, spraying and closing of cavities, all received attention. Roadsides have been cleared of underbrush, and in woodlands previously thinned the underbrush has been removed. These various operations have been pushed vigorously during their proper seasons, and excellent results have been obtained.

The clearing of Sucker Brook valley during the winter and spring of 1907 has helped materially in controlling the moth pests in the central section of the town.

The improved condition of the residential sections will now allow the local superintendent to take up the work of clearing the woodlands in the western part of the town, thereby protecting not only Menotomy Rocks Park, but the entire residential section at Arlington Heights. This will help in reducing the cost of the coming season's work, and allow an extension of woodland work on the eastern side of the town another year.

Nine thousand trees were burlapped and 11,000 banded with tanglefoot in Arlington this year, while all street trees and those on town property were sprayed, with good results. At the present time the street trees have been cleaned, and the same is true of nearly all the trees on town property. About one-half the work on private property is done.

Belmont.

A. W. Elson, *Local Superintendent.*

The important condition of this town, as far as the gypsy moth is concerned, speaks well for the local organization. The condition of the street trees in residential sections is greatly improved over that of 1906, much progress has been made in caring for the woodland trees lying south of Marsh Street, and the attractive belt has been thinned out along the north side of this street.

The local superintendent has pushed the work against the moths vigorously, his efforts being ably assisted by town officials and many public-spirited citizens.

The destruction of egg clusters in the winter, cutting and burning, and the burlapping, spraying, etc., have been thoroughly attended to at the proper seasons, and a continuance of these methods will soon bring the moth well under control in this town. The most serious hindrance to successful work against the insect here is found in the numerous old orchards full of hollow, worthless trees, which constantly harbor the gypsy moth. Until these trees find their way to the bonfire, or are properly cemented or tinned, the gypsy moth will be plentiful in Belmont.

In caring for the large tract of pasture and woodland lying principally between Concord Avenue and Marsh Street, which was generally infested by the gypsy moth, we have received hearty and effective co-operation from the owners, Messrs. E. F. Atkins and H. O. Underwood. We anticipate that the results of the work during the summer of 1908 will be so satisfactory that nearly if not all the woodland may be cleared up another fall, thereby bringing the whole infested area under thorough control.

Beverly.

Josiah S. Brown, *Local Superintendent.*

The early part of the year was devoted to clearing private estates of both kinds of the moth. Later, all of the trees in the residential part of the city were burlapped and well attended during the caterpillar season. All badly infested places were thoroughly sprayed, with good results. The fall scouting shows that the sections worked over to date are in a greatly improved condition, as far as the moth pests are concerned. The woodland proposition is an entirely different matter; the force of men employed by the central office are now making a careful search of the wooded areas, and have already located a number of colonies of serious importance which will require thorough treatment before the opening of the caterpillar season. Beverly is fortunate in numbering among its residents a large number of wealthy citizens owning considerable areas of beautiful woodland, in the protection of which they have freely spent time and money. There is an occasional neglected estate which has caused more or less trouble, but as a rule the co-operation of both summer and permanent residents has been most hearty, while the work has been well supported by the city officials.

During 1908 burlapping and spraying will be necessary to hold the ground gained, and particular efforts must be made to stamp out the woodland colonies previously mentioned. At the present writing the local force is engaged in clearing the street trees.

Boston.

D. Henry Sullivan, *Local Superintendent.*

A vigorous campaign against the gypsy and brown-tail moths has been carried on in this city under the efficient management of the local superintendent, the results being better than those usually obtained from the average untrained city employees; although it is but fair to say that, had a sufficient number of experienced men been available for the moth work, greater progress would have been made in securing the control of the insects.

In 1906 the Allston and Brighton districts were so badly in-

fested that practically all the work against the moths in the city was done there simply to control them, with the result that the outlying sections were of necessity neglected. During 1907 the work of the previous year was followed up, and much attention was given to destroying the moths in the outer sections of this city. In addition to an enormous amount of work on private estates done during the winter of 1906–07, extensive spraying operations were also carried on, with good results. The work of destroying the egg clusters of gypsy moths and removing the webs of the brown-tail moth has been prosecuted this fall as weather permitted, and good progress has been made. The work in the city has had good financial support, and, were it possible to secure a more experienced and efficient class of laborers, the control of the moth here would not be difficult.

In the care of the parks and boulevards under the control of the park department, the principal reliance has been placed on spraying operations, which have kept the moths fairly well under control. There has been, of course, a considerable scattering of the gypsy moth caterpillars early in the season, where the egg clusters were not creosoted. Franklin Park is quite generally infested, and in certain sections of it the numerous egg clusters should be destroyed, the trees burlapped and sticky bands used.

During the coming year particular attention should be given to controlling the gypsy moth by the use of burlaps and spraying, particularly in the southern wards of the city. The general clearing up of brush and worthless trees in back yards, along the fences, etc., is also desirable.

Brookline.

Usip Perrin, *Local Superintendent.*

The work of suppressing the gypsy and brown-tail moths in Brookline, both on town and private property, has been carried on during 1907 without reference to the owner's liability under the act, the cost being met through the general tax levy. The interest in the protection of trees in this town shown by the shade tree committee in past years has been in evidence in many ways during the year just ended. The work of the local super-

intendent under the direction of this committee has been notably efficient, and ably seconded by the hearty co-operation of property owners.

The principal work done against the moths here has been in spraying and burlapping, both methods giving good results. At the present writing the northern part of the town, which practically includes the thickly settled residential section, has been carefully cleaned of gypsy and brown-tail moth pests; and, if this work can be well followed up by burlapping and spraying in 1908, the numbers of the moths here will be greatly reduced. The large estates in the remaining part of the town include much woodland which is generally infested. Here the moths have gained a strong foothold, and vigorous efforts on the part of the local authorities and continued co-operation of the land owners will be required to control the pest. So long as this woodland infestation continues, the entire surrounding territory will remain particularly liable to reinfestation.

The work for the coming year, aside from the burlapping and spraying in the district where the gypsy moth is already under control, should include the clearing up of the known badly infested woodland colonies by removing worthless trees, cutting brush, cementing or tinning cavities, etc., this to be followed up by liberal burlapping and spraying. Sooner or later the entire wooded area in this town must be worked over and the moth brought under control, if permanent progress is to be made. From considerations of economy, it is desirable that this work should be done at the earliest possible moment.

Burlington.

Walter W. Skelton, *Local Superintendent.*

This town remains seriously infested by the gypsy moth, notwithstanding the fact that a very large gain has been made in the struggle for the control of the insect here. As in other towns in the vicinity, the principal danger here is in the woodland colonies, but we are glad to report that a notable beginning has been made in bringing them under control. The street trees are now well protected, and a large amount of work of a semi-permanent character has been done in many of the infested

orchards. A thorough cleaning was given the town in the early part of the year. This was followed by excellent work in burlapping and spraying. During the fall months, brush cutting along roadsides, cementing and tinning of cavities in badly infested orchards and the destruction of the nests or webs of the moths, occupied the attention of the local force. At the present writing the cleaning of the street trees is in progress.

An excellent showing has been made in this town, considering the amount of money expended. The purchase of a power sprayer for the 1908 campaign would be highly desirable, particularly in view of the number and size of the woodland colonies.

CAMBRIDGE.

J. F. DONNELLY, *Local Superintendent.*

Excellent results have been obtained from the work against the moth in this city, due very largely to good management on the part of the local superintendent. In the most seriously infested sections burlaps were freely used, and a considerable amount of spraying was done during the caterpillar season. The street trees, generally speaking, are in excellent condition as regards the gypsy moth, and the same is true of many private estates, so that the cost of the winter and spring work will be much less. With the bulk of the gypsy moths practically wiped out in Cambridge, more general use of burlap will be desirable during the coming summer. Spraying operations will be required wherever the caterpillars are found in unusual numbers.

Cambridge is particularly liable to reinfestation from outside sources. Many thousands of persons annually visit the Harvard College grounds, Mt. Auburn Cemetery, the Washington Elm and other places of special interest; and the chances are highly probable that a very large number of gypsy moth caterpillars are annually brought into this city as unwilling passengers on the vehicles or persons of these visitors. This point is mentioned to emphasize the need of constant watchfulness, which shall detect and suppress any incipient colonies that may become established.

Chelsea.

Alfred Maggi, *Local Superintendent.*

The same earnest efforts to suppress the moths manifest in past years have been continued in 1907, and the situation in this city is well in hand. There is practically no woodland within the city limits, and the street trees and those on private estates have been well protected from caterpillar damage by the liberal use of burlap. There still remains to be done a considerable amount of tinning and cementing of orchard trees, while in certain sections numerous worthless trees should be removed and burned. Owing to the temporary lack of funds the latter part of the year, the work against the gypsy moth in Chelsea is not so far advanced as in some other cities, although practically all of the ground work, so called, has been done.

Danvers.

Thomas E. Tinsley, *Local Superintendent.*

The infestation in this town is general, but its condition shows a great gain over that of 1906, owing to the able management of the local superintendent, the cordial support of town officials and the large amount of good work done by private citizens. During the early part of the year the work of clearing street trees and private estates was completed. Following this, burlap was freely used and a large amount of spraying done. Both these operations gave excellent results, particularly in orchards where cementing and tinning of cavities had been done. In the late summer and fall the clearing of infested roadsides received proper attention, and at this writing the work of clearing the street trees is in progress. The usual operations of burlapping and spraying will be in order here next year, and two matters in connection with this work should receive particular attention.

In the thinly settled portion of the town there are a great many stone walls bordered with brush on either side, the whole being generally infested by the gypsy moth. The brush should be cut and the walls burned out as soon as the eggs have hatched.

Near the Peabody line an important colony has been located, which should have thorough attention during the year.

Essex.

Otis O. Story, *Local Superintendent.*

Early in the year all trees on private property were thoroughly cleaned and later burlapped, and spraying was also done with the usual good results. But few towns in the entire infested district show better results from the use of burlap than Essex, — a condition of affairs which speaks well for the local management. In the territory worked over not over one-half as many gypsy moth egg clusters have been found this fall as was the case in 1906. At this writing the street trees have been cleaned and brush removed from the infested roadsides. Employees of the central office are now scouting the woodland in the southern part of the town, finding numerous scattered infestations which will require attention in 1908.

Everett. — Park Commissioners.

William Kennerly, *Local Superintendent.*

The work against the moth in this city has been performed under the direct supervision of the park commissioners, and has resulted in a marked improvement in the condition of the territory as a whole. The street trees and those on private estates are in better condition than for some years past, while notable progress in suppressing the moths has been made also in Woodlawn Cemetery.

The work the coming season should consist of burlapping, spraying, removing worthless trees and underbrush and closing all cavities with tin in the remaining trees. If this latter work is performed before the eggs hatch in the coming spring, good results will follow next season's operations against the moths in Everett.

Gloucester.

William D. Corliss, *Local Superintendent.*

The good quality of work done here in the past against the moth pests has been continued during the year just closing. Following the ordinary winter work of clearing street trees and those on private estates, burlaps were liberally applied and carefully attended during the caterpillar season. In this way many thousands of caterpillars were destroyed, and in certain badly

infested sections spraying with arsenate of lead gave the usual good results. In the important colony in the woodland off Magnolia Avenue, locally known as the Heater Piece, where between 10,000 and 15,000 egg clusters were destroyed a year ago, the cutting of brush, thinning out of the trees and free use of the burlap gave notably good results. Very little expense will be required in this colony during the coming year. Two colonies of considerable size were found in the woodland in the late summer, one at Bay View and the other off Magnolia Avenue. Here underbrush has been cut, the trees thinned, and all necessary work done to put the colonies in good condition for the use of burlap. At the present writing the street trees have been cleared of moths, and the work of caring for neglected private estates is in progress. We are glad to acknowledge the hearty co-operation of city officials and citizens alike in Gloucester during the past year. While the moth problem here is still a serious one, it is well under control; and if the present good work can be continued, the cost of the necessary operations should be notably reduced in the near future.

Lexington.

Cornelius Wellington, *Local Superintendent.*

This town still continues very seriously infested by the gypsy moth, although a notable gain has been made in reducing the numbers of the insect in sections which have been worked over. The condition of affairs in the woodland at Lexington is comparable to that existing in Arlington and Medford in 1905. A large number of important gypsy moth colonies are scattered throughout the woods, and, while much good work has been done in preventing the spread of the moths to the roadsides, much more remains to be accomplished. The work in this town has been well handled, and the general directions of the central office have been carefully followed out at all times. Co-operation on the part of the town officials and citizens in general has been constant. At this writing, the trees in the residential sections, in orchards and along the streets are in good condition as far as the gypsy moth is concerned, although a considerable amount of cleaning on private estates yet remains to be done.

Following the thorough winter cleaning of the town a con-

siderable amount of brush cutting in preparing old orchards was carried on, and a beginning made of work in certain important woodland colonies. Burlaps, banding and spraying were all used during the summer with satisfactory results, and a force of from 25 to 50 men was employed continuously throughout the year. The work along certain important woodland roads done by the employees of the United States Department of Agriculture has been of much assistance in preventing the spread of the moths. During the coming year there should be in Lexington a general use of burlap and sticky bands, both of which should have better attention in the latter part of the caterpillar season than it was possible to give them in the year just closing. A part of the woodland and nearly all the orchards are now in shape for economical spraying, and the purchase of one or more power sprayers is earnestly recommended. The work in the woodland colonies during the summer should be pushed just as hard and fast as funds will permit.

LYNN.

A. C. DOAK, *Local Superintendent.*

The hearty co-operation of the mayor and city government and the board of park commissioners have enabled the efficient local superintendent to take excellent care of the trees on streets and on private estates throughout the entire city. A very large force of men was employed early in the year in destroying the nests and egg clusters of the two species of moths. At the same time a force varying from 50 to 100 employees was kept at work thinning certain very badly infested sections in the Lynn Woods. A considerable force was effectively employed during May, June and July in burlapping and spraying. The condition of affairs in the Lynn Woods Park was most serious at the beginning of the summer season. By July 1 upward of 500 acres of woodland was practically defoliated, and heroic measures were necessary to protect the pine and hemlock groves from destruction. At the request of the superintendent the park was closed to public travel, in order to prevent the scattering of caterpillars on vehicles. The co-operative plan of work between the city park commission and State having been agreed upon, important steps were taken to combat the moths in certain im-

portant sections of the park, and to spray thoroughly the borders of the principal roads and drives. In the previously mentioned coniferous groves the deciduous trees were cut, and the remaining trees thoroughly banded with sticky materials and duly examined. In the latter part of July the caterpillars became full grown, and pupated in very large numbers on rocks, undergrowth and tree trunks, over approximately 300 acres. As the weather conditions at this time were favorable to the use of fire, this badly infested area was burned over section by section, and in this way millions of larvæ and pupæ were destroyed at a minimum outlay of labor and money. That this measure was most effective was shown by the small number of egg clusters found at the time of the fall inspection; and a notable reduction of the caterpillars also took place in certain sections as the result of an epidemic disease which destroyed them in enormous numbers. In this co-operative work a great deal of cutting and thinning has been done in the most important colonies, and protective belts have been cut along the roadsides where the greatest danger of spreading of the moths existed. Much work has also been done in treating egg clusters in the various colonies throughout the entire woods.

There are in reality two separate problems involved in controlling the moths in this city, and in the residential sections such progress has been made that an ordinary amount of burlapping and spraying will not only hold the moth in check, but greatly reduce its numbers. The woodland question is a problem by itself, and here large expenditures, as indicated in previous reports, must be made if the trees are to be preserved. Thinning operations should be prosecuted over the entire park, and a remarkably large amount of spraying will be required to bring the moths under control. If this work can be well done at the proper time, much progress should be made here during 1908.

Lynnfield.

Henry Law, *Local Superintendent.*

In the month of January the clearing of trees on neglected private estates was carried on, and cutting, cementing and tinning operations were in progress during the remaining winter

months. All street trees were burlapped, and in the majority of the orchards sticky bands were applied to the fruit trees. The large amount of spraying along the streets, in orchards and in certain badly infested woodlands gave excellent results, while the assistance of the employees of the United States Department of Agriculture in treating the badly infested roadsides was most helpful. Roadside trimming, the cleaning of street trees and thinning of certain badly infested woodlands is now in progress. The residential section of this town shows a great improvement over the condition of 1906, but in many sections of the woodlands the moths have greatly increased, — a fact which is now beginning to be apparent to interested property owners. A very large amount of work will be required in this town to cope thoroughly with the woodland problem.

Malden.

Geo. L. Stiles, *Local Superintendent.*

Owing to the efficient management of the local superintendent in this city, conditions have continued to improve throughout the whole residential section, and at the present time very few gypsy moth nests can be found except in the outlying woodland districts. This result has been obtained principally by the use of tanglefoot bands, and by spraying in certain badly infested sections. At the present writing all city property has been cleaned of the moth pests, and the enforcement of the law on neglected private property is well under way.

The coming season the work should consist of the continued use of sticky bands or burlap, spraying of woodlands near residential sections, tinning cavities in the street trees formerly filled with cement, cutting and removing decayed or worthless fruit and ornamental trees on private property, the closing of cavities in the remaining trees with tin, the clearing up of underbrush in the woodlands adjoining the residential section, and thinning the remaining growth as far as practicable. The woodland work the coming year should be extended as far as available appropriations will allow, thus reducing the cost of future work by preventing the reinfestation of the residential section.

The city government has ably supported the local work at all times, and the co-operation of numerous property owners has been most helpful.

MANCHESTER.

WILLIAM YOUNG, *Local Superintendent.*

The trees and orchards along the streets and on private grounds, aside from woodlands, were carefully inspected and cleared of both moth pests in the early part of the year, this work being followed later by burlapping, to which special attention was given during the caterpillar season. In a few localities where the caterpillars were most numerous, spraying operations gave most satisfactory results. Trees in the Pine Street colony were also burlapped and attended two years ago. The Town House Hill colony was thoroughly burned over with the oil burner. It is most gratifying to be able to say that it still remains entirely free from the gypsy moth.

The woodland infestation in Manchester is becoming most serious. An important colony borders the Beverly line, while in the woodland off Summer Street there are several important infestations. During the fall months much good work has been done in cementing and tinning old orchard trees, and at this writing all the street trees have been cleared of the moths and the work of cleaning private estates is in progress. In Manchester many owners of large estates prefer to care for their own property, and the assistance given the town forces in this way is no small item. Although much remains to be done on these estates, much of the beauty of the woodlands held by wealthy summer residents is dependent upon the maintenance of natural conditions of growth of trees, underbrush, vines and herbage; yet these natural conditions, if maintained, will increase greatly the cost of dealing with the gypsy moth. It is impossible to clear thoroughly any woodland of the moth pest until the underbrush has been cut out, the ground cleared up and trees thinned, and the insects forced to the trees, there to be caught under the burlap or killed by feeding upon poisoned foliage. If the tangled growth of shrubs and vines and the crowded trees are to be allowed to remain, thorough spraying will be required nearly every year, at a large expense, merely to keep the moths under control.

MARBLEHEAD.

WM. H. STEVENS, 2d, *Local Superintendent.*

The work here the past year has been carried on successfully by Mr. Stevens, and at the present writing the condition of the town is much improved over that of last year.

The cutting and burning of worthless trees, burlapping, spraying and winter cleaning operations have been carried on in various sections of the town. There remains, however, a large amount of work to be done throughout the whole town, but particularly in the northern and western sections, such as the clearing up of brush along walls and vacant lots, the removal of many worthless trees and the closing with tin of cavities in others.

There still remain, in the residential section proper, vacant lots here and there, filled with brush and small trees, which form breeding places for the moths, and from them in the past caterpillars have swarmed, to reinfest adjoining property. Immediate steps should be taken to clear up all such localities. If this is done before the hatching season, the residential section well burlapped and all necessary places sprayed, there should be a notable improvement in the condition of Marblehead another season.

MEDFORD.

HARVEY HANSCOM, *Local Superintendent.*

The condition in Medford has continued to improve during the past year, and there remains but little work preparatory to securing the complete control of the moths here. To one familiar with the badly infested condition of the street trees in this city in 1905, the scarcity of gypsy moth egg clusters in the same localities at this writing is as surprising as it is gratifying. At the present time the winter cleaning is nearly completed, and the work of clearing woodlands is in progress. Early in the year cutting and burning operations, the tinning of cavities in orchard trees and the clearing up of certain waste land areas was carried on in connection with the work of destroying egg clusters and nests of the moths on private estates. Later, burlapping, banding with tanglefoot and spraying with insecticides gave most excellent results. As in former years, Gen. S. C. Lawrence, with his large force of trained em-

ployees has continued to care not only for his own large holdings, but for all contiguous lands as well. He has also treated thoroughly extensive areas of outlying territory, such as the Water Board land between Forest and Elm streets and Highland Avenue, and also a considerable acreage of brush land on either side of Central Avenue in the eastern part of the city. This latter section was densely covered with infested brush, which was cut and burned. In addition to this, the trees in many strictly residential sections, as well as a large number of street trees, have received careful attention throughout the season. So successful has been his work that he states he will soon be able to make a material reduction in the number of employees in his field forces.

The future work in this city should include the burlapping and spraying of all residential sections, and the clearing up of the area bounded by Fellsway West, Fulton Street and the Malden line, as well as the removal of all the worthless fruit and shade trees throughout the city, and the closing with tin of all cavities in the remaining trees. This last-mentioned work is of the utmost importance, for it is the main source of the reinfestation of private property so often noticed. This work should be done before the hatching of the eggs in the spring, and will result in the much improved condition of the residential sections. The work in this city has been properly supported by liberal appropriations, and has been well administered by the local superintendent.

Melrose.

John J. McCullough, *Local Superintendent.*

We are glad to be able to report the greatly improved condition in this city as far as the gypsy and brown-tail moths are concerned, due to the efficient work of the local superintendent and hearty support of the city officials, and the most excellent co-operation of public-spirited citizens. During the early part of the year the treating of egg clusters, particularly on private estates, was vigorously prosecuted, while the work of closing cavities and cutting and removing decayed trees also had attention. Burlapping, banding with sticky materials and spraying all gave good results. The residential sections and the street

trees are now in excellent condition, and a continuation of the effective methods used in the past will easily keep the moths under control in this city. There are several badly infested woodland areas in Melrose, and an important beginning has been made in the work of thinning the trees and putting these sections in condition for economical spraying. In co-operation with the State, much has been done in wiping out the infestations in Pine Banks Park and in Ell Pond, Sewall's Woods Park. Much cutting, burning and cleaning of trees has been done in each of these localities, which are now in good condition for most thorough suppressive work. There still remains to be done a considerable amount of cutting of trees, and tinning or cementing of cavities should be done during the winter months. The work next season should include the liberal use of burlap and spraying operations on an extended scale.

NAHANT.

THOMAS J. DEVENEY, *Local Superintendent.*

The condition of this town continues to improve under the thorough work of the local superintendent. Following the winter cleaning operations, the street trees were burlapped and spraying was done wherever the caterpillars were numerous. There should be more spraying done in 1908 on many private estates, where the large masses of shrubbery make it almost impossible to find all the egg clusters at the time of the fall and winter inspection. In certain sections of the town there are small blocks of infested brush land on vacant lots, which should be burned. If this can be done at the proper time, burlapping and spraying will hold the moths perfectly in control during the coming year.

NEWTON.

CHARLES W. ROSS, *Local Superintendent.*

It is apparent that the officials and residents of this city do not fully realize the size of the moth problem before them, and, as a result, through lack of sufficient and timely preparations and of systematic and continuous work, the gypsy moth has greatly increased both in residential and woodland districts. The condition of the city as regards this insect is far worse than it was a year ago.

The work done in 1907 in Newton consisted mainly of the winter destruction of egg clusters and the removal of brown-tail moth webs. This work should have been followed up by thorough spraying and a liberal amount of burlapping. An improvised hand-spraying outfit was used on a few private estates where the trees were being stripped by the caterpillars, but a sufficient amount of spraying was not done in any one locality to make a permanent gain. The winter work of egg destruction now in progress at the present time should be followed up with the cutting and cleaning of all woodland colonies throughout the city, the removal of worthless fruit and ornamental trees and the tinning over of cavities in orchards. There are many badly infested stone walls which should be burned out as soon as the eggs have hatched, while burlapping will be required generally throughout the city. In the woodland colonies, which are now of notable size, the use of sticky bands will be needed, and a thorough spraying should be made of all infested property throughout the city. This is a large program, and one which will call for large expenditures. Had it been possible to get the needed work done in 1907, the cost would have been much less. Conditions must be met as they exist, and nothing but the most thorough-going measures, persistently followed up, will suffice to check the multiplication of the gypsy moth in Newton. The local superintendent has handled the work here to good advantage as far as his resources permitted, but his efforts have been repeatedly hampered by lack of funds at critical periods.

PEABODY.

JAMES F. CALLAHAN, *Local Superintendent.*

The good quality of work which has characterized the efforts against the gypsy moth in this town in the past has been in evidence at all times during the year just closing. By the middle of April the central part of the town was thoroughly cleared of the moths, and before the caterpillars hatched, practically all the residential district and street trees had been thoroughly worked over and a large amount of brush cutting and burning in the infested districts had also been done. Sticky bands and burlaps were generally used throughout the town, and carefully attended during the caterpillar season. Spraying

operations here gave excellent results, and materially reduced the cost of the fall and winter cleaning in many sections. The work of clearing up infested roadsides was prosecuted vigorously during the fall months, and, as a consequence, the scattering of caterpillars on vehicles in this town will be largely prevented in the year to come. There are certain notable woodland colonies which should be thoroughly overhauled and put in condition for the summer's work. Unfortunately, a few of the most important of these infestations occur on estates whose owners will not go to the expense of spraying their trees, neither will they consent to the thinning operations necessary before spraying can be economically done in these localities. As a whole, the co-operation of the citizens in this town has been very gratifying, and the work has received proper financial support.

The work in 1908 should include a continuance of the use of burlap; and now that it is possible to take up actively the treatment of the woodland colonies, the purchase of a power sprayer will be desirable.

Quincy.

Thomas F. Burke, *Local Superintendent.*

We are glad to report an improved condition of affairs in this city, as far as the gypsy moth is concerned. About 25 per cent. of the orchards in town were thoroughly overhauled, and put in condition for the summer's work. Every street tree in the city was burlapped and attended two or three times each week during the caterpillar season, with the result that the number of egg clusters found at the time of the fall inspection was greatly decreased. The western section of the city is badly infested, and the woodland problem is also a serious one, and should have thorough attention during 1908.

The brown-tail moth infestation is well under control, care having been taken each year to clear the trees of this insect wherever it appeared. The local superintendent has taken a great deal of interest in the work against the moths, and, while his efforts at times have been seriously hampered by lack of funds, and in some cases by the open opposition of property owners, he has succeeded in accomplishing a great deal of good work, which should prove of permanent value. The city is now

in a condition where a liberal expenditure of money in the moth work in 1908 will greatly decrease the amount required for succeeding years.

READING.

GUY A. HUBBARD, *Local Superintendent.*

While marked improvement has been made in this town in the condition of the street trees and in all residential sections, the woodland colonies have made considerable progress during the year. In the southern and westerly parts of the town there are important woodland colonies, which must be thoroughly dealt with in the near future. The winter work of clearing street trees and trees on private estates was well done, and later burlapping and spraying operations were carried on with notable results. Roadsides have been trimmed out, and on Charles, Pear and Forest streets protective belts 50 feet wide have been cleared of underbrush and dead trees, and put in suitable condition for spraying operations. The work done here has been of excellent quality, and has been well supported by the town officials and citizens in general. The general infestation at Wakefield is a serious menace, at least to the southern part of Reading, and is responsible for a considerable part of the cost of the work in this town, — a condition of affairs which should be rectified during the coming year.

At the present writing, the town gang is engaged in clearing street trees and private property, removing worthless trees and putting old orchards in suitable condition for next season's work. There has been a notable decrease in the number of brown-tail moths, although this insect is generally distributed throughout the town.

REVERE.

WILLIAM G. COOK, *Local Superintendent.*

While there has been a continued improvement in the condition of this town during the past year, there still remains much work of a somewhat permanent nature that must be done before the gypsy moth can be brought under control. During the winter and spring the usual work of creosoting gypsy moth egg clusters and removing brown-tail moth webs was prosecuted on street trees and private estates alike, and a notable reduction made in the numbers of these moths. Burlapping, banding and

spraying were used where needed during the summer season, with fairly good results. As soon as the eggs were laid the work of clearing the street trees was commenced, and at the present writing has been practically completed. Owing to the lack of funds, all town work was stopped in November, but we have assurances that the necessary preparations will be made in the near future. There are two or three things absolutely necessary to be done in Revere before the gypsy moth can be controlled. First, there should be a general clearing up of all waste brushland and the removal of worthless trees and brush along walls and roadsides. At Oak Island and Point of Pines dead and hollow and superfluous trees should be removed. In certain old orchards there is still considerable to be done in the way of cementing and tinning of cavities. When this preliminary work is finished, burlapping, banding and spraying will be doubly effective. If the work in Revere can be properly financed and carried on systematically during 1908, there is no good reason why the town should not then be in as good condition and the moths as easily controlled as is the case with the adjoining cities of Everett and Chelsea. One year of thorough work in Revere will bring the town into such condition that a very small expense, relatively speaking, will control the moths in future years.

Salem.

Amos Stillman, *Local Superintendent.*

In the report for 1907 the superintendent was obliged to state some very plain facts concerning the work done in this city in the year 1906. We are glad to be able to say at this time that a marked improvement has since been made in the condition of the city with reference to the gypsy and brown-tail moths.

With the hearty co-operation of Mayor Thomas G. Pinnock and the city government in making liberal appropriations, the local superintendent has made great progress in reducing the moth pests in this city. While much remains to be done, so much has been accomplished during the past year that, with approximately the same appropriations in 1908, perfect control of the moth pests should be obtained throughout the city, with possibly the exception of the waste land in Salem Great Pasture.

From the nature of the trees and brush growing in the pasture, there should be no great difficulty in wiping out the gypsy moth there when time and funds permit the taking up of this work.

Following the fall and winter cleaning, the cutting of many worthless trees, the clearing up of brush along roadsides and the cementing or tinning of cavities and orchards, burlaps were freely applied and attended, with good results. A considerable amount of spraying was done, to the great benefit of certain badly infested sections. During 1908 the work of closing cavities in trees and removing worthless, decayed trees should be continued. A liberal burlapping and spraying campaign will then give most satisfactory results in reducing the numbers of the moths.

Saugus.

Thos. E. Berrett, *Local Superintendent.*

The work against the moth in this town has been carried on continuously throughout the season. Good management on the part of the local superintendent, and a sufficient amount of funds for the work at all times, have resulted in a very much improved condition of the street trees of practically all the residential sections of the town and of many large areas of woodland.

The ordinary methods have been carried out at the proper time, and, in addition, large areas of brush and woodland were burned when the gypsy moths were changing from the larval to the pupal stage. This radical method without question destroyed millions of larvæ and pupæ, and has reduced the cost of the work very materially throughout the woodland area so covered. Large areas of badly infested woodland abutting the residential sections have been cleared of undergrowth and worthless trees removed, which to a considerable extent will protect the adjoining residential sections from reinfestation the coming year; in fact, the moth problem is so well under control throughout the residential section that with the same liberal appropriation the coming year the work can be pushed into the outlying woodlands not already under control. This will greatly reduce the cost of dealing with the moths here in the future.

The co-operation of the townspeople has been constant and hearty. Particularly helpful has been very practical assistance

given the work here by Messrs. Frank P. Bennett and Benjamin Johnson, large owners of infested lands, who have employed a considerable number of men through the greater part of the year, working in co-operation with the town forces.

Somerville.

Charles I. Bucknam, *Local Superintendent.*

The same earnest efforts that have been used in past years to suppress the moths have characterized the work in this city during the year that just closed. In the winter and spring months the brown-tail moth webs were removed and the gypsy moth clusters creosoted, and a general campaign of cementing cavities in decayed trees, brush cutting and clearing up of infested estates was carried out. As a result of this most excellent work, the moth pests have been held in check throughout the city both on public and private property.

The work here has been well administered, and has received proper support from the city government and from the citizens alike.

At the present writing, the gypsy moth clusters have been destroyed up to the probable snow line throughout the city, and the general winter cleaning up of all estates is now well under way.

Owing to the large number of automobiles and electric cars passing through Somerville, this city is peculiarly liable to re-infestation from outside sources. The work for the coming year should include the general burlapping of the trees throughout the entire city. If this can be thoroughly done, the cost of moth work will be appreciably reduced in the future.

Stoneham.

George M. Jefts, *Local Superintendent.*

The good work done in this town in previous years has been ably continued during 1907, and the condition of Stoneham, as regards the moth pests, is at the present writing most satisfactory. This town gives a good illustration of the results which can be obtained by efficient management, backed up with proper financial support, and kept free from the hindrances of political considerations.

In 1905 the trees in the residential section of this town were literally loaded with gypsy moth egg clusters and brown-tail moth webs. The numbers of the latter insect have been greatly reduced, while the reduction of the gypsy moth has been most remarkable.

Following the cleaning of private estates and street trees in the winter and spring months, each area of woodland was put in condition for economical spraying operations. The use of burlap, sticky bands and spraying gave excellent results in reducing the number of the caterpillars.

Much additional work has been done in the woodlands during the fall months, and the town is in good condition for next season's work. A general burlapping and spraying campaign will be needed here in 1908 to make further progress against the moth pests.

Swampscott.

George Newhall, *Local Superintendent.*

Under the management of the local superintendent, a gain has been made in bringing the moths under control over a large part of the strictly residential section of the town. The ordinary methods of work have been carried out, and on the whole have given good results.

The residential section of the town is surrounded on the north and west by woodland abounding with loose rock, ledges, etc., which presents a serious obstacle to the economical handling of the moth problem in this town. Until this woodland is properly brought under control by ordinary woodland methods of cleaning, the residential section is liable to continued reinfestation. The work in this town the coming season should therefore consist of the caring for territory already under control, the removing of all worthless trees and the closing of cavities in others, the clearing up of all blocks of woodland contiguous to the residential sections, and as much more as time and money will allow.

Wakefield.

W. W. Whittredge, *Local Superintendent.*

There has been considerable headway made in reducing the numbers of the gypsy moth in the strictly residential sections, particularly in the central part of the town. The Greenwood

district still remains badly infested, and the moth is found in enormous numbers in the woodlands.

A great deal of serious stripping of the woodlands took place in Wakefield during the summer of 1907, but we are glad to report that a considerable area in this infested section has now been put in proper condition for effective spraying and burlapping operations.

The usual methods of work have been employed effectively during the past season, but if more extensive spraying and burlapping had been done at the proper time, a still greater improvement in the condition of the trees would have been obtained.

Unfortunately, the scarcity of suitable labor, and certain local complications, have at times prevented the local superintendent from prosecuting the work to the best advantage. The work of the coming season should consist of the thorough cleaning of the residential section, the cutting and burning of worthless trees, the tinning of cavities in orchard trees and the thinning of woodlands immediately adjoining residential sections. These operations should be followed up by a liberal amount of burlapping and spraying. In the badly infested woodlands the ground should be burned directly after the hatching of the egg clusters.

WALTHAM.

RICHARD A. JONES, *Local Superintendent.*

There has been great difficulty at times in getting the citizens of Waltham to realize fully the extent to which the city has become infested by the gypsy moth, and the great need for the adoption of vigorous methods to secure its control. Because of this state of affairs, the moths have been but slightly reduced in numbers in the residential sections, except in that part of the city lying south of the Charles River.

The condition of the street trees is greatly improved, but private estates remain badly infested. The most serious problem in Waltham, however, is furnished by the woodlands, where the gypsy moth occurs in great numbers, and where a considerable amount of stripping took place in the caterpillar season of 1907. These infested woodland districts, particularly those immedi-

ately adjoining residential sections, will furnish annually the caterpillar swarm to reinfest the estates previously cleaned of the moths; hence it is most important that neither time nor money should be spared in wiping out the gypsy moth in the woodlands.

Prospect Hill Park, a block of some 165 acres, is thoroughly infested, and a considerable amount of defoliation has occurred here, particularly in 1907. Co-operative work between the city and State is already in progress here, with the object of bringing the moths thoroughly under control. There is also under consideration a plan for co-operative work between the large owners of woodlands, the city and the State, to the end that the incipient moth colony in these woodlands may be suppressed.

During the coming season, besides the usual preparatory work in orchards, numerous worthless trees should be cut and burned, and a thorough cleaning made of infested roadsides not previously attended to.

Much burlapping and spraying will be required in the residential district, as well as the use of sticky bands; and spraying will give good results in the woodlands, which have been thinned out and put in condition for economical work.

We are glad to say that in this city the field operations have had adequate financial support by the city government, and the work, as far as it has gone, has been well administered.

Watertown.

John C. Ford, *Local Superintendent.*

A gain has been made in this town during the past year, and the work of controlling the moth pests has been successful. The present methods used in thickly settled districts have been employed as needed, and have given fairly good results. Local considerations at times have made it impossible to apply these methods of work in season and in the most efficient way, otherwise a much greater gain in reducing the number of the moths would have been made.

In the early part of the year a force varying from 15 to 45 men was employed in clearing street trees and those on private estates, while a considerable amount of work was done in Whit-

ney Hill Park. Sticky bands, burlapping and spraying were used to good advantage during the caterpillar season, and a considerable amount of burning out of infested walls was also done.

During the fall months, gypsy moth egg clusters on rocks and the lower part of trees were destroyed over the greater part of the town. This was followed by work on stone walls on private estates, and by work on street trees, which is now in progress.

The work for the coming season in Watertown should consist of a thorough clearing up of all underbrush and worthless trees, and a considerable amount of cementing or tinning of cavities in orchard trees. This should be followed by burlapping or spraying over the entire residential section. If this is done at the proper time, a considerable gain will be made against the moths in this town.

Winchester.

Irving T. Guild, *Local Superintendent.*

The standard of excellent work previously established in Winchester has not only been maintained, but in certain respects improved during the past year. As a result, the numbers of the moths have been greatly lessened in the residential district, along the eastern border of the town and in the Myopia Hill section. This condition of affairs has been brought about by the use of the ordinary methods of control applied at the proper time in a thorough manner. In the early months of the year from 20 to 50 men were employed in clearing private estates and in thinning certain woodlands near the Stoneham line. A considerable amount of banding with sticky materials was done in May, and this was followed up by burlapping and spraying operations. As soon as the caterpillar season was over, brush cutting and pruning of trees was begun, and continued until the leaves had fallen. During the fall months roadsides were cleared or trimmed out, and a large part of the street trees thoroughly cleaned of the gypsy moth nests.

The work for 1908 will consist of the thorough care of the territory where the moth is now under control, the completion of the operations begun in the Myopia Hill district, and the clearing up of woodlands in the western part of the town, where the gypsy moth exists in the largest numbers. Aside from the

woodland question, the moth work in Winchester now offers no unusual difficulties; and, if the operations now planned can be thoroughly carried out, the woodland problem here will be solved in the comparatively near future.

Winthrop.

James H. Whipple, *Chairman of Commission.*

Under the management of a special commissioner in charge of the moth work in this town, a considerable gain has been made in bringing the moth pests under control. Following the winter destruction of egg clusters, burlaps were generally applied throughout the town, and still later a limited amount of spraying was done in the more seriously infested localities. There was an unfortunate delay in getting the burlap on the trees in season for its most effective use, a condition which can be easily avoided another year by employing a larger force of men in time of burlapping.

At the close of the caterpillar season numerous pupæ were destroyed under the burlaps and on tree trunks. The treating of egg clusters near the ground and on rocks was next taken up, and, following this, a cleaning of street trees and those on private property. At the present writing a large part of the town has been thoroughly gone over. This town is generally infested, and is liable to continue in this condition for some time, owing to the very large number of cottagers and other summer visitors.

There will be no great difficulty in keeping the moth absolutely under control if the vacant lots and roadsides can be cleared of underbrush and worthless hollow trees, and the underbrush burned liberally. Along these lines the work of 1908 should progress; and if these suggestions are thoroughly followed out, the cost of future operations will be greatly reduced.

Woburn.

John H. McGann, *Local Superintendent.*

The badly infested condition of this city still continues, although a net gain has been made in bringing the moths under control. There were not sufficient funds to clean thoroughly the trees and residential sections in the winter and spring

months. Later, excellent work was done in burlapping, banding and spraying. From the fact that it was impossible to do thorough work in destroying the egg clusters, great swarms of caterpillars appeared at various points during the summer, devouring all vegetation around them, and threatening to undo all that had been accomplished through the previous work. The situation called for prompt action, and, as sufficient funds were not forthcoming to meet the emergency properly, it became necessary for the central office to place a number of spraying outfits in the field, in order to check the caterpillar invasion. We were successful in preserving the foliage on most of the trees in City Park, and all spraying operations, whether done by the State or by the local organization, were highly effective.

In the beautiful Shaker Glen section pines and hemlocks were threatened by the caterpillar plague; and, as this locality is much frequented as a pleasure resort, and as the danger of scattering the moths from it was very great, the superintendent felt justified in giving the city some direct special assistance, to the end that the coniferous trees at least should be kept from destruction. A thorough spraying here accomplished the desired results, but a very large amount of work is yet needed if the integrity of the woodland in the Glen is to be preserved. A large belt of woodland on the westerly side of Horn Pond has been cleared of the gypsy moth, all dead and decayed trees removed, the gypsy moth egg clusters treated and the underbrush cut and burned. Work here should be pushed still further before the opening of the caterpillar season.

Considering the obstacles in the way of successful work, particularly that of delayed and reduced appropriations, those in charge of the work against the moth in Woburn have accomplished a great deal towards keeping the moth in check. This city, like the adjoining town of Lexington, will present a big problem in the way of controlling the gypsy moth for some years to come. We are informed that one power sprayer has been ordered for 1908 work, and it is hoped that at least two more of these machines will be purchased before the caterpillar season opens. Much of the badly infested territory in Woburn is now in such a condition that spraying operations may be very effectively and economically carried on.

Outer District.

Abington.

C. Fred Shaw, *Local Superintendent.*

There were 87 known gypsy moth infestations last May in Abington. Over 4,100 burlap bands were put on the trees in these places and in others where the moths were discovered later, and these bands were well cared for, a large total of caterpillars being killed. By extending the burlaps to property adjoining the original infestation, a number of new infested estates were found. Some good work was done in the town by the local superintendent. The spraying of all street elms reduced to a great extent the numbers of caterpillars on these trees. This should be repeated in 1908, and the infested orchard trees, where necessary, should also be sprayed. A good deal of cleaning work has been done in orchards, but much more cutting, scraping, trimming and cementing will be required before the opening of the burlap season of 1908. A burlap campaign more extensive than that of last year must also be carried on. During the fall scouting of the town, up to December 15, 140 infested estates were found. About 1,300 egg clusters have been destroyed since the burlap season. Abington, like the adjoining town of Whitman, is very seriously infested with the gypsy moth over practically its entire area, and only the most careful kind of work will hold the moth in check. During the larval season many gypsy moth colonies were found in Abington and Whitman by Inspector L. W. Hodgkins of the central office, to whom these towns were assigned last June.

The selectmen of the town have at all times supported the work against the moths in a most gratifying manner.

Acton.

Charles J. Williams, *Local Superintendent.*

The work here has progressed satisfactorily, under the able supervision of the local superintendent, during the year just closing. There has been proper enforcement of the provisions of the law with reference to neglected private estates. The work as a whole has been well supported by the public and the

officials in general, the badly infested orchards have been well cared for, and a great deal of excellent work in the way of tinning and cementing cavities has been done.

The woodland colonies are in a serious condition as regards the number of moths found. The work of thinning has been mostly done, and at the present time the general winter work against the moths is in progress.

Next season's campaign should include considerable spraying and burlapping throughout the town, particularly the thorough spraying of woodland colonies.

Amesbury.

A. L. Stover, *Local Superintendent.*

The winter work was done thoroughly here, and at the opening of spring private estates, street trees and orchards had been thoroughly cleared of gypsy and brown-tail moths. Burlaps were applied and attended in all places where gypsy moth egg clusters were found, and spraying gave excellent results wherever used. In the badly infested section near the Chain bridge, where thousands of caterpillars were killed last year, but a very small number were taken during the burlapping in 1907. In all places where the burlapping was used but little work will be required before the next burlapping season. Good work has been done in repairing a large number of badly infested orchard trees, while the cutting of worthless trees and brush along infested roadsides will greatly aid in controlling the moths in this town. The work of clearing both kinds of the moths from street trees is now in progress.

Andover.

J. H. Playdon, *Local Superintendent.*

In the residential sections, where the gypsy moth was found last winter and spring, the trees were burlapped and well attended during the caterpillar season. In these sections an improvement of about 50 per cent. over the conditions of last year was noticed. Where the moth colonies occurred on the roadside the brush was cut and burned, and the remaining shade trees put in proper condition for the summer's work. In the woodlands there has been a considerable increase of gypsy moths, as shown by the result of the fall scouting. In the south

and east parts of the town a large amount of woodland has been inspected, and some 25 colonies found. A considerable amount of thinning of trees and cutting of underbrush will be necessary in different colonies the present year. Work in this town has been well supported and ably directed; particularly commendable has been the hearty co-operation on the part of nearly all the property owners in this town.

Ashby.

H. A. Lawrence, *Local Superintendent.*

A single gypsy moth nest was found in this town on December 25, by scouts employed by the State office. The infested locality is on Foster Road. The scouting of this town occupied the period from December 16 to 28, inclusive, but no more gypsy moths were found. We are assured by the board of selectmen that the necessary organization for local work will be effected.

Ashland.

Theo. P. Hall, *Local Superintendent.*

During March and April the brown-tail moth webs were removed and the gypsy moth egg clusters destroyed on private estates, while many dead trees have been removed and general tinning and cementing of cavities carried on in infested orchards. The burlaps were well attended during the summer months, caterpillars being taken in nearly every locality where egg clusters had been found in the winter and spring work.

On the 43 known infested estates burlapped, egg clusters were found at the time of the fall inspection on only 11 estates. During the fall months a thorough examination was made of the town, and 12 small new infestations found, the most important one being in the orchard on the Richardson estate, where trimming and cementing and tinning of cavities will be required.

Compared with 1906, this town is in a greatly improved condition.

Avon.

Willard W. Beal, *Local Superintendent.*

The usual work of cleaning the infested orchards was done in this town during the winter and spring, and at the opening

of the caterpillar season burlaps were applied as needed. A considerable amount of brush cutting, cementing or tinning of cavities was also done. In the 13 gypsy moth colonies about 500 burlaps were used, and but a single egg cluster was found at the time of the fall inspection. This result gives evidence of the thorough work done by the local superintendent.

After the leaves had fallen a general inspection of the entire residential section was made, and 11 small colonies found, the one on Pond Street being the most important.

This town lies on the main thoroughfare between Boston and the Cape, and is peculiarly liable to infestation from the towns to the north.

Ayer.

L. A. Carmen, *Local Superintendent.*

The trees in the single gypsy moth colony found in the center of the town in 1906 were burlapped and attended, but no caterpillars were found.

The work of inspecting the street and orchard trees is in progress, and it is planned to make a thorough inspection of certain suspected woodland areas in the near future.

The brown-tail moth infestation is very slight in this town.

Barnstable.

H. W. Bodfish, *Local Superintendent.*

In the Osterville colony about 350 caterpillars were taken during 1907. A small amount of cutting of worthless trees and brush will be required here before the infestation can be stamped out. Three small gypsy moth colonies at Cotuit are well in hand, spraying operations giving excellent results in the case of the infestation opposite the Santuit House, while upward of 3,000 caterpillars were taken under the burlaps. Vigorous and careful scouting of this latter colony this fall showed but 5 egg clusters. During the winter months all infestations will be put in condition for thorough work, preparatory to the burlap season of 1908. An inspection of the town is now in progress by trained men, and this may reveal the presence of a few more small colonies. As yet the infestation of Barnstable by the gypsy moth is scattered, and can be easily

dealt with by the application of thoroughgoing measures. A much smaller number of brown-tail moth nests have been found along the North Shore, as compared with the quantities taken in the winter of 1906–07.

Bedford.

W. A. Cutler, *Local Superintendent.*

A small force of men was employed from January to April cleaning out infested roadsides, removing brown-tail moths and doing a limited amount of work on private estates and along the State road. After the annual town meeting this force was increased to 15 men, and a general search throughout the town was made for gypsy moth egg clusters and brown-tail moth webs. This search showed the gypsy moth to be present in large numbers throughout the town. Previous to the burlapping season a number of badly infested orchards were put in suitable condition for effective work. During June, July and the early part of August the burlaps were well attended and many thousand caterpillars destroyed. The operations of the late summer included a considerable amount of cutting of brush along infested roadsides and the repairing of a large number of orchard trees. As soon as the leaves fell the work of destroying gypsy moth egg clusters was taken up, and during the closing weeks of the year a vigorous campaign of winter cleaning of the trees was under way.

The work in this town has progressed satisfactorily during the past year, and the co-operation of citizens and town officials has been most helpful. Now that the general situation in the town has been well developed and a considerable part of the infested area put in condition for economical treatment, it will be desirable to do a large amount of spraying here during 1908. Particular attention must be given to the infestations in the southern part of the town, particularly the one at Lexington Park.

Berlin.

Willis Rice, *Local Superintendent.*

The gang of scouts employed by the central office under the direction of F. C. Estes examined the roadsides and orchards in this town in the period from April 17 to 26, with the result

that 2 infestations of the gypsy moth were found on the Gates Pond Road. The necessary preliminary work was done here, and burlaps were used with good results during the season. The work having been well organized, the local force made a thorough fall scouting, finding another infestation in the same locality and 1 on the Hudson Road. The infestation here is slight, and should be easily controlled at a moderate expense.

Billerica.

Francis J. Dolan, *Local Superintendent.*

A small force of men has been kept at work in this town through the greater part of the year. From January to late in April the local force was employed in clearing street trees and trees on private estates from the webs of the brown-tail moth and egg clusters of the gypsy moth, a large number of both insects being found. At the beginning of the caterpillar season this work was practically completed, and many of the orchards put in good condition for spraying. A beginning had also been made in certain important woodland colonies with a view to burlapping and spraying operations. The burlaps were carefully attended during the summer months, with the customary good results. A considerable amount of infested brush along the State highway was cleared up in August and September, and still later the work of tinning or cementing of cavities in orchard trees was done in certain badly infested sections. From November to the close of the year the ordinary winter work of web and nest destruction was carried on. This town is very generally infested by both moths, the brown-tail moth being particularly abundant here. The gypsy moth is well established in the woodlands, and now that the work in residential sections is so well in hand, special attention should be given to the wooded districts. The purchase of a power sprayer for use in this town is highly desirable. Aside from a general campaign of burlapping and banding trees, much spraying will be required in this town during 1908, particularly in the woodland sections. At the present writing the work in Billerica has been suspended for lack of funds.

BOLTON.

C. E. MACE, *Local Superintendent.*

In the 4 gypsy moth infestations located by the State scouting gang in this town in the spring of 1907 burlaps were freely used during the summer, and but 3 caterpillars found. No egg clusters were found here at the time of the fall inspection. The scouting made by the local superintendent, as time permitted, resulted in finding 7 more egg clusters, which have been treated, and the trees in the vicinity put in proper condition for burlapping. The citizens and officials of this town have co-operated in a most excellent manner with the local superintendent.

BOURNE.

HIRAM F. BAKER, *Local Superintendent.*

Ten colonies of the gypsy moth were found in this town in 1907. All trees in the vicinity of each colony were burlapped, and upward of 2,000 caterpillars were killed under the bands during the summer months. In one colony, while the local conditions as regards neglected trees, rubbish, etc., were very bad, no caterpillars were taken. The effective work of the local superintendent during the fall months resulted in the finding of 3 infestations, — 1 in Sagamore Village, 1 on the State Road at Monument Beach, and 1 on the State Road at Buzzards Bay. Later this work of inspection was supplemented by a thorough examination of the town by a gang of trained State employees, temporarily hired by the local authorities. This inspection, which is now in progress, has resulted in the discovery of 3 infestations at Gray Gables. The gypsy moth situation in Bourne will call for a great deal of suppressive work in 1908. There should be a general use of burlap in the woods. The usual cutting and general thinning of trees will be required. Only scattering numbers of the brown-tail moth have been found in this town.

BOXBOROUGH.

JOHN J. SHERRY, *Local Superintendent.*

Excellent work has been done in this town under the efficient management of the local superintendent. Early in the year scouts from the central office discovered about 31 gypsy

moth infestations, where the egg clusters were carefully creosoted and the colonies watched during the summer months. The fall inspection, possible for the first time in this town, showed no gypsy moths in places where egg clusters were found in the spring. In other parts of the town 28 nests, all told, were found. These colonies are being put in good condition for next year's work. Brush is being cut, cavities tinned and dead trees removed. The work of destroying the brown-tail moth webs is now in progress, and the support of the work by the citizens in general and the board of selectmen in particular has been constant throughout the year. With such conditions prevailing, thorough work next summer with burlap and spraying should bring about a great improvement in the condition of this town.

Boxford.

Charles Perley, *Local Superintendent.*

Much good work has been done here against the moth pests during the year. Particularly commendable has been the thorough overhauling of infested orchards by the local superintendent, while the infestations along roadsides have been well attended to. Street trees and those on private property were cleaned of moth nests, and later were burlapped and cared for during the season. A limited amount of spraying on the badly infested private estates gave good results. Aside from the single gypsy moth colony on the Ipswich Road, where lumbering operations were carried on before the trees were cleared of egg clusters, the trees in the entire town are in a greatly improved condition as compared with 1906. At the present writing the clearing of the street trees is in progress. After private estates have been cleared the work will be followed up during the coming year with the usual operations of burlapping, spraying, etc.

Braintree.

E. E. Abercrombie, *Local Superintendent.*

A very thorough scouting of this town was made during the winter months by the local authorities, gypsy moth egg clusters being found throughout the entire town. A beginning was made in the work of clearing up the old orchards, but un-

fortunately this was not carried far enough to make the use of burlap most effective. A few trees were defoliated by the caterpillars during the summer season.

The work at Braintree in 1907 was handicapped to a considerable extent by the fact that burlaps were not applied sufficiently early in the season, and by the scarcity of help.

The winter inspection now in progress shows upward of 400 infested estates, while to date the gypsy moth has been found on but 67 street trees. It is absolutely necessary that the old orchards should be given a thorough overhauling during the winter and spring, and should be put in proper condition for effective burlapping and spraying where necessary. The town is in a serious condition as regards the gypsy moth, and much thorough work will be required here in the future to hold the insect in check.

Bridgewater.

R. J. McNeeland, *Local Superintendent.*

The town of Bridgewater is not so badly infested with the gypsy moth as are many towns in Plymouth County. In the comparatively few colonies previously discovered the usual burlap work was done last summer, and only 55 caterpillars were found. During the fall scout, up to December 15, 14 colonies of the gypsy moth not before known were found, the worst infestation being in an orchard on Cherry Street, where 800 egg clusters were destroyed. The only other locality where egg clusters were found in great numbers was in a pasture on South Street, where several large oaks were badly infested. On these, 1,500 egg clusters were destroyed.

The usual scraping, cementing and other preliminary work will be done in infested orchards in this town before the burlap season of 1908. In addition to burlapping, it is planned to carry on next summer a vigorous spraying campaign against the gypsy caterpillars where need arises. The gypsy moth infestation in Bridgewater may be expected to be much reduced in 1908, for the work here has been carried on in a very thorough manner by the local superintendent, and he has had at all times adequate support from the selectmen and citizens.

The brown-tail moths in Bridgewater are in rather small numbers and the infestation is scattered.

Brockton.

Edward Mottau, *Local Superintendent.*

Troublesome infestations by the gypsy moth on Battles, Cherry and Garfield streets were thoroughly dealt with by the use of burlap during the summer months. All told, 31 infested estates were cared for during the caterpillar season. As soon as the eggs had been deposited a general scouting of the entire city was made by the local force, and 32 additional estates were found to be infested. This makes it necessary for us to consider the condition of Brockton with reference to the gypsy moth worse than it was a year ago.

On the other hand, largely due to the interest and effective co-operation of Mayor John S. Kent, there has been a great improvement in the quality of work done here.

The colonies found this fall were several years old, but, as the city had not been thoroughly inspected, their presence was not known. With proper local management the gypsy moth problem at Brockton offers no unusual difficulties. While the brown-tail moths are still scattered throughout the city and occur in considerable numbers in certain sections, the general situation as regards this insect is much better than a year ago. The gratifying feature of the work in this city has been the hearty co-operation of the municipal authorities, the work at all times being adequately supported by suitable appropriations.

Canton.

Augustus Hemenway, *Local Superintendent.*

The work in Canton was placed by the local superintendent directly in charge of an experienced former employee of the State office, Mr. C. E. Merrill, who first made a very thorough inspection of the entire town. The colonies found were thoroughly burlapped and well attended during the summer, and everything possible was done to stamp out the gypsy moths. The fall inspection showed 45 small new infestations, many of them in the woodlands, none of which, however, offers any serious obstacle to suppressive measures.

Co-operation on the part of the local officials and citizens of

the town has been most helpful, and if the same thorough work can be kept up in Canton, there will be no great difficulty in controlling the gypsy moth here.

Carlisle.

G. G. Wilkins, *Local Superintendent.*

Work in this town under the direction of the local superintendent has been done in an admirable manner. The problem here is a serious one, since it will take much time and money to put the orchards now so generally infested in proper shape for exterminative work. While a great deal of tinning and cementing of cavities and removing of dead and diseased trees has been accomplished, much remains to be done. The badly infested woodland owned by Mr. Charles A. Skelton on the River Road was defoliated by the caterpillars during the summer, and will be cut and burned over later. At this writing the clearing of street trees has been completed and the work in orchards is well under way. Much more scouting of woodlands remains to be done here, and should receive early attention. During the coming year, aside from a liberal burlapping of infested trees, a very large amount of spraying will be required.

Carver.

E. H. Murdock, *Local Superintendent.*

In the town of Carver, last summer, 16 estates were known to be infested with the gypsy moth, and on these 5,750 caterpillars were killed. The worst orchard colony found was on Plymouth Street, and here about 3,000 egg clusters were treated on apple trees, outhouses, hen coops and rubbish. The fall scouting of the town resulted in the discovery, up to December 15, of 36 infestations not before known; 7 of these were in the woods, the most important being between Plymouth Street and the railroad. Over 200 egg clusters were treated here. Another woods colony, in which more than 100 egg clusters were treated, lies on the line between Carver and Middleborough, and is virtually an extension of a much larger infestation in that town. The gypsy moth infestation is chiefly in the northern half of the town, there being about a score of infested estates in the

village of North Carver. In the southern part the fall scouting developed only a few scattered colonies.

Thorough field work was done last summer in Carver by the deputy superintendent, although he was hampered by the scarcity of labor. Later it became possible to hire competent men, and field operations last fall were vigorously pushed. Considerable work has been done both in orchards and woods in preparing infested places for the burlapping season, but much clearing up still remains, especially in the woods. In some cases the owners of wood lots where the moths were found rendered material aid by cutting the large trees on these lots.

The moth campaign in Carver has been well handled by the local superintendent, who has always been ready with summary measures against the moths when occasion has arisen. A continuance of such a policy in 1908 should result in a decided improvement in the gypsy moth situation in the town next year.

Few brown-tail moths are found in Carver, and the infestation is much scattered.

Chelmsford.

George B. Wright, *Local Superintendent.*

The local force, benefiting by the experience gained in the work during the past year, has been able to do considerable effective scouting, and as a result Mr. Wright estimates that upward of 4,000 egg clusters will be destroyed the present winter. The orchard problem is indeed a serious one here, and a large amount of semipermanent work in the way of trimming, closing cavities and removing dead and hollow trees must be done in the orchards throughout the town before a net gain can be effected in the struggle against the moths.

Much good work has been done here during 1907. When all possible had been done in the way of winter and spring work, burlapping and spraying were resorted to with good results. Nearly all the streets and lanes were cleared of roadside brush, — a measure that will reduce the scattering of the moths and the cost of future work.

The important woodland colony opposite Alfred Clark's place on the Carlisle road will require cutting out, followed by bur-

lapping and spraying, during 1908. For this work and the effective treatment of orchards the purchase of a power sprayer is desirable.

Clinton.

M. A. Monahan, *Local Superintendent.*

The small gypsy moth colony in this town located by the State employees in the early part of the year has received careful attention, burlaps being used during the summer with excellent results. A force of 3 men was employed during the fall months in scouting operations and in burning brush, tinning cavities in orchard trees and destroying the webs of the brown-tail moth. The infestation developed here is not of great importance as yet, but a thorough scouting of the town at an early date is most desirable.

Cohasset.

Henry L. McMahon, *Local Superintendent.*

The work of removing brown-tail webs, destroying gypsy moth egg clusters and cutting roadside brush was carried on during the winter and spring months, and the known infestations, aside from those in certain woodlands, put in good condition for the season's work. The liberal use of burlap gave good results, and a considerable amount of effective spraying was done in the most badly infested places. In August and September the work of putting old orchards in proper condition was prosecuted, and later the general fall scouting of the town was made.

It has been difficult in many cases to get several of the large property owners to consent to having their infested woodlands cleared of underbrush and dead and crowded trees, in order to permit of effective spraying later on; and it may be that nothing short of a serious gypsy moth outbreak in the section will be required to give them an adequate idea of the destructive powers of the gypsy moth caterpillars. Such a state of affairs we earnestly hope to prevent, but unless more spraying and other effective methods can be adopted in treating the woodland sections, such an outbreak is bound to occur before many years have passed.

CONCORD.

H. P. RICHARDSON, *Local Superintendent.*

A very difficult gypsy moth problem is found in Concord, the conditions here being similar to those obtaining in the near-by towns of Lincoln and Weston. Concord is a well-wooded town, and the gypsy moth is scattered in small numbers throughout the entire area. Work of most excellent quality against the insect has been done here by the local organization, aided by the hearty co-operation of town officials and the citizens in general. By the first of March the work on street trees had been completed, and 10 men were employed in the work of destroying the moths on private property. A force of 7 competent men scouted the woodland for gypsy moth egg clusters, and found the insect widely scattered. The burlaps were well attended during the summer, a very large number of caterpillars being destroyed, while a limited amount of spraying gave good results. In the late summer and fall months badly infested roadsides were cleared of brush and worthless trees, and a considerable amount of excellent work done in the way of repairing decaying orchard trees. At this writing the work of scouting for the gypsy moth and the general destruction of gypsy moth eggs and brown-tail moth webs on street trees is in progress.

It will be necessary in Concord to increase the general use of burlap in 1908, and more spraying should be done than in 1907. The purchase of a power sprayer here will prove a good investment, and, if possible, such an outfit should be obtained in ample season for the work of the coming year.

DEDHAM.

GEORGE W. PHILLIPS, *Local Superintendent.*

The agent in charge of the district reports this town as being in a worse condition as regards the gypsy moth than in past years. The trees in the 69 colonies in this town were burlapped and attended during the summer season. The spraying for the elm leaf beetle in June was of considerable assistance in destroying gypsy moth caterpillars on street trees. The work of

turning the burlaps was discontinued early in August, at a time when gypsy moth pupæ were still being found.

The fall inspection, now in progress, shows the gypsy moth to be generally distributed throughout the town, and a great deal of very thorough work will be required here, particularly in old orchards, before the opening of the caterpillar season.

There has been an unfortunate tendency on the part of property owners in this town to rely too much upon the efforts of the local superintendent, and to give him too little assistance in his work, — a state of affairs which undoubtedly accounts for the increasing infestation.

Dover.

George D. Hall, *Local Superintendent.*

In the early part of the year work against both moths was vigorously carried on, practically all the private estates cleaned and a large number of orchards put in condition for the summer's work. Burlaps were put on in good season in all infested sections, and well attended during the summer, about 22,000 burlaps, all told, being used. Upward of 1,000 larvæ were taken in the residential sections, and about 3,000 in the woodland colonies.

The deputy superintendent, who was directly in charge of the field work, used most excellent judgment in extending his burlapping operations wherever the caterpillars were found in abundance, and, as a result, discovered several extensions of a number of the colonies. As yet no single section of this town is badly infested, but the scattering of the moths is general over the entire area of the town.

In 16 of the 26 infested localities egg clusters were found at the time of the fall inspection, and about 70 small new infestations were also located. While the total number of nests found this fall is much less than that in the previous year, careful attention must be given to the work, particularly to the use of burlap, during the season of 1908.

Dracut.

R. D. Coburn, *Local Superintendent.*

The gypsy moth has increased in the eastern part of this town, the worst infestations being on Methuen Street. An important orchard colony also occurs on the property of B. A. Cliff, near the New Hampshire line.

Following the winter cleaning of the trees, which was confined to orchards and roadsides, a considerable amount of burlap was used, with good results. In this town a great deal of excellent work has been done in cutting brush along infested roadsides and in repairing decayed and neglected orchards, thus doing away with many hiding places of the moths. The work of scouting, burning brush and destroying gypsy and brown-tail moth nests is now in progress. As in other towns in this section, the orchard problem is a serious one, and in addition the woodlands require a very thorough scouting at the earliest possible date. The orchard and roadside work should be continued through 1908, with a very liberal use of burlap.

Dunstable.

James A. Davis, *Local Superintendent.*

A number of small infestations have been found in this town, and those located before the caterpillar season were well cared for by the use of burlap. The local force has done much excellent work in the way of removing roadside brush in the infested localities, and in repairing partially decayed trees preparatory to next season's work. At the present writing the general work of cleaning street trees and those on private estates is in progress. The moth problem here is not a very serious one as yet, but the infestations discovered should be kept closely under supervision for a year or two more. Next season's work should include as much in the way of scouting operations as possible, and the liberal use of burlap wherever the moths are found.

Duxbury.

H. A. Fish, *Local Superintendent.*

The vigorous campaign against the gypsy and brown-tail moths in Duxbury was begun early last year by the local super-

intendent. The brown-tail winter webs were carefully sought and destroyed, with the result that to-day there is only a scattering and light infestation in the town, mostly in the center and the south villages. Operations were also pushed with vigor against the gypsy moth. Careful cleaning work was done, trees were scraped, trimmed and cemented, and many worthless ones removed. The value of this preliminary work was fully realized by the local superintendent, who spared no effort to get the known infestations in condition for effective work during the burlap season. All told, 1,600 trees were burlapped and 4,303 larvæ and pupæ were killed.

The fall scouting of the town, while failing to reveal any gypsy moths on more than one-half of the estates known to be infested prior to June 1, 1907, nevertheless added 104 new estates to the list, making a total of 141 infested estates. This increase is to be accounted for largely by the fact that the shade trees generally on private estates and the woodlands of the town were never before inspected. While the situation in the residential sections of the town is now well in hand, the woodland conditions present a serious problem. The fall scouting of the town concluded in December last revealed 49 infestations in the woods, and in these 832 egg clusters were destroyed. In 13 of the woods colonies a great deal of cutting will be required, and all will require close attention during the coming summer. Because of its location on the State road, a thoroughfare for automobiles and other vehicles, the woods colony at the corner of Depot Street may be considered the most important in town. Here the necessary thinning of trees and cutting of underbrush has been done over six acres in a most satisfactory way. The same summary method is at present being applied at other infested points in the woods. The town is to be congratulated on the good judgment shown and the remarkable results secured by the very efficient local superintendent in his scouting for the gypsy moth in the woodlands, and upon the energy with which he has begun the task of suppressing the insect in the infestations found.

The excellent public spirit of the selectmen and citizens of Duxbury is evidenced by the business-like methods of carrying on operations against the moths. At a special town meeting,

held on November 26, a sum equal to the town's full yearly liability was provided to continue the work.

East Bridgewater.

William T. Greene, *Local Superintendent.*

The fall examination in 1906 showed the presence of the gypsy moth in 63 localities. The necessary cleaning work was well done in these places, together with considerable cutting in woodland colonies and cementing, scraping and tinning in old orchards. At the opening of the caterpillar season the known infestations were in good condition for the burlaps, of which 3,852 were used. The bands were frequently examined during the summer, and over 2,300 caterpillars were destroyed. In a number of the places burlapped, including the woods colony, no caterpillars were found. During the very thorough fall scouting of the town, up to December 15, 15 additional infestations were located, containing the small total of 414 egg clusters, — a great gain over the condition of affairs in the previous year. The local superintendent has taken a great interest in dealing with the moth pest in this town, has planned his work with excellent judgment, and has carried on the necessary operations in a thoroughly efficient manner. In this work he has been well supported by officials and citizens alike.

Easton.

R. W. Melendy, *Local Superintendent.*

The 3 small gypsy moth colonies found in 1906 in Easton were burlapped in the summer of 1907, but no caterpillars were taken in them. During the fall scouting of the town egg clusters of the gypsy moth were found in 5 localities, the most important finding being at Washington Street, where 23 egg clusters were treated. The tree warden and the local superintendent of the town are carrying on the moth work in a very satisfactory manner.

The brown-tail moths in the town are few.

Falmouth.

W. B. Bosworth, *Local Superintendent.*

The first colony of gypsy moths found in this town was located in March (last) by Inspector John F. Carleton of this

office. The trees in the vicinity of the colony were burlapped and well attended during the summer, and upward of 100 larvæ were killed. There were no special difficulties in the way of the extermination of this colony. The entire town should be thoroughly inspected as soon as possible, as it is quite probable that other small gypsy moth infestations exist here.

As in Bourne, the brown-tail moth infestation is scattering, the largest number of winter webs being found in West Falmouth.

FITCHBURG.

GEORGE H. HASTINGS, *City Forester.*

A few gypsy moth egg clusters were found in this city by scouts employed by the central office during November. These were treated, and the local authorities notified. There should be no great difficulty in dealing with the gypsy moth situation here, if no further findings are made. It seems quite probable, in view of the number of automobiles passing through this city, that a complete examination of the woodlands may show small additional colonies.

FRAMINGHAM.

N. I. BOWDITCH, *Local Superintendent.*

Most excellent work has been done in this town along all the lines ordinarily followed in combating the gypsy and brown-tail moths. Particularly commendable is the work of repairing infested orchard trees and putting them in shape for economical treatment. Few towns in the district make a better showing of progress than Framingham. Careful records have been kept here, which show that during 1906 31,536 caterpillars and 880 egg clusters were destroyed. For 1907 the figures are 21,275 caterpillars and 125 egg clusters. The work here has been ably handled, and has been well supported by the citizens in general.

FRANKLIN.

JOHN W. STOBBART, *Local Superintendent.*

The work of scouting this town by the State forces was begun on December 17. A few gypsy moth egg clusters were located in various parts of the town, chiefly in apple orchards. These infestations were pointed out to the local superintendent, who had already been appointed by the town to deal with the brown-

tail moth situation. The extermination of these colonies offers no serious obstacle, although it is quite probable that further examinations, particularly of the woodlands, may reveal the presence of the gypsy moth elsewhere in this town.

Georgetown.

William E. Sherburne, *Local Superintendent.*

An unfortunate delay in securing funds necessary for the moth work early in the year retarded the necessary operations, but before the beginning of the caterpillar season the cleaning of street trees and those on private estates was practically completed. Gypsy moth colonies to the number of 322 were treated while this work was in progress, and, as a result of the good attention given to the burlaps, in about 705 of these colonies no egg clusters were found this fall. A very thorough scouting was given the town during the fall months, and 174 small additional infestations, containing from 1 to 5 egg clusters, were located. These should be cleaned by the use of burlap, and well cared for during 1908.

The most important colony so far discovered in Georgetown is in the woodland of Samuel Fuller, on North Street, where about two acres are badly infested. The orchard problem in Georgetown is a serious one, and should have careful attention. There are numerous worthless old apple trees to be removed, and a liberal amount of timning of cavities in the remaining trees will be required to put them in good condition for the effective use of burlap. The town officials and citizens have well supported the work against the moths, and if this co-operation can be continued during the next few years, the cost of holding the moths in check in Georgetown should be greatly reduced.

Grafton.

John E. Sheridan, *Local Superintendent.*

State employees made a scouting of this town in the period between November 18 and December 24, with the result that the gypsy moth was found in considerable numbers in 5 well-separated localities. On an estate on Westborough Street 46 egg clusters were found; 42 on another on Ferry Street. The 2 findings on Hall Street were respectively 6 and 14 egg clus-

ters, while 17 were destroyed in the Follet Street colony. Work will soon be organized here. It is probable that when a local gang has been organized and trained still other findings will be made.

Groton.

The work in this town against the brown-tail moth has been done under the direction of Chairman J. F. Ryan of the board of selectmen, who has taken an active interest in the work. This town has no permanent local superintendent, the work being carried on under the direction of the selectmen. The gypsy moth colonies were well burlapped and attended, and a number of caterpillars destroyed. The fall scouting is now in progress. Three new colonies have been cleaned. The most important infestation is near the Groton School.

The orchards in this town will require careful attention during the coming season. Worthless trees should be cut and burned; also, cementing and tin patching should be done.

The brown-tail moths are on the increase in this town.

Groveland.

Fred A. Wood, *Local Superintendent.*

This town was thoroughly inspected by employees of the central office in the early spring, and 111 new infestations found. The trees in the infested section were burlapped, with good results. At the present writing the ground work and cementing or tinning of cavities in old trees have been completed except in the woodland colonies, and here a considerable part of the ground work has been done. In approximately 75 per cent. of the 111 colonies mentioned no egg clusters were found last fall, — a condition of affairs which speaks well for the efficiency of the local work. At the present writing a considerable amount of roadside trimming has been done, and local forces are now engaged in clearing the street trees. A park of some size in this town, "The Pines," owned by the Boston & Northern Street Railway, has been thoroughly examined by the caretaker, Mr. Murphy, and his assistants, and 92 egg clusters found. The necessary trimming in the infested district has been done, and the brown-tail moth webs removed. Burlapping and other careful work will be needed here next season.

Halifax.

Frank D. Lyon, *Local Superintendent.*

An improved state of affairs is shown in the orchards of this town. Up to May 1, 1907, 25 infested orchards had been discovered, but during the recent fall scouting egg clusters were found in only 18 orchards, and 10 of these were infestations not before known. During the summer the local superintendent personally cared for the 574 burlapped trees in town, and killed about 1,000 caterpillars. The total number of egg clusters found later in orchards was about 160.

The fall scouting of the town has been carried on in a satisfactory way, and, as in many other towns, has been extended for the first time to the wood roads. The gypsy moth has been found in 10 places in the woods, 548 egg clusters in all being destroyed. Many of these egg clusters were found on white pines. While none of the 11 infestations are in an alarming condition as yet, the woods problem in the town is nevertheless a serious one, and much thorough work must be done here in 1908.

Very good preliminary work was done last year in the infested orchards preparatory to burlapping. Additional work of this sort may be required in several of these orchards and in others that may be found later to be infested.

The brown-tail infestation in the town of Halifax is exceedingly light.

Hamilton.

Fred A. Nason, *Local Superintendent.*

The work of the early part of the year included the thorough treatment of private estates and the closing of cavities in old fruit trees. Later in the season burlapping and spraying were used to good advantage. The infestation in and near Asbury Grove Park has been a source of considerable anxiety. This park is much frequented by cottagers and campers during the summer months, with the consequent danger of scattering the gypsy moth caterpillars. Although the park proper was badly infested two years ago, the number of the moths has now been reduced to a minimum. Early in the year 1907 the under-

brush in the infested woodland adjoining the park was cut, the trees thinned, burlapped and thoroughly attended during the summer. The result of the fall examination shows that the numbers of the moths have been greatly reduced.

At the present writing the street trees have been cleared of the moths, and a large amount of roadside trimming and brush cutting has been done. In connection with the work of clearing private estates this winter, worthless hollow trees will be removed and the cavities in those remaining cemented or closed with tin.

Hanover.

W. S. Stoddard, *Local Superintendent.*

In the town of Hanover, where the problem of the gypsy moth in orchards reaches great importance, there were killed last summer about 17,000 gypsy moth caterpillars. Seven thousand yards of burlap were put on trees by the local superintendent, and were well attended, as the above figure shows.

Following the larval season over 2,400 egg clusters of the gypsy moth were destroyed, 500 of these being on two pasture oaks. In the fall of 1906, 96 estates in Hanover were known to be infested with the gypsy moth; and since May 1, 1907, 66 additional infestations have been located.

There are a number of badly infested localities, due mostly to the existence therein of hollow, worthless old apple trees. Operations against the gypsy moth in the town have been pushed with very great energy by the local superintendent. Under his direction infested walls have been worked over, and eggs, larvæ or pupæ hidden under the stones destroyed; while many trees have been either cut or trimmed, scraped, burned out and cemented. Much orchard work yet remains to be done, for the number of worthless or neglected trees is still great, and these are a distinct hindrance to the work against the gypsy moth. A continuance of the energetic orchard campaign in 1908 should show a great advance in the work of suppressing the gypsy moth in Hanover next fall.

The fall scouting of the town did not develop serious woodland conditions. The known gypsy moth infestations are not many or in bad shape to handle; but the woodland area between

Webster, Washington and Main streets, where scattering egg clusters have been found, must receive careful attention in the future.

The brown-tail moth infestation in Hanover is light, and can be easily taken care of. It is estimated by the local superintendent that there are not over 500 winter webs in the town.

Operations against the moths in Hanover have been well supported by the local authorities, and the citizens generally have shown much interest in the work and in some cases have cleared up their infested orchards.

HANSON.

A. L. DAME, *Local Superintendent.*

Prior to May 1, 1907, in the town of Hanson 104 estates had been found infested with the gypsy moth. From about one-half of these the moths were practically cleared last year, and on each of 30 others but a single egg cluster was found. On the other hand, the careful scout of the town last fall by the local superintendent added to the list 35 infested estates in the open country. The most important result of the fall scouting was, however, the discovery of additional woods infestations of the gypsy moth. Most of these colonies at present are small, some having 1 egg cluster each. The largest woods colony is near Wampatuck Pond, and here 48 egg clusters were destroyed. A good deal of woods scouting in Hanson has been done by Inspector W. A. Wight of the central office.

During the larval season of 1907 about 5,000 yards of burlap were used and attended, with the result that 2,300 caterpillars were destroyed. Specially good burlap work was done in the woods colony at Oldham Pond, and only 2 egg clusters were found here in the fall scouting. A great deal of work against the gypsy moth will be required in 1908 in Hanson. The effective work done in 1907 in neglected orchards, in the way of cutting, cementing, trimming and scraping trees, must be resumed this year in the orchards not yet cared for. The woods present an even graver problem than the orchards, for to handle the scattering infestation there will require much time and labor.

As in other towns in this part of the State, the brown-tail moths in Hanson are few and scattered, and their continued suppression will be a matter of no difficulty.

Harvard.

George Maynard, *Local Superintendent.*

Twenty gypsy moth colonies were located in this town in the spring of 1907. There was an unfortunate delay in getting out the necessary notices to property owners, requiring them to clean up their places, and as a result they have done but little work to assist the local organization. The condition of the town as regards the brown-tail moth has improved over that of 1907. During the present year the chairman of the board of selectmen, Mr. Fairbanks, has given a great deal of personal attention to the prosecution of the work, and his advice and assistance have been most valuable. A great deal of burlapping will be required in this town next season, and everything possible should be done in the way of repairing decayed orchard trees and in cutting and burning those which have survived their usefulness.

Haverhill.

George F. Moore, *Local Superintendent.*

During the spring of 1907, in the clearing of private property of the gypsy and brown-tail moths, upward of 135 gypsy moth infestations were found. The trees in these moth colonies were burlapped and well attended during the caterpillar season, with excellent results. As the result of the experience gained in this work, the local superintendent and his assistants were able to make a more thorough inspection of Haverhill, including the Bradford district, than had heretofore been attempted. This fall inspection showed 928 new infestations, containing, all told, 5,423 egg clusters. The most important infestation is on Seventh Avenue, while another colony which will require careful attention is located on High Street. In the Bradford district a few egg clusters were found in nearly every orchard.

The spraying operations in this city during the summer months gave good results. The usual campaign of burlapping and spraying will be needed here in the summer of 1908. The general co-operation of the citizens during the year has been gratifying as well as helpful.

Hingham.

Arthur W. Young, *Local Superintendent.*

The progress of the work in Hingham has been both remarkable and gratifying. Practically all the orchard trees have been trimmed and the cavities tinned or cemented. That the citizens of this town take a most commendable pride in the care of their property is shown by the large amount of very practical assistance given to the local superintendent in his work. At this writing Inspector T. Willard Burke reports that not over 25 orchards remain to be treated.

The trees in the infested districts were well burlapped and thoroughly attended. No better illustration has ever been given of what thorough burlapping and careful attention will do than the results obtained in Hingham during 1907. The orchard infestations found in the winter of 1906–07 range from 50 to 500 nests each. In the fall inspection of 1907 place after place was found absolutely free of the moths, while in those infested but from 1 to 6 egg clusters were found. A thorough examination of the woodlands is now being made, and a number of small colonies have been found. Next year's work should include the free use of burlap in localities where egg clusters have been found, and particularly in the Old Colony Hill district.

Holbrook.

William Hayden, *Local Superintendent.*

This town has about held its own as far as infestation by the gypsy moth is concerned. Burlaps were used in the 38 known colonies, and a considerable amount of trimming, cementing, etc., was done. There are about 60 estates infested by the gypsy moth, as shown by the fall inspection, while the fine elms along the main street are generally infested. A more vigorous campaign should be made against the insects in Holbrook in 1908.

Holliston.

Frank Case, *Local Superintendent.*

The somewhat hasty scouting of the town made in the winter of 1906–07 showed 5 places infested by the gypsy moth. The

trees were trimmed and the cavities closed with tin, while later burlaps were used to intercept the caterpillars, but not one was taken during the summer. A thorough scouting of this town by trained men should be made before a correct opinion of its condition as regards the gypsy moth can be formed.

Hopkinton.

Samuel Smith, *Local Superintendent.*

The usual winter and spring work of removing the brown-tail moth webs and creosoting gypsy moth egg clusters occupied the attention of the small force employed in this town during the winter and early spring, and the necessary work of tinning cavities in orchard trees and of thinning and brush cutting was carried on. The burlaps received satisfactory attention during the season, caterpillars being found in nearly every colony. The section so cared for during the summer was in very good condition at the time of the fall inspection, but some 10 small additional infestations were located, the one on the shore of Whitehall Pond being of serious importance, since 376 egg clusters were destroyed there. The general condition of this town, so far from the central infested district, is a serious one, and much good work must be done here to hold the gypsy moth in check.

Hudson.

John E. Walsh, *Local Superintendent.*

By the middle of April the winter work of clearing street trees and those on private estates in the residential district was completed, and during May much attention was given to trimming, cementing and tinning infested orchard trees preparatory to burlapping. Burlaps were freely used and well cared for during the summer, with the result that a large number of caterpillars were destroyed. In the late summer scouting operations and the general work of clearing up infested roadsides and orchards was in progress. A number of new gypsy moth infestations were found as a result of the fall scouting, none of them being of notable size. At this writing the work of removing brown-tail moth webs and creosoting gypsy moth nests is in progress. During 1908 a general burlapping

campaign will be needed in this town, and doubtless a limited amount of spraying. There yet remains a considerable amount of work in the way of tinning and cementing of cavities in orchard trees in or near infested localities.

Hull.

Smith F. Sturgis, *Local Superintendent.*

Much good work was done in clearing the town of gypsy and brown-tail moths during the winter and early spring months, particular attention being given to infested orchard trees. Burlaps were freely used, but not attended as thoroughly as they should have been as shown by the fact that many gypsy moth egg clusters were found upon them in the late summer. We have done but little more than hold our own in this town, and next season a somewhat larger force than was employed in 1907 may be necessary.

Hyde Park.

Harry G. Higbee, *Local Superintendent.*

In the winter of 1906–07 a thorough scouting was made of this town, and 297 localities were found infested, the most serious infestation occurring in the northern part, showing that the close proximity to badly infested sections in Boston was having its effect in the distribution of the moths. Until the Roxbury district can be thoroughly cleared, Hyde Park is liable to continued reinfestation from this source. In contrast to this condition, the southern part of Hyde Park was found to be lightly infested, the nests being but a few in a place and widely scattered.

The places where the moths were located were well cleared up, more than 25,000 burlaps being used and well attended. A limited amount of spraying was also done in the most badly infested sections. Two important colonies are at Clarendon Hills, where more than 200 egg clusters were destroyed, and in the woodland near Ashland Street on the Boston line, where defoliation occurred last summer. The local superintendent was successful in preventing serious damage by the moth on the Hyde Park side of the line, but this latter locality must be

carefully watched for some years to come. Throughout the woodlands in this town the gypsy moth is generally scattered, yet in these latter colonies, where 500 egg clusters were found last year, only about 300 were found in the fall of 1907. So far this town has assumed the care of private estates, paying for the cost of this work from the town appropriation. The infestation is so severe at Hyde Park, however, that it will be better policy in the future to assess each property owner for the care of his place in accordance with the terms of the act, and thus induce citizens to take a more active interest in suppressing the moths on their estates. The situation in Hyde Park is a serious one, and a liberal expenditure of funds in fighting the moths here during 1908 will be in the interests of economy. The work for the coming year should include a general burlapping campaign, together with a considerable amount of spraying. The purchase of a power sprayer for use here is desirable.

Ipswich.

James A. Morey, *Local Superintendent.*

The condition of this town has been greatly improved during the past year. Before the caterpillar season arrived the street trees and those on private estates had been thoroughly cleaned of moths and a considerable amount of scouting also accomplished. In the most severely infested sections spraying was used, with good results. Street trees and others on infested estates were burlapped and attended throughout the summer. The work of the local superintendent has been of excellent quality, and the townspeople have co-operated with him in a most commendable manner. During the fall roadside trimming has been continued wherever the moths have been found, and a large proportion of the trees cleared of gypsy moth egg clusters to a distance above the probable snow line. In the course of the fall work a small woodland colony was located near the Rowley line, which will be thinned out and put in condition for burlapping and spraying.

At the present time the work of cleaning the street trees is in progress.

KINGSTON.

DANIEL WESTON, *Local Superintendent.*

In the orchards infested with the gypsy moth the local superintendent cut many worthless old trees and cemented holes in others, preparatory to the burlap season. Unfortunately, this preliminary work was not supplemented by other methods equally necessary, such as scraping the bark and removing dead wood. About 500 burlaps were well attended during the caterpillar season, and more than 4,500 larvæ and pupæ taken.

In the fall the selectmen of the town practically took charge of the work, and spent much time in the field. As a result of their public-spirited efforts, nearly all the town has been scouted, aside from the woodlands, and its condition has become quite definitely known. Of the 53 infested estates found prior to June 1, on which in 1906–07 664 egg clusters were destroyed, 36 were found to be still infested in the fall of 1907, with 749 egg clusters. This inexcusable increase of the moths on so many estates may be attributed chiefly to the neglect to apply the approved cleaning methods in the orchards before the hatching of the eggs.

Only 2 woods colonies are known in Kingston at the present writing, but it is probable that the woodland is scatteringly infested. The town officials are awake to the importance of the moth work, and many owners of private estates have done much work in cleaning their orchards and cutting worthless trees. We are assured by the chairman of the board of selectmen that the necessary work of cutting, cementing, trimming and scraping of trees will be done before the larval season. This will involve a considerable amount of labor during the winter and spring, but the work is indispensable if the gypsy moth is to be brought under control here.

LAKEVILLE.

S. T. NELSON, *Local Superintendent.*

Since the finding of the single egg cluster in 1905, no form of the gypsy moth has been found in the town, but a thorough inspection of the whole area will be made prior to May 1, 1908.

The brown-tail moth infestation in Lakeville is very slight.

Lawrence.

Isaac Kelley, *Local Superintendent.*

Early in the spring of 1907 the examination of this city by Inspector John J. Fitzgerald showed 191 gypsy moth egg clusters. The trees in the infested sections were burlapped and well attended during the season, with the result that a very large number of caterpillars was destroyed. A limited amount of spraying was done, with excellent results. In the fall months, the local men having acquired sufficient experience to qualify them for scouting work, a thorough examination of the entire city was made, with the exception of woodlands remote from highways. Seven hundred and sixty-two gypsy moth infestations were found, containing more than 500 egg clusters, the largest number (425) being destroyed on the trees standing in the Common. The colony at Mount Vernon Street, where 225 nests were treated, is also a dangerous spot, which should be thoroughly cared for next year. In the 191 infested sections found last spring egg clusters were found this fall in less than 30 per cent. In fact, very few clusters were found in any of the colonies which had been burlapped and properly attended during the summer, — a state of affairs which reflects great credit upon the local superintendent. In common with other municipalities, where manufacturing is the main industry, but little interest, relatively speaking, has been taken by the citizens in caring for the trees.

Now that the general condition of the city with reference to the moth pests has been determined, a vigorous campaign of burlapping and spraying should be put through in the summer of 1908.

Leicester.

If evidence were needed to show how automobiles scatter the gypsy moth, no better illustration could be found than in the case of the colony in this town located by State scouts on December 14. Two men were detailed to scout roadsides and orchards thoroughly along the State road from Boston to Springfield, the gypsy moth being known to occur as far west as Worcester. No egg clusters were found in Leicester until the center of the town was reached, when 2 were discovered on a

tree in the rear of the Leicester Inn garage. We are assured that the necessary work will be done in this town to care for this infested spot.

LEOMINSTER.

S. F. WALKER, *Local Superintendent.*

A single gypsy moth nest was found in this town at the time of the spring scouting. No caterpillars were taken under the burlap in this locality, but later caterpillars were found in one locality in the northern part of the town. Although the burlaps were well cared for here, no gypsy moth egg clusters were discovered at the time of the fall inspection. The property owners have greatly assisted the local superintendent in his work, and there should be no special difficulty in holding the gypsy moth in check in this town.

LINCOLN.

EDWARD R. FARRAR, *Local Superintendent.*

This town contains a very large amount of woodland, much of which is included in the many beautiful estates of summer residents, who desire, as far as possible, to preserve its integrity. It is practically impossible to attempt to clear the moths from this woodland until it has been thinned and underbrush removed, in order to permit of economical and efficient spraying. Much good work has been done in the orchards here, yet much more will be required. After the usual work of clearing street trees, orchards and private estates had been completed in the early part of the year, a dozen or more men were put at work scouting and cleaning woodland territory, and kept so employed until after the egg clusters had hatched. In May and June burlaps were applied and faithfully attended during the summer season. A limited amount of spraying was done, with good results, while during the late summer a considerable amount of brush was cut in certain infested localities. A small force of men began work in the latter part of November, and is now engaged in destroying brown-tail webs and gypsy moth egg clusters.

The work for 1908 in Lincoln should include a very thorough treatment of the infested woodlands, and for this purpose much

burlapping and spraying will be required. At least one power spraying outfit is needed here, and two can be used to advantage during the caterpillar season.

Littleton.

George Davidson, *Local Superintendent.*

The work against the gypsy moth in this town has been delayed at times by lack of suitable help and unfortunate local complications. In the early part of the year the street and orchard trees were looked over, the brown-tail moth nests removed, and considerable work done in repairing infested orchards and putting them in shape for the effective use of burlap. This town is thoroughly infested, particularly in the orchard sections, and probably in the woodland districts. If it had been possible to give better attention to caring for the burlaps during the summer, a greater gain against the moth pest would have been made.

At the present writing a considerable amount of tinning and cementing in orchards is under way, brush is being cut along infested roadsides, and numerous dead and decayed trees are being removed. We are obliged to report that the gypsy moth has made a gain in this town in 1907. It therefore means that more effective work and larger expenditures will be required the coming year. The work for 1908 should include the liberal use of burlap, and particularly a large amount of spraying. A thoroughgoing, vigorous campaign over this town will put the orchard sections and residential district in good condition. If such a campaign is not carried on, the increase of the moths here will be rapid.

Lowell.

Charles A. Whittet, *Local Superintendent.*

A very large number of gypsy moth egg clusters were found in this city last winter and spring, when a gang of from 20 to 30 men were employed in the work of clearing street trees and private estates. There was an unfortunate delay in obtaining and applying burlap in season for its most effective use, but during the latter part of the summer it was well attended, and a considerable amount of spraying was also done in the most seriously affected places.

Good work has been done here against the brown-tail moth, but this city is peculiarly liable to reinfestation by this insect from outside sources. The masses of bright lights at night prove a strong attraction during the flying season of the moths, thousands of which are thus drawn from the woodlands which surround the city. Since it is not practicable to clear all the low-cost woodlands lying within a few miles radius of this and other manufacturing cities in the Merrimac valley, we must expect at Lowell, as well as at Lawrence and Haverhill, repeated reinfestations of the insect, varying in intensity with the numbers of moths and the direction of the winds at the flying season. There has been a net gain in the work against the moths in this city, due to the active efforts of the local superintendent, who has been supported at all times by the park commissioners having the work in charge.

The lack of proper financial support at critical times has made it necessary to lay off the force of trained men engaged in this work, with the consequent loss of efficiency. If funds can be provided for a thoroughgoing, systematic campaign without let-up or hindrance throughout the entire year of 1908, notable progress will be made in wiping out the moths in this city. During the coming year extensive burlap operations will be required, while additional spraying outfits should be purchased and freely used during the caterpillar season.

Lunenburg.

S. Farnsworth, *Local Superintendent.*

The scouts from the central office located 3 gypsy moth egg clusters in this town in April, 1907, 1 on the State road over the Fitchburg line, and 2 at Whalom Park, where a large number of trees were burlapped and attended during the summer. This park is in high favor as a pleasure resort, and has doubtless become infested from the large number of automobiles and the electric cars which pass through it.

At the present writing the local superintendent is making a thorough scouting of the town. A considerable amount of burlapping will be needed here next summer.

Marlborough.

F. B. Proctor, *Local Superintendent.*

From January through April the local force, averaging from 25 to 30 men, was kept diligently occupied in cleaning the brown-tail moth webs from street trees. On private property some 45 small gypsy moth colonies were located and treated. While this work was in process burlaps were freely used on the infested estates, and in 19 of the colonies gypsy moth caterpillars were taken. A great deal of good work has been done in the way of thinning out infested roadsides and tinning cavities in orchard trees. The fall inspection shows this city to be very generally infested by the gypsy moth, while the brown-tail moth is notably abundant. In the northerly part of the city the latter insect is unusually abundant. The work for the winter and spring should include a considerable amount of brush cutting along fences, and the putting of numerous old orchards in such condition that burlapping and spraying operations next summer may be carried on economically and effectively.

Marshfield.

P. R. Livermore, *Local Superintendent.*

In the latter part of March, 1907, Mr. Livermore was appointed local superintendent of Marshfield. At this time there were but 4 estates known to be infested by the gypsy moth. The superintendent at once organized a gang of 3 men (all inexperienced), and began work with such vigor that before June 1 the gypsy moth had been located on 58 estates, and 437 egg clusters destroyed. All the infested estates were put in good condition for burlapping, which was used with good results, about 1,300 trees being banded and 8,463 larvæ and pupæ destroyed. A complete scouting was not possible in the spring, with the great amount of cleaning work to be done; but a thorough inspection of the town was made for the first time last fall, with the result that over 100 estates (33 of them located in the spring) were found infested with the gypsy moth. Eleven of these are woods colonies of no great extent, presenting no special

difficulties in the way of handling. Five of them have already been cleaned, and in all the necessary cutting, etc., will be done before the caterpillar season of 1908. A certain amount of woods scouting, hindered by unfavorable weather, still remains to be done.

The brown-tail moth is not much in evidence in Marshfield, but the regular winter search for the webs of the insect will be made, to insure its suppression.

The work of the local superintendent in this town is entitled to much praise, and has been effectively supported by the board of selectmen.

MAYNARD.

LUKE S. BROOKS, *Local Superintendent.*

About 40 gypsy moth infestations have been found in this town, mainly in the southern and western sections. The most important colony was that on the property of George Brown, where numerous egg clusters were found, more than 300 being discovered in a single abandoned bee-hive. Good work was done here in the winter and spring months by the local gang in clearing street trees and those on private estates from the gypsy and brown-tail moths. Burlaps were used with good results during the caterpillar season, and a considerable amount of excellent work has been done in putting infested orchards in good shape for next season's work. Aside from the ordinary work of burlapping, repairing orchard trees and cutting and burning worthless roadside trees and brush, we shall recommend for 1908 the purchase and use of a power sprayer, which will prove of great value during the caterpillar season.

MEDFIELD.

G. L. L. ALLEN, *Local Superintendent.*

In the 7 known gypsy moth colonies caterpillars were taken in 5 during the summer season. Where necessary, brush cutting and the filling of cavities in hollow trees was done, and later the burlaps were well attended. Infestations here, as shown by the fall scouting, are small but widely scattered. A considerable amount of roadside and orchard work yet remains to be done in this town.

Medway.

Capt. Francis H. Leonard, *Local Superintendent.*

The State gang of scouts made a thorough examination of this town during the month of December. It was found to be generally infested by the gypsy moth, scattered in small numbers over the entire area. Here the old orchards are often found infested, and will require much careful attention during the coming year. We have assurance that the necessary work in this town will soon be under way. The scouting of the woodlands here will be very desirable at an early date.

Merrimac.

Gilbert G. Davis, *Local Superintendent.*

The local forces finished clearing the moths from private property early in the year. The thorough scouting of the town by the employees of the central office showed 12 small new infestations of 1 or 2 egg clusters each. All the trees in the infested sections of the town were burlapped and well attended during the caterpillar season, a small number of insects being taken in a few of the colonies. At the present writing the work of clearing the street trees is in progress, and later the local superintendent will thoroughly examine all private estates for the moths.

Methuen.

A. H. Wagland, *Local Superintendent.*

In January and February the work of clearing private estates of the gypsy and brown-tail moths was vigorously prosecuted, and some work done in badly infested orchards, to put them in condition for the caterpillar season. The trees in all infested localities were burlapped, and attended twice a week during the summer season. Spraying operations in the sections where the caterpillars were most abundant gave excellent results. The fall scouting showed a number of new infested localities, but not more than 2 or 3 egg clusters were found in any of them. During the fall months a considerable amount of work was done in old infested orchards, where trees were removed, cavities tinned over or cemented and the brush burned. A large

amount of trimming of infested roadsides has been accomplished, and at this writing the gypsy moth work has been done over the entire town up to the probable snow line, and the work of thorough clearing of the street trees is now in progress. The local street railway company have done most excellent work against the moths in Glen Forest Park, one of the most badly infested sections.

MIDDLEBOROUGH.

JOHN C. CHASE, *Local Superintendent.*

The large town of Middleborough, over much of its area, appears to be free from the gypsy moth. Nevertheless, the infestation is serious, for on Dec. 15, 1907, more than 50 estates were found infested. The most important single orchard infestation was on an estate on Chestnut Street, where 201 egg clusters were treated on one apple tree. In the residential section burlaps were turned during the summer in 6 places, and 1,015 larvæ were killed.

The most extensive infestation in Middleborough is in the Rocky Meadow Street neighborhood, in the extreme eastern part of the town. Some orchards on this street were found infested during the summer, and the infestation has since been found spread over a number of acres, including both woods and open land, and extending scatteringly over the line into Carver. In the woodland of the town the most important infestation is on the Carver line in the same locality.

The necessary cutting, trimming, etc., is already completed in two woods colonies and in many orchards. This work will be continued until all infestations are in readiness for the burlap season. In addition to the burlapping, spraying will be needed on many estates. With adequate care and labor, the gypsy moths in Middleborough should not only be prevented from spreading from the present known infestations, but also reduced in numbers and eventually suppressed.

The brown-tail moths in the town are few in number and are scattered, the largest number being found near the central railroad station.

The moth work in Middleborough is in competent hands, and has been well supported by town officials and citizens.

Middleton.

M. J. Emerson, *Local Superintendent.*

The good work done here in 1906 has been continued during the year just closed. In all the infested localities the street and orchard trees were burlapped or banded with sticky materials, while in certain colonies burning with the oil flame was resorted to, with excellent results. Along Forest and Boston streets a considerable amount of roadside thinning has been accomplished, and in the important woodland colony lying between Haswell Park and Boston Street underbrush and dead or worthless trees have been removed. Nearly all the necessary work in orchards in the way of cementing or tinning cavities has been done, and a large number of worthless trees cut and burned. The condition of this town, aside from certain of the woodland colonies, is greatly improved. The street trees have been cleaned of the moths, and local forces have commenced a thorough scouting of the woodlands.

Milford.

George E. Stanley, *Local Superintendent.*

A single colony was located in this town by State employees during the winter. The trees in the vicinity were trimmed, and cavities cemented and put in condition for the summer work. During the caterpillar season the burlaps were well attended, but nothing was found. A thorough scouting of this town will be needed before a proper estimate of its condition can be made.

Millbury.

John J. Garvey, *Local Superintendent.*

In December a gang of scouts from the central office spent the entire month in making a thorough inspection of all roadsides and orchards in this town. Gypsy moth egg clusters were found on Canal, Curve, Martin and Greenwood streets, 14 egg clusters being found in one locality and 41 in another, the most serious infestation being on Martin Street and Parkhill Avenue.

Work against the moths will soon be organized here. It will be necessary to do considerable orchard work in this town, and the woodlands should be scouted at an early date.

Millis.

Henry W. Alden, *Local Superintendent.*

In one locality in Millis near the Medfield line the gypsy moth has been found. The underbrush in this section was cut out, the trees burlapped and attended during the summer, but only 4 caterpillars were taken. This town should have a thorough inspection before the opening of next season.

Milton.

Nathaniel T. Kidder, *Local Superintendent.*

The general infestation of this town continues, although a net gain has been made against the gypsy moth here. The work in Milton has been well carried on, and has been properly supported by town officials and citizens alike. Particularly commendable is the spirit shown by the property owners in cooperating fully with the local authorities in this important work, as in Canton, Scituate and many other towns it has been difficult to convince several owners of large wooded estates of the necessity of a considerable amount of brush cutting and spraying. In order that spraying may be done economically and effectively during the caterpillar season, the citizens of this town should realize that the gypsy moth is not a pest to be trifled with, and that the application of most vigorous measures alone will suffice to keep the pest in check.

All told, about 40,000 burlaps were applied to trees in the infested sections, and the 8 men employed to examine them gave most faithful attention to their work. During the fall months brush cutting along roadsides and scouting operations occupied the attention of the local forces. At the present writing the work of cleaning street trees and infested estates is in progress.

Milton is particularly liable to infestation from Boston and other cities and towns lying to the north. Much careful work will be required here for some years to come.

Natick.

Henry S. Hunnewell, *Local Superintendent.*

Throughout the town the gypsy moth is generally scattered, both in woodlands and on private estates, but serious damage

by the gypsy moth has been prevented by the use of thorough control measures. In the late winter and early spring trees on private property were thoroughly cleared of the pests, and a considerable amount of most excellent work was done in putting old orchards in good condition for spraying and burlapping. About 65,000 burlaps were applied and attended during the summer, over 30,000 caterpillars being killed in this way. About 80 per cent. of the caterpillars taken were in the woodland, a fact which reflects great credit on the good work done in the residential sections in 1906.

The fall inspection of the residential district has been completed, and shows great gain over last year, only 314 egg clusters being found. The woodland inspection is now in progress, and a large number of scattering nests have been destroyed.

In the course of the summer's work an important colony on South Main Street, where 383 egg clusters had been destroyed, was sprayed so thoroughly that not a single caterpillar was taken there under the burlaps. At the Wignot colony in South Natick, where 802 egg clusters were destroyed, the spraying was so effective that only a single caterpillar was found later. The work against the moths in Natick has been ably administered, and has not suffered from lack of sufficient financial support at any time. The most important problem on hand here at present is the condition of woodlands in the northern part of the town along the Weston line, where co-operative work between the two towns will be necessary. We have assurances from the Weston authorities that the colonies over the line in that town will be thoroughly treated before the opening of the caterpillar season.

Needham.

Ernest E. Riley, *Local Superintendent.*

The gypsy moth has become well established in nearly every portion of this town. Early in the year the street trees were cleared of the moths, and in the latter part of June the work of cleaning private estates and certain important woodland colonies was under way. A number of infested orchards were thoroughly treated, and at the opening of the caterpillar season more than 35,000 burlaps were applied to the trees in the infested districts. A careful attention to the burlaps reduced the

moth infestations in the residential sections about 80 per cent. and in the woodlands about 70 per cent. During the fall inspection 3,612 egg clusters were destroyed in various parts of the town, a fact which shows the need of very thorough measures against the gypsy moth in 1908. Needham is exposed to reinfestation from Wellesley, and more particularly from Newton, where many important woodland colonies have not yet been brought under control. In turn, the condition of affairs at Needham is a menace to Dover and Medfield. The work done here has been of good quality, but much remains to be done.

Newbury.

Charles O. Bailey, *Local Superintendent.*

This town was thoroughly scouted in the spring of 1907, and found to be generally infested by the gypsy moth, particularly in the orchard sections. These orchard sections were thoroughly sprayed later in the season, with excellent results, while the liberal use of burlap greatly reduced the numbers of caterpillars on street trees and in orchards alike. The fall scouting showed a few new infestations, none of which present any serious difficulties to thorough suppressive measures. The most difficult factor to deal with in the Newbury situation, as far as the moths are concerned, is the large number of old orchards containing numerous hollow and decayed trees. There should be a general cutting of the worthless apple trees and a systematic effort to cement or tin cavities in the remaining ones, especially in the central part of the town and in the Old Town district. A considerable amount of roadside trimming has been accomplished this fall, and in the orchards the gypsy moth egg clusters have been destroyed up to a height of the probable snow line.

Newburyport.

Thomas T. Upton, *Local Superintendent.*

In the early months of the year all private property was thoroughly inspected and cleared of gypsy and brown-tail moths. A few new infestations of minor importance were found. A very large amount of spraying was done in this town during the summer season, with the result that the number of caterpillars

and consequently of egg clusters found in the fall inspection was greatly reduced. The trees in the infested districts were burlapped and thoroughly attended during the summer months. While the gypsy moth infestations have now been found in practically all parts of the city, the situation is well in hand and is much improved over that of 1906. All ground work against the gypsy moth has been done, and at the present time the cleaning of the street trees is nearly finished. As soon as this latter work is completed, the work of clearing private estates will be taken up. In the greater part of this city burlapping and spraying operations during 1908 will suffice to keep the moths under control.

North Andover.

Peter Holt, *Local Superintendent.*

The work against the brown-tail moth in this town has been well done; but owing to the many other duties of the local superintendent, it has not been possible to give the work against the gypsy moth as much attention as seemed desirable. The result is that in this town the gypsy moth has made a gain during the past year, and a thorough scouting of the entire town should be made before the egg clusters hatch next spring. The numerous old apple orchards are generally infested, and should be thoroughly overhauled during the winter. There are several small colonies in the woodland in the southern part of the town and one large colony covering several acres between Farnum Street and the Boston & Maine Railroad track. The work of clearing the street trees is now in progress.

North Reading.

George E. Eaton, *Local Superintendent.*

Throughout this town the gypsy moth infestation is general, while the brown-tail moth is found in woodlands and orchards alike. The woodland gypsy moth colonies have increased in size considerably, due to the fact that it was not possible to provide funds for their thorough treatment during 1907. In the residential sections and along the highways the condition of affairs as regards the moths is certainly 40 per cent. better than last year. The most important woodland colonies occur along

Swan Pond Road and Central Street. A large amount of roadside thinning and brush cutting has been done, while in the northern part of the town about 20 acres of infested woodland have been thinned and put in proper condition for next season's operations. During the season of 1908 a very vigorous campaign must be made against the moth pests in the woods, in order to prevent serious stripping of the trees by the caterpillars.

Northbridge.

A thorough scouting was made of this town in the latter part of December, and a single infestation of the gypsy moth was found in the Whitinsville district. This will be properly dealt with by the local authorities.

Norwell.

John H. Sparrell, *Local Superintendent.*

The town of Norwell, like Hanover, contains a large number of apple orchards in which are many worthless or neglected trees, — notorious breeding places for the gypsy moth. The orchard work against the moths, comprising the usual scraping, trimming and cementing, done by the local superintendent, has been of good quality. In addition many worthless trees have been summarily disposed of by fire and the axe.

About 4,000 yards of burlap were used in the town last summer, and a large number of caterpillars were killed. As the result of a careful scouting last fall, there were on December 15 109 known colonies of the gypsy moth. There still remain to be looked over some infested territory in the western part of the town, and the wooded area to the north and south of Grove Street and west of Prospect Street.

The woods problem is also a serious one in Norwell. In its northern portion the town is extensively wooded, and several gypsy moth infestations are already known there in the section west of Prospect Street. One of these, situated north of Grove Street, not far from the Hingham line, was discovered by Chairman Alpheus Thomas of the board of selectmen. The light infestation here extended over several acres, much of which was pine woods of good size. These trees are now being cut by the owner. To the south of Grove Street there is another similar infestation, and the pines here will also be cut and marketed.

The existence of the gypsy moth in various places in the woods west of Prospect Street makes imperative an inspection of the entire area, so that any additional infestations there may be promptly located and cared for. Such inspection will be made before May 1. The only known woods colony in the southern part of the town is a very slight infestation off Pine Street, near Green Street.

Much work in orchards infested by the gypsy moth still remains to be done, and a large amount of burlap must be used during the coming summer.

Norwood.

H. F. Winslow, *Local Superintendent.*

The winter scouting when completed showed 6 infested estates. These were cleared up, burlapped and well attended during the summer. The colony on Pleasant Street, covering some 5 acres, and another of about the same size on Leyden Street are the two most important infestations in the town. In all, over 3,200 caterpillars were taken under the burlaps in these two colonies. The fall inspection of the residential district has not increased the number of known infested places, and with good work the moths should be controlled here without unusual difficulties.

Orleans.

Albert W. Smith, *Local Superintendent.*

The two former infested places in this town were burlapped last summer, as in 1906, but again nothing was found. In December last a single egg cluster was found by Inspector Carleton on the South Orleans road. A large part of the town has been inspected, and the area that still remains to be looked over will be cared for before spring.

The brown-tail moth infestation in this town is slight and scattering.

Pembroke.

Calvin S. West, *Local Superintendent.*

In Pembroke, as in so many other towns of Plymouth County, the orchard problem has been given the first attention. In 1907 the local superintendent and various property owners did considerable work in orchards, worthless trees being cut and others

cemented, trimmed and scraped, but a great deal of this kind of work remains to be done.

In the summer of 1907 about 2,000 yards of burlap were put on trees in Pembroke. The burlaps were diligently cared for, but more should have been put on in and around the infestations. In round numbers, 2,000 larvæ were killed during the season. The careful, close work done in 1907 by the local superintendent and his deputy resulted in the destruction of about 1,500 gypsy moth egg clusters, several hundred of which were found in one stone wall. The entire town was carefully scouted last fall, and to-day over 100 infestations of the gypsy moth are known. Eight of these are woods colonies, in which cutting will be required before the burlap season of 1908. On account of the number of egg clusters found, 4 of these colonies will require special care. Much good work will be needed throughout the town, to keep the moths under control in 1908.

Pepperell.

Joseph A. Wiley, *Local Superintendent.*

Four gypsy moth egg clusters were found in this town, near the center, by State inspectors in January, 1907. The necessary cutting and thinning operations have been done by the local superintendents, and burlaps were used freely and well attended. In November and December attention was given to the work of preparing old orchard trees, removing brown-tail moth nests and scouting for the gypsy moth. A few egg clusters were found in the section near the old colony. The infestation here is light, but the town must have thorough attention during the coming year. As the town is quite badly infested by the brown-tail moth, it will be desirable that at least a large hand-spraying outfit be purchased and used as needed during the coming summer.

Plymouth.

George R. Briggs, *Local Superintendent.*

The usual good work against the moths in Plymouth has been carried on by the town authorities, through the local superintendent, his efficient deputy and employees, and a distinct gain has been made in the work of suppressing the gypsy moth.

About 7,000 trees were burlapped last summer, and 4,559 larvæ and pupæ were killed. Prior to June 1, 1907, the known infested estates in Plymouth numbered 122, and on these 903 egg clusters had been found. During the fall scouting of the town only 36 of these estates were found to be still infested, and on them but 87 egg clusters were discovered. The fall scouting also revealed 77 additional places, infested with 249 egg clusters. The total result of the scouting was therefore but 336 egg clusters destroyed on 113 estates. The largest number of egg clusters found on a single estate was 15, while on each of 61 estates only a single one was found. These figures sufficiently testify to the present good condition of the orchards of Plymouth.

There were 4 infested estates last fall in the vicinity of Long Pond, but the total number of egg clusters found was small. At certain other points in the pond district where formerly there were slight infestations no egg clusters were found during the fall scouting. On November 30, at White Island Pond, on the Wareham line, a small gypsy moth infestation was located and 2 egg clusters were destroyed. The slight but scattering infestation which has been noted in the extensive pond district of the town has emphasized the need of a thorough inspection along the borders of all the roads in this area, and the probability of the discovery of additional small colonies of the moths. Such an inspection it is planned to make, weather permitting, during the present winter. The brown-tail moths in Plymouth are few and scattering, and will be cared for before spring.

Plympton.

Zina E. Sherman, *Local Superintendent.*

Plympton is very seriously infested with the gypsy moth over its entire area. Prior to May 1 of last year there were 38 known infestations in the town. Eighteen additional colonies were located during the summer by Inspector Souther, while the fall scouting developed later 45 more infestations. There were 1,537 trees burlapped here last summer, and about 50,000 caterpillars were killed. In round numbers there have been destroyed since the larval season about 950 egg clusters. There are nearly 30 known woods colonies in Plympton, and during

1908 a large outlay of money and much hard work will be required to hold the gypsy moth in check.

Excellent work was done during the burlap season as the large total of larvæ killed and the small number of eggs later found in orchards sufficiently indicate. In addition to the good burlap work, trimming, cementing, scraping and cutting operations were pushed vigorously, so that the orchard problem in the town to-day, while still serious, is of less moment than the serious infestation of the woods. The largest wood colony lies off Upland Road. The egg clusters here, while not excessive in number, are scattered over an area of more than 7 acres.

The woodland in Plympton, much of which is white pine, will require a great deal of watching in 1908, in order that the gypsy moths may be kept within the present known infestations, and that any colonies as yet unknown may be located as soon as possible.

RANDOLPH.

ROYAL T. MANN, *Local Superintendent.*

About 50 infested estates had been discovered in this town at the close of the winter inspection. All were put in condition for burlapping before the caterpillar season was well under way. The thorough attention given to some 1,300 burlaps was notably effective in reducing the numbers of the moths. In many of the former colonies no egg clusters were found at the time of the fall inspection. A few egg clusters were found on about 90 different estates, which indicates that the previous scouting work was not done as thoroughly as was desirable. Such a condition of affairs is not unusual in towns where the local force must be taught to recognize the moth and to know where to look for it. In all the outlying towns the skill of the local employees will doubtless increase with the lapse of time.

RAYNHAM.

GEORGE LEACH, *Local Superintendent.*

No caterpillars were found last summer at the only known gypsy moth colony in this town, nor were any egg clusters discovered later. A thorough cleaning was given this place in the spring, and the burlaps were well attended during the summer. The town will be thoroughly scouted before May 1, 1908.

Rockland.

Frank A. Shaw, *Local Superintendent.*

The town of Rockland in most of its residential section is generally but not heavily infested with the gypsy moth. Work against the moths was carried on in 1907 in a very thorough manner by the local superintendent, who did a great deal in the way of trimming, scraping and cementing in infested apple orchards. At his urgent request many citizens cut their worthless trees, regardless of the question whether or not the trees were infested. It follows that Rockland to-day, as far as the orchard problem goes, is in better condition over most of its area as concerns the gypsy moth than many towns in eastern Massachusetts. The preliminary operations of the spring were supplemented later by an extensive burlapping campaign. Over 7,000 yards of burlap were put on about 5,000 trees, which were diligently cared for throughout the summer by the local gang. Since egg laying time over 2,000 nests have been treated.

The fall scouting of the town has developed several rather badly infested places in the town proper, in some of which spraying will be required next spring. The woodland problem in Rockland is not yet a serious one. In the rather extensively wooded southern part of the town no moths have been found, although 7 woodland infestations are known to exist elsewhere. The most important are the 3 off Pond Street, near the Hanover line, where about 60 egg clusters were found, many of them on pines, and the one at Accord Pond, where 200 larvæ were taken last summer under the burlaps, and later 75 egg clusters were destroyed. Some cutting will be required in both these places. A burlapping campaign as extensive and energetic as that of last summer will be needed in 1908, and this should bring about a marked reduction in the numbers of the gypsy moth.

Operations against the moths in Rockland have been aided in a most public-spirited way by the selectmen, and much interest in the work is evinced generally by the citizens.

ROCKPORT.

ELI GOTT, *Local Superintendent.*

In the month of February the trees on private estates were thoroughly cleared of both moth pests, the gypsy moth being found in nearly every orchard, although few infestations were found upon the street trees. The burlaps on public trees were thoroughly attended during the caterpillar season; but those on private estates were not as well inspected as they should have been, owing to the limited amount of money available for the work. Very little assistance was given to the local superintendent by private citizens, with the result that private estates in general throughout this town are in much worse condition as regards the gypsy moth than last fall. The spring infestation showed a few egg clusters in Manning Park, where the underbrush and worthless trees were removed and the burlaps thoroughly attended during the summer; but few were found in the park this fall. The thinning out of roadsides in infested sections has been commenced, and if the local superintendent has suitable funds with which to enforce the law thoroughly against the negligent property owners and to put the infested orchards in shape for next season's work, there is no reason why this town should not show a marked improvement in 1908.

ROWLEY.

DANIEL O'BRIEN, *Local Superintendent.*

The quality of the work done in this town has been most satisfactory. In the early part of the year all orchards were examined and a few gypsy moth infestations found. These were thoroughly burlapped, with gratifying results. The "Stack Yard" colony, so called, badly infested in 1906, where a large amount of cutting and burning was done last winter, is in most excellent condition this fall, and now offers no serious obstacle to control measures. In common with other towns in this section, a large number of old orchards are generally infested. Here the hollow and dying trees should be removed, and much cementing and tinning of cavities will be required if the work against the gypsy moth is to be carried on to the best advantage. This the local superintendent will attend to in connection with

his regular winter work of clearing private estates. Plans have also been made for a thorough scouting of at least a part of the woodland, where the gypsy moth has already been found in small numbers.

Salisbury.

Henry C. Rich, *Local Superintendent.*

A general campaign of burlapping was carried on here during the summer months, with good results, many thousands of caterpillars being killed by hand. The orchard problem here is a serious one, and, while a great deal of good work has been done in the way of closing cavities and in cutting and burning a number of hollow trees, much remains to be done along this line. There is a considerable amount of woodland in this town, which should be thoroughly scouted before the opening of the caterpillar season.

On the island, where a large colony was found in the fall of 1906, good attention given to the burlaps has greatly reduced the number of moth nests. Notwithstanding the fact that this town is the gateway, as it were, through which passes a very large part of the automobiling to New Hampshire and Maine points, and hence is particularly liable to infestation from outside sources, a net gain has been made against the gypsy moth during the year just closed. The 1908 work here should include the liberal use of burlap and a larger amount of thorough work in orchards, and the vigorous treatment of the small woodland colonies known to exist within its limits.

Sandwich.

Joshua E. Holway, *Local Superintendent.*

In the gypsy moth colony, in which 8 egg clusters were found in the winter of 1906, a thorough cleaning was given the trees, the cavities being cemented, dead wood taken out and loose bark removed. During the caterpillar season burlaps were applied and thoroughly attended, but no gypsy moths were found. In common with other Cape Cod towns, Sandwich should be given a thorough scouting during the winter months.

Very few brown-tail moth webs have been found in Sandwich since 1905–06. Very thorough local work was done against this insect.

Scituate.

Jetson Wade, *Local Superintendent.*

The neglected orchards in Scituate are still the chief hindrance to effective work against the gypsy moth, although a considerable amount of trimming, cementing and tinning was done by the local superintendent before the burlap season. Nearly 5,400 caterpillars and pupæ were taken under the burlaps in this town. The fall inspection showed 162 estates infested, and on a dozen or more the moths were found in important numbers. Much good scouting work has been done in this town by Inspector C. S. Mixter of the central office.

This town is in a worse condition with reference to the gypsy moth than it was a year ago, due to the fact that the scouting of 1906 was not properly done, and, as a result, in the colonies overlooked the moths have increased. It was not possible to examine the town thoroughly in 1906, because of lack of funds. We hope to be able to make a thorough scouting of the entire town before the caterpillar season of next year. It is apparent that the local authorities have not properly grasped the importance of the infestations here. A notably large amount of thorough work will be required in the orchards and woodlands before the caterpillar season of 1908, if the gypsy moth is to be held in control in Scituate.

Sharon.

Thomas J. Leary, *Local Superintendent.*

The gypsy moth was found in this town by the local organization during November. Good work by the local superintendent, assisted by Inspector T. F. Curry of this office during December, has resulted in locating a few egg clusters of the gypsy moth. These have been treated, and the infested localities will be properly looked after during the coming year.

Sherborn.

W. H. Coolidge, *Local Superintendent.*

Forty-five colonies had been found in this town at the close of the scouting season of last winter, in which 527 egg clusters were destroyed. The burlaps were used with good results dur-

ing the summer, but the fall scouting showed egg clusters in 34 of the known colonies, although the number in each colony was greatly reduced over that of 1906. The previous scouting operations had only included a belt 50 feet wide on each side of the roads and streets. The fall scouting of 1907 included a thorough search of the residential and orchard sections and a considerable amount of woodland scouting, with the result that the gypsy moth has been found widely scattered throughout the town. Much thorough work will be required here during the next two or three years, to bring the insect completely under control. The quality of the work done in Sherborn has been good, and a considerable amount of assistance has been given by the property owners.

Shirley.

J. Hazen, *Local Superintendent.*

The infestation in this town is slight as yet, only 2 egg clusters having been found. This of course indicates the need of thorough scouting of the town as soon as funds permit. In the infested localities the trees were burlapped and well attended during the season, and no egg clusters were found at the time of the fall inspection. The work of destroying the brown-tail moth is now in progress, and while this is going on careful attention will be given to making a search for the gypsy moth.

Shrewsbury.

Frank L. Ott, *Local Superintendent.*

During November and the early part of December this town was thoroughly scouted by State employees, and a few gypsy moth egg clusters found on Gulf, Reservoir, Prospect, North and School streets. Scattering numbers of the brown-tail moth were also noticed in this town.

From the large number of automobiles passing through Shrewsbury, this town is peculiarly liable to infestation by the gypsy moth from outside sources. A considerable number of old orchards in Shrewsbury will make the problem of handling the moth here somewhat difficult. The work will be organized at an early date, and the necessary operations completed before the hatching time of the eggs.

SOUTHBOROUGH.

HARRY BURNETT, *Local Superintendent.*

In the known gypsy moth colonies the trees were trimmed, cemented and put in good condition for burlapping early in the season, while thorough work was done against the brown-tail moths over the entire town. A liberal amount of spraying was done here, with good results. In the 34 old colonies gypsy moths were found only in 5 places, with a total of only 15 caterpillars, — a most remarkable result. In the fall scouting only a single nest was found in the old colonies. An incidental result of the spraying work in the infested orchards was an unusually fine crop of fruit. During the fall inspection but 8 estates were found infested by the gypsy moth, a total of 78 egg clusters being found. The brown-tail moth is well under control in this town, although a considerable number of webs are in evidence near the Marlborough line.

STOUGHTON.

WILLIAM P. KENNEDY, *Local Superintendent.*

About 400 burlaps were used in the 5 gypsy moth colonies here, and at the last examination of the bands no caterpillars were found, neither were any egg clusters discovered at the time of making the fall inspection of these colonies. Two egg clusters were found in a new locality near the West Stoughton depot, and one on Page Street. The results in this town are remarkably good, considering the fact that local appropriations have not always been made in season to be used to the best advantage. The known infested places should be kept under thorough observation next season, and a considerable amount of woodland scouting is recommended.

STOW.

J. F. ROBBINS, *Local Superintendent.*

The most important gypsy moth infestation in this town is that at the Red Acre Farm. Here a number of egg clusters were found in 1906. During the summer months a great many horses are brought to this farm for boarding, and this travel from Boston and other badly infested central towns is no doubt

responsible for the presence of the moths here. The infested trees in this section were put in good condition for burlapping, and received careful attention during the summer. A considerable number of caterpillars were destroyed, but only 1 egg cluster was found at the time of the fall inspection, as against more than 100 egg clusters destroyed here in the fall and winter of 1906–07. Much good work has been done by the local superintendent in repairing decayed orchard trees and in removing and burning underbrush and dead trees in the gypsy moth colonies. A limited amount of spraying was done here with good results. A considerable amount of burlapping and spraying will be necessary here during 1908.

Sudbury.

William E. Baldwin, *Local Superintendent.*

Over 3,000 gypsy moth egg clusters were treated by the local superintendent in the orchard sections during the month of January. Following this, in February and March the street trees were thoroughly cleaned, and at the end of April the winter work on street trees and residential sections was completed. A limited amount of tinning and cementing of cavities was done in the early part of the caterpillar season, while burlaps were freely applied and attended. In September, October and November the work consisted mainly of repairing orchard trees, cutting brush along infested roadsides and destroying brown-tail moth nests. During December about 6 men were continuously employed in treating gypsy moth egg clusters and removing the webs of the brown-tail moth.

At the present writing the work of cleaning infested orchards is in progress. But few woodland infestations have been located as yet, but a thorough examination of all the woods in the town will be desirable at an early date. The quality of the work done at Sudbury has been most excellent, and the efforts of the local superintendent have been well supported by citizens and town officials.

Tewksbury.

Henry C. Briggs, *Local Superintendent.*

The partial scouting of this town by the State inspector showed a considerable number of infestations, in which the

trees were later burlapped and well attended during the caterpillar season. During the fall months the residential section, as well as a part of the woodland, was thoroughly scouted by the local men. Twenty-one small colonies were found in the latter, and a considerable amount of cutting of underbrush and thinning of trees will be required to put the woods in condition for next season's work. The work of cutting worthless orchard trees and cementing and tinning of cavities has been commenced, although at the present writing no work is going on, for lack of funds. During the caterpillar season of 1908 a thorough campaign of burlapping should be carried on, and a limited amount of spraying will also be required.

Topsfield.

C. W. Floyd, *Local Superintendent.*

Very encouraging results have been obtained from the work in this town during 1907. In infested districts burlaps were liberally used and well attended, while the sticky bands were used on shade trees standing near infested walls. A great many property owners co-operated with the local superintendent by attending to the burlaps on their orchard trees, thus giving very practical assistance in the work. A limited amount of cutting of brush by roadsides has been done in the districts where the gypsy moth was most numerous. The woodland colonies received good attention during the season, and are in a much improved condition. The two most important ones on the property of Messrs. Conant and Shattuck, in which the moth is now under control, give the best kind of evidence of the good quality of the work done by the local superintendent. The fall work in orchards is well in hand, and the work of clearing street trees of the moth pests is now in progress.

Townsend.

J. S. Cook, *Tree Warden.*

A single infested tree was found December 11 by scouts from the central office, on the property of A. H. Wilson on the old Fitchburg road, so called. The local organization having charge of the work against the brown-tail moth will do the work needed in this small gypsy moth colony.

Tyngsborough.

Arthur R. Marshall, *Local Superintendent.*

The usual operations of burlapping and repairing orchard trees have been carried on in the sections where the gypsy moth had been previously located. A great deal of excellent work has been done in cutting brush along infested roadsides, thus reducing the danger of scattering the gypsy moth pest. The most seriously infested section in the town now is an estate on Varnum Avenue opposite Tyng's Island, where about 40 gypsy moth egg clusters were destroyed. The work here is now well in hand, and has been carried on in a very efficient manner.

For much of the success of the operations in this town the present year we are indebted to the excellent co-operation of property owners and constant support on the part of the town officials.

Upton.

George H. Evans, *Local Superintendent.*

A number of gypsy moth egg clusters were found in this town in woodland on Westborough Road, near the Westborough line; on Orchard Street, near Braddish's Road; and on Winter and Wood streets. The scouting of this town by State employees from November 6 to December 11 shows that the gypsy moth has established itself in sufficient numbers to cause anxiety. Many of the infestations are in orchards which contain the usual proportion of hollow trees, part of which should have the cavities cemented or tinned, and others should be cut and burned. A considerable amount of brush cutting and thinning will be required in the sections where the gypsy moth has been found. Work will soon be organized here, and we hope to have the necessary operations completed before the eggs hatch next spring.

Walpole.

Philip R. Allen, *Local Superintendent.*

A single egg cluster was found in this town last winter, near the Medfield line. The worthless trees in the infested locality were cut, and cavities in the remaining ones cemented. Burlaps were applied and well cared for during the caterpillar season, but no larvæ were taken. This fall it was possible to make

a thorough examination of all streets and cultivated lands in the town, and over 20 infestations of the gypsy moth were found, though only a single nest was discovered in each locality, with the exception of 2, where 2 were found. The Walpole infestation can be handled without serious difficulty.

Wareham.

James J. Walsh, *Local Superintendent.*

The most important event of last year in Wareham was the finding on July 13 of the gypsy moth colony at Onset Bay by Inspector N. S. Souther of the central office. The first caterpillars were located near the new Auditorium building of the Onset Bay Association. A plentiful supply of burlap was immediately put on the trees in the neighborhood, and a rather slight infestation developed. Two additional infestations were found later in this village. A total of 1,100 caterpillars were killed last summer in the 5 known gypsy moth colonies.

As the result of the fall inspection of the town, there were found 16 additional gypsy moth colonies, of which 3 were in the woods. Two of these, while not in a serious condition, will require considerable cutting and careful attention in 1908. One rather bad orchard colony was found on Tremont Street, near the Carver line, where 100 egg clusters were treated.

Prior to May 1 of 1908, much trimming, cementing, cutting, etc., in infested orchards will be required. In addition, all infested orchards should be sprayed at the proper time. One of the infestations on Main Street and that at Onset Bay, by reason of their location, are as important as any in town, and in them the immediate suppression of the gypsy moth should be brought about. To effect this, persistent, careful work will be required, such as has not yet been done in this town.

The selectmen of Wareham are to be commended for their public spirit in the matter of the work against the gypsy moth in their town. Realizing the need of prompt action if the moth was to be suppressed, they arranged for an inspection of the area by trained men taken temporarily from the State force. As a result of the inspection, the location of the gypsy moth colonies in the town is for the first time definitely known.

Wayland.

George W. Fairbank, *Local Superintendent.*

While the work in this town has been of good quality, much could have been accomplished had funds been available. In the early part of the year street trees and private estates were cleared of the gypsy and brown-tail moths, and during the summer burlaps were generally used and well attended.

A considerable amount of work has been done in putting the infested orchards in condition for effective burlapping next year. The gypsy moth is generally scattered throughout this town, and much work will be required in the woodlands before it is brought under control. During 1908 a vigorous effort should be made to check the increase in certain important woodland colonies, as well as to hold the ground gained in the residential and farming sections. The purchase and free use of a power sprayer will be desirable during the next caterpillar season.

Wellesley.

Fletcher M. Abbott, *Local Superintendent.*

The work against both species of the moths on town property and private estates was well done by a gang of about 8 men in the winter and spring months. A considerable amount of work was done in the woodland colonies in April and May, and with the opening of the caterpillar season about 45,000 burlaps had been placed on the trees, while a considerable amount of banding with sticky materials had also been done. The spraying done here for the elm leaf beetle was also of considerable value in keeping down the gypsy moth infestations. The net gain has been in the condition of street trees and trees on private estates, and in woodland colonies which were worked over. Much remains to be done, however, since the town is infested practically from one end to the other. A great deal of work will be required to put the old orchards in condition for effective burlapping and spraying. Woodland colonies will also require constant attention during 1908, work which will be somewhat hampered by the fact that much of the woodlands form parts of the many beautiful private estates, whose owners, not fully realizing the necessity for thorough measures in fight-

ing the moth pest, do not look with favor on the brush cutting and thinning operations so necessary before effective spraying can be done.

Wenham.

J. D. Barnes, *Local Superintendent.*

Although no residential sections in this town were found to be seriously infested in the thorough scouting operations of last winter, several important colonies were found in the woodland in the eastern part of the town. Wenham may be considered as generally infested throughout by both species of the moth. Orchard and street trees were burlapped and carefully attended during the caterpillar season, thousands of caterpillars being thus destroyed. The good condition of the residential districts speaks well for the quality of work done by the local superintendent. Much remains to be done, however, in the way of cutting worthless trees and cementing cavities in those remaining, while woodland colonies should be thinned out and put in condition for spraying and burlapping. At Highland Wood Lake, where there is a little colony of summer camps, the gypsy moth was found in considerable numbers. Here the trees were thinned and burlapped, and attended in part by the cottagers and in part by the town forces. That this co-operative work was successful is shown by the small number of egg clusters found here this fall. At the present writing the street trees have been cleared, and the destruction of egg clusters and brown-tail moth webs on trees on private estates is in prosecution.

Westborough.

Charles S. Henry, *Local Superintendent.*

About a dozen small infestations were located in this town in the winter and spring, and in March and April a gang of 6 men were used in clearing up infested sections and removing brown-tail moth webs on private estates. About 500 caterpillars were taken under the burlaps during the summer, the majority being found at the so-called Parker colony. In the fall inspection no egg clusters were found in the colonies, but in 6 other localities a number of nests were found. With the experi-

ence gained in the work of 1907, the local force should be able to make a much better showing in 1908. At this writing the work of clearing street trees has been nearly completed.

West Bridgewater.

Octave Belmore, *Local Superintendent.*

In the 12 known gypsy moth infestations the necessary work preliminary to the summer operations was excellently done by the local superintendent. Burlaps to the number of 555 were used in places where the gypsy moth had been found, and were so well attended that but few egg clusters were discovered at the time of making the fall inspection. In an orchard on Matfield Street, where a large number of egg clusters were found in 1906, faithful attention to the burlaps apparently resulted in the extermination of the insect, since no egg clusters were found in the fall.

A thorough scouting of the town has been made, and about 25 small colonies located. The work against the moth in this town has been well supported by officials and citizens, with the result that the local superintendent has the situation well in hand.

West Newbury.

William Merrill, *Local Superintendent.*

During the month of February the residential section of this town was thoroughly scouted by the State force, and more than 100 small gypsy moth colonies were located. The infested trees were burlapped and well attended during the caterpillar season, and a limited amount of spraying gave excellent results. Much remains to be done in this town in the way of orchard work before a notable gain can be made against the gypsy moth. The hollow and worthless orchard trees should be cut and burned, and the cavities in the remaining trees closed with tin or cement. If this work can be done before the opening of the caterpillar season and properly followed up by burlapping and spraying, the future cost of the work at West Newbury should be greatly reduced.

WESTFORD.

H. L. NESMITH, *Local Superintendent.*

From one end to the other this town is thoroughly infested by the gypsy moth, although no large colonies have yet been found. The necessary work against the moth has been well done here, more than 5,000 trees being burlapped and carefully attended during the caterpillar season. As a result, the gypsy moth has been greatly reduced in numbers where the burlaps were used. In common with the neighboring towns of Littleton, Carlisle and Chelmsford, the orchard problem here is a very serious one. Before a permanent gain can be made against the moth, the orchards should be thoroughly overhauled, dead trees removed, cavities cemented and the necessary trimming done. When the orchards are once put in good shape, a single season of thorough burlapping and spraying will reduce the numbers of the gypsy moth to a minimum. The woodlands have not been thoroughly scouted as yet, but are probably generally infested. This work should have attention as soon as funds permit.

The purchase of a power sprayer for use in 1908 is desirable, and burlap must be generally used in all the infested localities.

WESTON.

E. P. RIPLEY, *Local Superintendent.*

This is another of the extensively wooded towns in the gypsy moth district, and is much favored as a place of summer resort. Many beautiful country estates here include, as a rule, large areas of woodland which it is desired to keep as nearly as possible in their natural condition. Unfortunately, these woods are quite generally infested by the gypsy moth, and their economical treatment necessitates a considerable amount of cutting and thinning. To meet the owner's point of view, and also to accomplish the control of the gypsy moth, a large amount of hand work will be required, with a proportionate increase in the cost of the work.

The quality of the work done in this town by the local organization is of the best, while the co-operation of citizens and

town officials has been constant and helpful. The local committee organized to co-operate with the town officials in the work of suppressing the moths has been of great assistance, particularly in calling public attention to the danger of allowing the moths to increase, and in urging property owners to co-operate in the care of their estates.

During the early part of the year and up to the hatching period of the eggs a force of about 12 men was constantly employed in clearing street trees and private estates of the moths. Burlaps were applied in good season, and received thorough attention during the summer. On stormy days infested roadsides were cleared of brush, and a considerable amount of clearing done in certain woodland colonies. In the late summer and fall very thorough scouting operations were in progress, while the work of repairing orchard trees and thinning trees along roadsides where the moth had been discovered was being carried on. At the present writing the winter cleaning operations are under way, and it is hoped that the town will be thoroughly covered before the opening of the next caterpillar season. A very badly infested section near the Natick line, along with other woodland colonies, should receive thorough treatment at an early date. The power sprayer can be used here in 1908 to good advantage, although the principal reliance must be placed upon the use of burlap.

Westwood.

C. H. Southerland, *Local Superintendent.*

The scouting operations in this town in the winter and spring months showed 16 small gypsy moth colonies, 3 of them being on the border of woodland. The necessary work of clearing up these infestations, trimming trees, cutting brush, etc., was very thoroughly done, and later more than 1,800 burlaps were used and carefully attended. A large number of caterpillars were taken during the burlap season, but only 4 of the 16 old colonies contained gypsy moth egg clusters at the time of the fall scouting. A considerable number of new infestations were found elsewhere in the town during the progress of the fall inspection, but none of them offered any serious difficulties in

the way of suppressive treatment. The colony on Thatcher Street is the most important one, and should receive extra care. The work of cleaning street trees is in progress at this writing.

Weymouth.

Dummer Sewall, *Local Superintendent.*

Following the fall inspection of 1906, a small gang was employed in scouting woodlands along the Hingham line, with the result that the gypsy moth was found in several places. Before the caterpillar season opened the men went over the private estates, and those which had not been properly attended to by their owners were put in condition for the summer's work. More than 30,000 burlap bands were used, with excellent results. At the time of the fall inspection a large number of single gypsy moth egg clusters were found widely scattered throughout the town, but in the 548 places previously reported infested no egg clusters were found on 148. The roadside thinning is practically all done, but about 300 orchards yet remain to be thoroughly overhauled this winter. A considerable amount of thinning will also be required in the woodland colonies. There are very few brown-tail moths to be found in this town.

Whitman.

Clarence A. Randall, *Local Superintendent.*

Prior to May 1, 1907, 96 estates were found to be infested by the gypsy moth in Whitman. These places were cleaned early in the year, and nearly all of them put in good condition for the summer's work. Two small woodland colonies were found during the summer, and were promptly thinned out and burlapped. Over 3,000 burlaps were used in this town and were fairly well cared for, but the additional infestations found during the year make a total of about 150 estates that must be treated in 1908. During the fall months more than 1,400 egg clusters of the gypsy moth were destroyed.

An increased amount of burlapping must be done and more thorough attention must be given to turning the bands next year, while spraying and burning over woodland colonies will also be in order. Owing to the widespread infestation, only the most

thoroughgoing efforts will suffice to hold the gypsy moth in check during the coming year. Nowhere in the town are the brown-tail moths present in large numbers, although scattered nests are everywhere in evidence. The work in this town has been well supported by the local authorities.

Wilmington.

Oliver McGrane, *Local Superintendent.*

This town is thoroughly infested by the gypsy moth over its entire area, — a condition most unfortunate, because of a large acreage of woodland of low valuation. While but few sections of the woods were stripped of their leaves by the caterpillars last summer, there will be a much greater defoliation in the season of 1908 unless funds are available for thoroughgoing control measures. The most serious infestations are along that part of the town bordering on Woburn. In the important colonies the nests have been treated above the probable snow line, and a large amount of thinning of trees and cutting of brush has been done along the roadsides. In the residential section the numbers of the gypsy moth have been greatly reduced, and here burlapping will be sufficient to hold the insect in check. There is much to do at this writing in the way of putting orchards in condition for the summer's work, while in the woodland colonies the underbrush should be cut and burned to permit of economical operations.

Worcester.

J. H. Hemingway, *Local Superintendent.*

While visiting Worcester, June 16, Field Agent D. M. Rogers, in charge of the gypsy moth work of the U. S. Department of Agriculture, found several caterpillars of this insect on an estate on Hope Avenue. The following day an agent from the central office made a thorough examination of the infested district, and acquainted Mr. Hemingway with the facts discovered. The trees in the district were promptly burlapped, and early in July a considerable area in and around the moth colony was well sprayed. This colony received very careful attention both by the local force and by an inspector specially

detailed from the central office. So thoroughly was this work done that no egg clusters were found here at the time of the fall inspection. In October, while repairing tree guards on Union Street, a colony containing 35 egg clusters was found by the local superintendent's gang. Later, in December, Inspector J. J. Bruton and 6 men employed by the central office commenced a thorough scouting of the city. At this writing about one half of the city has been covered, and no additional infestations found. From the large number of automobiles and electric cars passing through Worcester, it seems quite probable that additional small infestations will be found here.

Yarmouth.

Charles R. Bassett, *Local Superintendent.*

In the single gypsy moth colony in this town burlaps were freely used and well attended during 1907, but, as in 1906, no caterpillars were found. Yarmouth has been much infested with the brown-tail moth, but present conditions are much improved over those of the past, as far as this insect is concerned. A thorough scouting of this town should be made at a fairly early date, with the probability that a few small gypsy moth colonies may be found.

Summary of Condition of Territory.

A careful survey of the results obtained in each city and town in the work against the gypsy and brown-tail moths in the year 1907 shows that a notable net gain has been made both in preventing the spread of and reducing the damage by these insects in thickly settled districts and in farming sections. It also shows that the infested woodland problem is a most serious one, and that the vigorous application of wholesale methods for destroying the moths will alone suffice to keep the insects in check. It is only fair to state, however, that great progress has been made in bringing the moths under control in the woodlands of what were three years ago the most seriously infested municipalities. At Belmont, Arlington, Winchester, Medford, Melrose, Saugus and Lynn, many infested woodland districts have been so thoroughly treated in recent years that damage by

the caterpillars in the summer of 1907 was scarcely noticeable. In many of the towns, particularly Brookline, Newton, Waltham, Lincoln, Lexington, Woburn, Reading, Beverly and Manchester, the gypsy moth has increased in numbers in the woodlands, and here the principal efforts as far as work in the forests is concerned must be made the present year. In the towns more remote from the central infested district the known colonies are well in hand, and local scouting operations in fall, winter and spring should detect incipient moth colonies in season for their effective treatment. An unfortunate feature of the work in these outer towns is the fact that such towns are practically non-revenue-yielding under the terms of the act; in other words, the amount of the town's financial liability is often so small as to be a negligible quantity, while the cost of the necessary field work, which must be continued along exterminative lines, is relatively large. Against this condition of affairs should be set the fact that the cost of controlling the work in a large part of the badly infested central district has already been notably reduced, and that a further reduction in outlay will here be made during 1908. The funds thus released will be available for work in the outer sections.

Those whose duty it is to keep closely in touch with the details of the field work from day to day are not in the best position to judge of the amount of progress made in the battle against the moths. We see so much work remaining to be done and the needs and responsibilities of the present moment press so heavily that it is with difficulty we can make a fair comparison between the conditions now prevailing and those which obtained in 1905. Yet the results of such a comparison are most striking. This work against the moths, viewed either from the standpoint of financial outlay or from its relation to the country at large, is without doubt the most remarkable and important entomological undertaking in the entire world. Never before has such a thoroughgoing, systematic effort been made to stamp out an imported insect pest, and never before has so much been expended in the way of money and labor to the accomplishment of the desired end. Because of this fact, visits to the field of action in eastern Massachusetts have been fre-

quently made by the leading entomologists of the country, and the enthusiasm with which the expert entomologists called to Massachusetts for consultation the past summer commented on the improved condition of the infested district, as compared with that prevailing at the time of previous visits was as gratifying as it was, for the moment, unexpected. The superintendent feels that it is but a fair and entirely conservative statement to say that notable progress has been made all along the line in bringing the moths under control, and that the results to date have amply justified the expenditures thus far made.

Future Work.

The plans for 1908 should include in each city and town the continued control of the moths in the sections already cleared. This can be done very largely by the winter cleaning, summer burlapping and spraying where necessary. The importance of keeping the street trees free from the caterpillars is apparent to all engaged in the work. Much more spraying should be done in the badly infested sections, particularly in woodlands. There is no cheaper or more effective way of treating these infestations than by liberal spraying operations, and the purchase and use of power-spraying outfits, as far as funds permit, will be insisted upon. In the selection of these outfits it should be borne in mind that low-cost rigs are often in the end the most expensive; and while, as pointed out elsewhere, the manufacture of heavy outfits suitable for our work has not yet passed the experimental stage, there are now available several types of substantially built machines, which, while commanding a relatively large price, will doubtless in the long run prove the most satisfactory.

The burning over of the woodland colonies with a light fire, where thinning operations have been done, is again recommended during the month of May, after the eggs from broken or scattered nests and on the ground have hatched. Extensive burning operations in a large area of the Lynn and Saugus woods in midsummer, when nearly all the insects were in the pupal condition, gave good results in 1907, and is worthy of further testing where conditions warrant. The injury to seedling trees caused by these operations is much to be regretted,

but nature will soon supply a new group. The preservation of trees already partly grown is of greater importance at the present moment. Again we recommend the general destruction of pupæ and female moths during the egg-laying period, the thorough treating of gypsy moth nests, on private estates and streets alike, up to the probable snow line in the fall months, and the cutting and burning of worthless brush along infested roadsides. "Clean culture" here is as desirable at present as in the orchard or garden of small fruits. With the greater skill gained by the local forces as a result of their experience in combating the moths, and the greater confidence in their methods on the part of property owners, we look forward confidently to greater and better results in the entire work during the coming year.

Report of Consulting Entomologist.

As in previous years, the consulting entomologist, Prof. C. H. Fernald, has kept closely in touch with the work of this office, and his helpful advice has been freely sought. As is well known, Professor Fernald has followed the developments of the gypsy moth as a pest since its first discovery at Medford in 1889, and is thoroughly familiar with all features of the efforts made to suppress it. The superintendent considers it most fortunate for the interests of the State work that he is able to consult on questions of methods and policy, as well as on technical outlays, an entomologist so well qualified to give advice by long and successful experience as well as by well-proven, sound business judgment. We are particularly indebted to Professor Fernald for help in selecting from his students assistants for our summer work on parasites, and for the very practical aid he is now giving us in building up a working reference collection. His report follows: —

A. H. Kirkland, Esq., *Superintendent for Suppressing the Gypsy and Brown-tail Moths, Boston, Mass.*

Dear Sir: — The spread of the gypsy moth in this country may be likened to a great conflagration, which, starting from a mere spark dropped accidentally and unintentionally into some inflammable substance, burns readily and quietly at first, but soon spreads in all directions where there is anything to burn, leaping from one mass of inflammable matter to another, and even being wafted a considerable

distance by the wind over streams of water or other obstacles, destroying every combustible object in its way. The further it goes, the wider the area of destruction becomes, and, as a result, the more rapidly it spreads.

Every one knows the danger of allowing a fire to get even the slightest headway, and so every precaution is taken to stamp it out at the start; but if it gets well under way no one attempts to belittle the danger, but every one aids and encourages the work of putting out the fire, regardless of whether it is accidental or of incendiary origin. No one stops to count the cost, but all realize that the conflagration must be stamped out, regardless of labor and expense. The authorities telegraph in all directions for assistance, and the fire departments of other cities, without the slightest hesitation, are rushed to the scene of conflagration, every available means being used to transport them to their destination. Many private citizens having means contribute freely to relieve the sufferers who have lost by the fire. Towns and cities pour out their money freely; State Legislatures take an active interest; and even the general government at Washington has made large and much-needed appropriations for the relief of sufferers from fires and other disasters. Such acts of kindness and generosity always appeal to the human heart, and give us a deeper appreciation of the instincts of humanity.

About forty years ago the gypsy moth was accidentally allowed to escape from confinement in Medford, where it fed readily but quietly on the foliage of trees near at hand. Soon, however, it began to spread in all directions where there was suitable food, making its way from one section to another, and even being carried a considerable distance by the wind and other means over streams of water or other obstacles, to fall upon and destroy any vegetation in its way. The farther it went, the wider was its area of destruction and the greater the rapidity of its spread.

Here the parallel ceases. No one at first knew or realized the danger from allowing this insect to make even the slightest headway, and hence no precautions were taken to stamp it out at the start. Even after the caterpillar plague was well under way, there were many who publicly belittled the danger both in public print and before the Legislature; and many also attempted to discredit the work because it was thought that some unprincipled employees were intentionally spreading the insect, yet no attempt was made to prove the statement and bring the guilty parties to punishment. It is human nature to stop to count the cost, and too few realize that it is quite as important to stamp out this insect and put an end to the destruction of property caused by it as it is to stamp out fire, — and for precisely the same reasons. If a new colony of gypsy moths should be discovered, which threatened the destruction of valuable forests as well as the vegetation on numerous private grounds, and the authorities should call for help from other

towns or States, they would not respond as in the case of a fire; yet the destruction of property by the moths in time is just as sure and just as severely felt as if by fire.

What would be the action of the Commonwealth of Massachusetts and of the other States of the Union if a fire were raging in all the forests of eastern Massachusetts, and, in spite of all that was being done to check it, was holding its own with every prospect that it would escape and spread over the rest of this State and into other States and finally over all of the United States? This supposed case parallels the present condition of the gypsy moth plague in Massachusetts.

The work is now carried on chiefly in the residential parts of the infested territory, along the lines of travel and to some extent in the forests; but for the latter work funds have not been sufficient to prevent the increasing spread of the insects. If it were a fire running through the forests and destroying the same amount of property with the same certainty of spreading over the State that there is of the spread of the moths, public opinion would demand that ample appropriations be made, and that no stone be left unturned to accomplish the stamping out of this destructive pest.

For the purpose of destroying the gypsy and brown-tail moths, it is necessary first to find the new colonies; and to do this the scouts who are sent out for this purpose should have ample legal authority to enter on private lands whenever circumstances require, with the privilege of searching the forests, orchards, shrubbery, etc., to ascertain whether these moths are present.

After a careful survey of the work, I regret to say that I do not feel satisfied with the condition of the forest lands. In the residential parts of the territory and along roadsides, where the greatest danger of scattering the caterpillars exists, very commendable progress has been made in nearly all of the cities and towns, but the condition of the forests grows more serious yearly. I understand perfectly that this state of affairs exists because there have not been sufficient funds to prosecute properly the work over the entire infested area, thus making it necessary to neglect the forests in order to suppress the moths along lines of travel and in the residential parts of the infested territory. If the forests had incipient fires in place of these centers of infestation, and every one knew that these fires would spread all over the State and country if they were not stamped out, as surely as we know that the gypsy moth will spread over the country if not checked, public opinion would demand that the Legislature make all necessary appropriations, and further demand that this pest be stamped out in the shortest possible time.

It is not enough merely to hold this insect in check. The only good, sound business policy is to make actual progress towards extermination, and for this work liberal appropriations are necessary.

Respectfully submitted, C. H. Fernald.

As an evidence of the interest in the effort to suppress the moth pests shown by the official entomologists of the country, the following resolution may well find place at this point: —

Resolution on the Gypsy Moth Work, adopted at the Chicago Meeting of the Association of Economic Entomologists, Dec. 28, 1907.

Resolved, That the association heartily approves the work now being done in the control of the gypsy moth and brown-tail moth by the State of Massachusetts and other States and by the Bureau of Entomology; and, inasmuch as we have heard of criticism of this work from certain quarters, we hereby express our unqualified approbation of the present management and of the methods which it has adopted; and, furthermore, would consider a change in policy as most dangerous to the vital interests concerned in the most important work in applied entomology that has ever been undertaken.

W. D. Hunter,
E. Dwight Sanderson,
F. L. Washburn,
Committee on Resolutions.

Work of Other State Boards.

Again we acknowledge the continued help of other State boards in the great problem of controlling the gypsy moth. The work of the Metropolitan Park Commission, the Metropolitan Water and Sewerage Board and the Massachusetts Highway Commission are worthy of particular mention, while other boards having under their control various public lands have given hearty co-operation. The summary of their operations is given in the following correspondence: —

Boston, Jan. 8, 1908.

Prof. A. H. Kirkland, *Superintendent for Suppressing Gypsy and Brown-tail Moths.*

Dear Sir: — I have the honor to submit the following in response to your request that our Board should furnish you a brief statement of its work against the gypsy and brown-tail moths during the past year on lands under its supervision.

The extensive work which has been carried on by the Board in previous years on the lands under its charge, not only at Spot Pond but in the towns of Medford, Arlington and Somerville, has resulted in greatly reducing the number of gypsy moths, and it is believed that the work of the past year will be felt by a still further reduction in their number in the future.

Although the cost of the work done at Spot Pond constitutes the larger part of the entire expenditure, the amount expended was reduced from that of last year by about two-fifths. There has, however, during the past year been a considerable increase in the number of gypsy moths along the lines of the Sudbury and Cochituate aqueducts in Newton, Weston, Natick and Framingham. The 220 acres of land about the Weston reservoir and lying along the Weston aqueduct between the reservoir and the terminal chamber were especially infested, and the cost of protecting these lands was more than double the amount expended in the previous year. No gypsy moths have been found upon the property of the Board situated west of the town of Framingham.

The number of brown-tail moths at the Chestnut Hill reservoir and on other lands in the vicinity of Boston has been greatly decreased, apparently from natural causes. Very large numbers of nests of the brown-tail moths have been destroyed at the Sudbury reservoir, and these nests in considerable and increasing numbers have been destroyed at the Hopkinton reservoir, along the line of the Wachusett aqueduct in Southborough and Northborough, and in the vicinity of the Wachusett reservoir in Clinton.

The methods employed for destroying and preventing the spreading of the moths have been as follows: —

At Spot Pond the egg clusters of the gypsy moths were painted during the winter with a mixture of creosote and fuel oil. During the latter part of April and the early part of May tanglefoot was used in large quantities for banding the trees. During June and July the trees on 23 acres of land were sprayed with arsenate of lead. To protect the lands of the Commonwealth along the lines of adjoining properties, where the moths were very prevalent, lines of boards set on edge and smeared with tanglefoot have been effectively used as in the previous year. The trees upon the grounds at Mystic Lake, Mystic pumping station and reservoir and at the Chestnut Hill and Weston reservoirs were treated in a similar manner. Along the line of the aqueducts and at Lake Cochituate the egg clusters of the gypsy moths were painted with creosote, and at Lake Cochituate great numbers of trees were banded with burlap.

Vast numbers of the caterpillars of both gypsy and brown-tail moths were destroyed along the lines of the Cochituate and Sudbury aqueducts, at Lake Cochituate, and of the brown-tail moths about the reservoirs in Framingham, Southborough and Clinton.

Inasmuch as experience has shown that the absolute suppression of the gypsy moth is very difficult, if not impossible, wherever there is a thick growth of underbrush, considerable work has been done, particularly along the lines of the aqueducts, in cutting away underbrush and undesirable trees.

The total amount expended for the work on all of the water works lands was $10,700, as against an expenditure of $12,700 the preceding

year. Of the total sum expended, $6,450 was devoted to the lands about Spot Pond and $1,300 to those about the Weston reservoir.

The work of suppressing the gypsy and brown-tail moths has been, as in previous years, carried on under the supervision of Mr. Dexter Brackett, the chief engineer of the metropolitan water works.

Very truly yours, HENRY H. SPRAGUE,
Chairman, Metropolitan Water Board.

BOSTON, Jan. 3, 1908.

Prof. A. H. KIRKLAND, *Superintendent for Suppression of Gypsy and Brown-tail Moths, 6 Beacon Street, Boston.*

DEAR SIR: — In accordance with your request, I take pleasure in sending you the following statement concerning the work against the gypsy and brown-tail moths during the year 1907, under the direction and at the expense of this Board: —

The work during the year 1907 in the reservations and parkways in the charge of the Metropolitan Park Commission has been done by the forces employed and directed by the superintendents regularly in charge of the several divisions, except that in the Blue Hills, as in the previous year, Mr. Minott of your staff has been employed by the Board to direct the work. At the request of the Board, you have sent assistants from time to time who have very courteously and thoroughly inspected the work after it was done.

The result has been very favorable. No serious defoliation has occurred at any point, and the number of new egg clusters is less than it was a year ago. This success is gratifying, but causes some fear that it may be misleading. The danger of renewal of the bad conditions of the past few years remains in lessened form, and can be met only by continued and unremitting work, especially in those districts where least effective work has been done on neighboring lands outside the reservations. The Board appreciates the thorough work done under your direction in those outside lands where co-operation of the cities and towns has been complete, and in some sections where even that co-operation was lacking. In the neighborhood of these lands the expense of the work for the coming year will be materially diminished.

Very truly yours, W. B. DE LAS CASAS,
Chairman, Metropolitan Park Commission.

By chapter 157, Acts of 1907, the Massachusetts State Highway Commission was authorized to expend in connection with the suppression of the gypsy and brown-tail moths on trees bordering on the State highways a sum not exceeding $10,000. At the request of the commission this office has taken full charge of this work during the year, made the necessary

inspections and arranged for the proper treatment of the infested trees. The preliminary inspection to show the kind and amount of work needed was first made, and later the necessary details were attended to either by local organizations or by contractors, the work being inspected and approved by employees of this office before the bills were forwarded for payment.

The State highway trees are particularly liable to infestation, because the most excellent roads built by the commission offer favorable routes of travel between various centers of population, and are much frequented by automobiles. All told, there was expended on this work up to December 1, $7,019.32. At the present writing the trees on the State highways are in a most excellent condition for future operations against the moths. A great deal of infested brush has been cut, and a large number of trees have been pruned, cemented or tinned and put in proper condition for the economical control of the moths. Work has been done on State highway trees in the following towns: —

Acton.
Amesbury.
Andover.
Ashland.
Bedford.
Beverly.
Billerica.
Bourne.
Boxborough.
Braintree.
Brockton.
Burlington.
Chelmsford.
Cohasset.
Concord.
Dover.
Framingham.
Gloucester.
Groveland.
Hamilton.
Harvard.
Haverhill.
Hingham.
Holbrook.
Hudson.
Ipswich.
Lexington.
Lincoln.
Littleton.
Lowell.
Lunenburg.
Marlborough.
Melrose.
Merrimac.
Methuen.
Newbury.
Newburyport.
North Reading.
Northborough.
Quincy.
Reading.
Revere.
Rockland.
Salisbury.
Scituate.
Southborough.
Stoneham.
Stoughton.
Sudbury.
Swampscott.
Tewksbury.
Townsend.
Wayland.
Wellesley.
Wenham.
West Bridgewater.
West Newbury.
Westborough.
Westford.
Weston.
Weymouth.
Wilmington.
Winchester.
Wrentham.
Yarmouth.

National Aid.

The excellent work done in Massachusetts by the Bureau of Entomology of the United States Department of Agriculture in caring for the main infested highways in the moth district has been a most valuable aid in preventing the further spread of the gypsy moth. The special field agent in charge, Mr. D. M. Rogers, has co-operated most heartily at all times with the efforts of this office to secure a better control of the moths and to reduce the danger of the scattering of the caterpillars. Nearly all the important highways in the district have been put in excellent condition for further treatment, which can now be applied at a relatively smaller cost. Particularly helpful also has been the assistance of the national forces in spraying operations in certain badly infested park lands much frequented by the public, and where the danger of scattering the caterpillars was particularly great. All told, Mr. Rogers' forces have worked over 122 miles of highway in Massachusetts.

By direction of His Excellency the Governor, the superintendent spent several days in Washington at the time when the appropriation for this particular work was pending. He was glad to find that the Senators and Representatives from this State were fully aroused to the importance of making liberal appropriations for the national work in Massachusetts, and to their united efforts, particularly to those of the Hon. Ernest W. Roberts, the appropriation of $150,000 by the National Congress was principally due. The good showing made by Mr. Rogers in his field work will amply justify further liberal appropriations to enable him to carry out his plans.

Other Entomological Work.

The function of this office primarily is to deal with the gypsy and brown-tail moths, no other insect pests being recognized by the law defining the scope of our work. The fact that both these moths are most serious pests of vegetation has become very widely known throughout Massachusetts, and as a result, farmers, orchardists and other property owners without as well as within the infested district are giving greater attention to

BROWN TAIL MOTH

After Dr. E. P. Felt,

State Entomologist, New York.

the attacks of injurious insects. It naturally follows, therefore, that throughout the year, particularly in the spring and summer months, several thousands of specimens of various insects are brought or sent to this office, under the impression that they may be the gypsy or brown-tail moths. In this way quite a number of infestations by the moth pests have been located, but at least 90 per cent. of the insects presented for examination prove to be some of the more common native species. Almost invariably the question is asked, "If this is not the gypsy moth, what is it, and what can I do to destroy it?" Information on these questions should be more properly sought from the experiment station at Amherst, the entomological department of which is so finely equipped with able entomologists, libraries and collections. At the same time, the farmer or orchardist cannot always wait to obtain information from this source, particularly if his trees or crops are being devoured.

Since this condition of affairs makes it possible to render a large amount of practical assistance to our citizens, particularly those in eastern Massachusetts, where the bulk of our population resides, the superintendent has at all times gladly given the desired information by identifying the insects and giving directions for their effective treatment. He feels that if a man has sufficient interest in the gypsy moth work to send or bring specimens of noxious insects to this office, through fear that they may be either the gypsy or brown-tail moths, that man is entitled to all the help and advice this office may be qualified to give. The inquiries of this nature which reach us in the course of a year cover practically the whole range of insect pests, from those of the household, of stored goods or of fruit and vegetable crops, to those ravaging shade and forest trees.

To aid in the rapid and accurate identification of such insects as may be sent in, the superintendent has obtained, through the courtesy of Hon. J. L. Ellsworth, secretary of the Massachusetts State Board of Agriculture, the reference collection of insects formerly in use at the office of the gypsy moth committee. To this has been added by purchase the valuable collection of moths and butterflies of the late George H. Harris, while by exchange and donation we have also obtained much valuable material from the insectary collection of the Massachusetts

Agricultural College. All this material is now being put in order by Mr. Frederick B. Lowe, formerly of the British Museum, London, and now assistant at our entomological laboratory. When this work is finished we shall have a very complete collection of all common injurious insects of this region, which at all times will be available for the information and assistance of the public.

Spraying Operations.

Appreciating fully the value of spraying as a means for controlling the gypsy and brown-tail moths, the superintendent from the beginning of the present work has constantly urged, as far as funds permitted, the purchase and use of spraying outfits by the cities and towns most generally infested. Financial considerations have prevented the buying, in any one year, of all the outfits needed in the most severely infested municipalities; there has been, however, a steady increase in the number of sprayers, and during the summer of 1907 there were operated in the field 54 power sprayers and 38 hand outfits. This does not include a very large number of sprayers owned by private citizens. The unusual drought made it possible to continue the use of the sprayers throughout the caterpillar season with but slight interruption because of rain. Notable improvements have been made by the manufacturers of power-spraying outfits, and, while there is still much room for improvement, the machines gave more satisfactory results in 1907 than in any previous year. The prepared arsenate of lead, or disparene, secured fresh from the manufacturers, fully upheld its reputation as an effective insecticide.

Two systems of spraying were used, that of the mist spray from Vermorel nozzles, used principally in orchards, on shrubbery and along roadsides, and the solid-stream spray from straight-bore nozzles on shade trees and in woodland. With the first system of spraying, a pressure of from 75 to 100 pounds to the square inch is sufficient; with the second, a pressure of from 150 to 200 pounds is desirable, the high pressure causing the stream to break into a mist at a considerable distance from the nozzle. The results obtained practically confirm our previous opinion in regard to the two systems of spraying, each of which has its champions. As usual, the mist spray gave the

Small Power Sprayer. — Medford, 1907.

best results, due to the more thorough coating of the foliage, and required less poison; but the cost of labor where it is used was considerably greater than with the solid stream. On the other hand, the solid-stream spray permitted of more rapid work, reduced the amount of climbing to be done, but required a much greater quantity of insecticide as compared with the mist spray. The superintendent is of the opinion that both systems of spraying are desirable in badly infested towns; that the proper field of usefulness of hand sprayers or low-pressure power outfits throwing a mist spray will be found in the treatment of orchards, trees on private estates, shrubbery and roadsides, or where exterminative measures are necessary. The high-pressure power outfits with the solid-stream spray are most useful in the treatment of tall shade trees, woodland, and where the wholesale destruction of the caterpillars in the shortest possible time is desired.

While in the past years we never had a *bona fide* instance of the death of live stock from grazing beneath trees where the mist spray had been used, during the past year a number of cows were killed by feeding in orchards and woodlands where the solid-stream spray had been employed. The reason for this is not far to be sought. With the solid stream a very much larger quantity of the poison is thrown into the trees, and much of it falls to the ground and thoroughly poisons the grass. In some cases, in their most commendable desire to wipe out the moth pests, the local superintendents increased the proportions of poison used, as recommended by the central office, from 10 pounds of arsenate of lead to 100 gallons of water, to 15 or 20 pounds of the insecticide to the same quantity of water. Notices giving warning that poison was being used on the premises were generally posted throughout the sprayed districts, and farmers were notified to cut the grass in the orchards before spraying operations commenced, and also warned against pasturing their cattle in the woodlands which had been sprayed. In spite of these precautions, the disastrous results above mentioned occurred in several cases. This indicates the necessity in the future work of adopting much greater and more complete precautions than were taken in the season of 1907.

One interesting and very gratifying result of the general

spraying operations against the gypsy and brown-tail moths in orchards was apparent when the fruit was gathered in the fall. As is well known, the year 1907 was, as our farmers term it, an "off year" for apples; in other words, the year in which but a very small crop was expected. Yet from the sprayed orchards good crops of fine, sound fruit was the general rule. This result was particularly noticeable in the apple-growing sections of Essex County. The statements made by farmers by letter or personally, regarding the increased yield of apples of improved quality, were very gratifying. While our spraying operations have been carried on solely with a view to controlling the moth pests, it is, of course, pleasant to know that, aside from protecting the trees from damage, this work has also directly benefited, financially, a large number of our farmers.

Cost of Spraying.

The efficacy of spraying with arsenical insecticides as an effective means for controlling the gypsy moth was long ago demonstrated. It is doubtful if any single wholesale method of work against this insect would give better or quicker results for the expense involved than spraying. To get this work done to the best advantage involves factors that are subject to great variation. The spraying outfit must be built on correct economical principles, in order to secure the greatest efficiency without unnecessary waste of power. It should be substantial, durable, and yet not cumbersome. Again, the skill and judgment of the operator and the care he gives to the outfit is a factor of great importance. The best possible type of spraying outfit in the hands of an ignorant or careless operator will not do the maximum amount of work possible, while under such conditions the repair bill and consequent loss of time in the spraying gang will be a large item.

While experience in actual field spraying operations has taught us how to judge approximately the probable cost of spraying operations under the known conditions in any locality, such estimates as the superintendent and his assistants have been called upon to make have been largely a matter of personal

opinion, based upon a somewhat extended experience. It is perfectly true that no two spraying problems present exactly the same conditions. The presence or absence of roads, the distance from the sprayer to the point to which the stream must be carried, the contour of the ground, height of the trees, abundance or scarcity of underbrush, and the distance from which water must be pumped or hauled to supply the sprayer, are a part of the many details which must be taken into consideration in estimating costs of work. Again, the type of outfit with reference to the manner of obtaining power is of importance. The three styles of rigs in general use in the gypsy moth district include those operated by hand, by gas or compressed air, and by gasoline engines. Each kind of outfit has its own field of usefulness, and each has its ardent champions. Still, again, the kind of spray used, whether the mist or solid stream, greatly affects the cost of spraying.

It seemed desirable this summer to get careful data on the actual cost of spraying operations in the field, and Mr. A. F. Burgess, assisted by Mr. C. G. Barnum, was especially assigned to this work. The data which follow are condensed from Mr. Burgess's very complete field notes: —

Watertown, Whitney Hill Park, June 11, 12, 1907.

On the steep hillside in this park 7 acres of large forest trees, viz., oak, hickory and beech, were sprayed with one of the outfits belonging to the United States Department of Agriculture. Although the caterpillars were less than half grown, the effect of their feeding was very noticeable. About 600 trees, averaging 60 feet in height, were treated. In the twelve hours required to make this spraying, considerable time was lost in moving the sprayer. Water was obtained from the city hydrants. Work was begun at the top of the hill, and but very few of the trees were climbed. June 11, 8 tanks, and June 12, 5 tanks of spray were used, the total amount applied being 7,800 gallons.

Outfit.

The outfit consisted of a 7 horse-power Olds engine, with double-acting pump and a 600-gallon tank. One 200-foot line of 1½-inch hose and a ⅜-inch nozzle were used, the pressure averaging 130 pounds. The insecticide was Swift's arsenate of lead, applied at the rate of 10 pounds to 100 gallons of water.

Cost.

1 team and driver, 1½ days,	$5 00	$7 50
1 engineer, 1½ days,	2 80	4 20
8 men, 1½ days,	2 00	24 00
780 pounds arsenate of lead,	11	85 80
5 gallons gasoline,	18	90
Oil, waste, etc.,		10
Total,		$122 50

Average cost of treatment, $17.50 per acre, or 20.5 cents per tree. Poison was used at the rate of about 110 pounds per acre.

MELROSE, JUNE, 1907.

Mr. John J. McCullough, local superintendent, supplied data concerning the treatment of an infested 6-acre wood lot. The trees, averaging about 40 feet in height, had been thinned to stand 15 or 20 feet apart, and the underbrush had been cut and burned.

Outfit.

A 2 horse-power Olds gasoline engine, connected with a double-acting pump and 300-gallon spray tank, supplied 4 lines of ½-inch hose equipped with 10-foot extension rods and single Vermorel nozzles. Four men and a foreman were required to operate this outfit, and 5 gallons of gasoline were consumed in the four days required to spray the wood lot. About 25 per cent. of the trees were climbed.

Cost.

The data of cost of this work was not kept in quite as much detail as in the cases previously described. Mr. McCullough's figures show, however, that the cost of arsenate of lead was $4 per acre, and the total cost of treatment averaged $12 per acre.

MELROSE, JULY 1, 1907.

On a private estate in Melrose Highlands 2 shade trees about 40 feet in height and 15 rose bushes were treated in one hour with an ordinary barrel outfit, such as is commonly used on private estates.

Outfit.

A common hand pump, mounted in a 40-gallon barrel and carried in an express wagon, furnished spray for a single line of ½-inch hose and for Vermorel nozzle.

Cost.

2 men, ¼ day,	$2 25	$0 56
1 horse, ⅛ day,	1 50	19
2 pounds arsenate of lead,	12	24
Total,		$0 99

Allowing 9 cents for spraying the 15 rose bushes, the cost of spraying the shade trees was 45 cents each.

Saugus, June 20, 1907.

This spraying included work on street trees, fruit and other trees in yards, and the forest trees in uncleared lots along the roadside. Three hundred and fifty trees averaging 35 feet in height, and about 1 acre of brush, a part of which was in the area where no trees were growing, were treated. About 25 per cent. of the trees were climbed.

Outfit.

A 1½ horse-power Lunt & Moss engine, with a small double-acting pump, connected with 5 lines of ½-inch hose, was operated. Single Vermorel nozzles were used, the insecticide, Bowker's arsenate of lead, being applied at the rate of 10 pounds to 100 gallons of water.

Cost.

1 team and driver, ½ day,	$6 25	$3 13
6 men, ½ day,	2 25	6 75
50 pounds arsenate of lead,	12	6 00
2 gallons gasoline,	20	40
Oil, waste, etc.,		05
Total,		$16 33

Average cost of treatment, 4.6 cents per tree.

Saugus, June 20, 1907.

Three hundred trees along streets and in vacant lots were sprayed with arsenate of lead, at the rate of 10 pounds to 100 gallons of water. About 25 per cent. of the trees, which average 25 feet in height, were climbed, and a small amount of brush in the vacant lots was also treated.

Outfit.

A 4½ horse-power Olds engine, with double-acting pump, a 350-gallon tank and 4 lines of ½-inch hose, equipped with single Vermorel and Bordeaux nozzles, was used; each hose line was 100 feet long.

Cost.

1 team and driver, ½ day,	$6 25	$3 13
5 men, ½ day,	2 25	5 63
35 pounds arsenate of lead,	12	4 20
2 gallons of gasoline,	20	40
Oil, grease and waste,		05
Total,		$13 41

Average cost of treatment, 4.5 cents per tree.

SAUGUS, JUNE 20, 1907.

During the period this outfit was under observation, 40 street trees, chiefly elm and Norway maple, from 25 to 40 feet in height, 40 fruit and small shade trees ranging from 10 to 15 feet in height, 30 shrubs and a few rows of currant bushes were treated. Forty per cent. of the trees were climbed.

Outfit.

A 3½ horse-power Fairbanks-Morse engine, with Deming triplex pump, 5 lines of ½-inch hose and single Vermorel and Bordeaux nozzles, was used. The tank carried 650 gallons of spray, the entire outfit when loaded weighing about 5 tons. Six hundred gallons of spray, containing 10 pounds of Bowker's arsenate of lead to 100 gallons, were used.

Cost.

1 team and driver, ½ day,	$6 25	$3 13
6 men, ½ day,	2 25	6 75
60 pounds arsenate of lead,	12	7 20
2½ gallons gasoline,	20	50
Oil, grease and waste,		05
Total,		$17 63

Average cost of treatment, about 22 cents per tree.

SAUGUS, JUNE 20, 1907.

Shade trees averaging 28 feet in height and fruit trees, mainly apple, averaging 20 feet in height, were sprayed in a residential section. A part of the shade trees and a few of the larger apple trees were climbed. One hundred and seventy-five gallons of spray, containing 10 pounds of arsenate of lead to 100 gallons of water, were used in this work.

Outfit.

A Bonanza hand pump, made by the Deming Company, Salem, O., mounted on a 100-gallon hogshead, with 2 lines of ½-inch hose, equipped with single Vermorel nozzles, was used. Two men were required to operate the pump. All told, 63 trees were treated during the time the outfit was under observation.

Cost.

1 horse, ⅞ day,	$1 50	$1 31
2 men, ⅞ day,	2 00	3 50
3 men, ⅞ day,	2 25	5 91
17½ pounds arsenate of lead,	12	2 10
Total,		$12 82

Average cost of treatment, 20.3 cents per tree.

Saugus, June 21, 1907.

The spraying operations in this case were along both sides of the road leading from North Saugus to Wakefield. Here the infested woodland had been thinned back to a distance of 100 feet on each side of the road. Owing to steep grades, the 600-gallon tank was only filled to about three-fourths of its capacity. Swift's arsenate of lead was used, at the rate of 10 pounds to 100 gallons of water. The trees ranged from 10 to 60 feet in height, with an average of about 50 feet. They were mainly oak, pine, ash and walnut.

Outfit.

A 7 horse-power Olds engine, coupled to a double-acting pump and connected with a 600-gallon tank, was the essential feature of this outfit. A single line of 100 feet of 1½-inch hose with a ¼-inch nozzle was used. About 2½ tanks were sprayed out during the morning, it requiring about thirty-five minutes to empty the sprayer. There was much loss of efficiency because of the time required to fill the tank.

Cost.

1	engineer, ½ day,	$2 80	$1 40
1	team and driver, ½ day,	5 00	2 50
1	supply team and driver, ½ day,	3 00	1 50
6	men, ½ day,	2 00	6 00
113	pounds arsenate of lead,	11	12 43
2½	gallons gasoline,	18	45
	Oil, grease and waste,		05
	Total,		$24 33

Average cost of treatment, about 20.6 cents per tree, or $12.16 per acre.

Stoneham, June 21, 1907.

The rough hillside off Franklin Street, covered with hardwood trees averaging 45 feet in height and running over 300 trees to the acre, was sprayed by the local gang, under the supervision of Mr. George M. Jefts. The trees were badly infested, and a part of them nearly defoliated at the time of spraying.

Outfit.

A 4½ horse-power Olds engine, with double-acting Myers pump with a 300-gallon tank, was used. A single line of 1½-inch hose, 400 feet in length, with a 3/16-inch nozzle, was being operated. The average pressure was 130 pounds, and a tank full was sprayed in about twenty-five minutes. Water was hauled about ⅛ of a mile, the same team being used to move the sprayer from one place to another. It required

seven minutes to transfer the water from the barrels to the spray tank. The insecticide was Swift's arsenate of lead, 10 pounds to 100 gallons of water.

Cost.

1	foreman, ½ day,	$3 00	$1 50
1	team and driver, ½ day,	4 50	2 25
1	engineer, ½ day,	2 40	1 20
4	men, ½ day,	2 25	4 50
1	man, ½ day,	2 00	1 00
200	pounds arsenate of lead,	12	24 00
2	gallons gasoline,	18	36
	Oil, grease and waste,		05
	Total,		$34 86

The cost of this spraying was $8.71 per acre for trees and brush, or slightly less than 3 cents per tree. Seven tanks or about 2,000 gallons of spray were applied during one-half day, poison being used at the rate of 50 pounds per acre.

MEDFORD, JUNE 25, 1907.

Here the work consisted of spraying street trees and those on private estates in the residential section of West Medford. Nearly all the trees were along the road, and averaged 55 feet in height. All told, 73 trees were sprayed with 10 pounds of disparene to 100 gallons of water.

Outfit.

The outfit was made up from a 5 horse-power Church engine, a triplex pump and a 400-gallon tank. The line of 1½-inch hose of varying length, to which was attached a 3/16-inch nozzle, was used. It was necessary to move the outfit frequently, with a consequent increase in the cost of work.

Cost.

1	foreman, ¼ day,	$3 00	$0 75
1	engineer, ¼ day,	2 50	63
7	men, ¼ day,	2 25	3 94
1	team and driver, ¼ day,	5 00	1 25
40	pounds disparene,	12	4 80
1	gallon gasoline,	20	20
	Oil, grease and waste,		05
	Total,		$11 62

Average cost of treatment, 16 cents per tree.

READING, JUNE 28, 1907.

The woodland in the northern part of the town was being treated by a power outfit on this date. The trees were principally oak, mixed with a few pine and other species, and averaged 50 feet in height. One

hundred and ninety trees were treated during the forenoon. Water was hauled about ¼ of a mile, and 30 per cent. of the trees were climbed.

Outfit.

A 4½ horse-power Olds gasoline engine, with duplex pump and a 300-gallon tank, was the essential feature of this outfit. A single line of 1-inch lead hose was connected with 4 lines of ½-inch hose. The pressure ranged from 90 to 125 pounds, and the nozzles used were of the Vermorel type.

Cost.

1 foreman, ½ day,	$2 25	$1 13
1 engineer, ½ day,	2 25	1 13
1 team and driver, ½ day,	4 50	2 25
5 climbers, ½ day,	2 25	5 63
2 ground men, ½ day,	2 00	2 00
30 pounds disparene,	12	3 60
2 gallons gasoline,	20	40
Oil, grease and waste,		05
Total,		$16 19

Average cost of treatment, 8.5 cents per tree.

Reading, June 28, 1907.

The spraying of small shade and fruit trees and shrubbery, by means of a gas power sprayer, was under observation here on this date.

Outfit.

This spray rig consisted of a 100-gallon iron tank, equipped with an agitator and connections with gas tank. The tank was mounted in a one-horse wagon, the mixture being constantly agitated while the spray was being applied. Two lines of ½-inch hose, equipped with gas pipe extensions and double Vermorel nozzles, completed the outfit. Disparene was used at the rate of 10 pounds to 100 gallons of water.

Cost.

3 men, ⅙ of a day,	$2 25	$1 13
1 horse, ⅙ of a day,	1 50	25
10 pounds disparene,	12	1 20
Gas,		32
Total,		$2 90

With this outfit 8 tanks can be used per day under good conditions, a tube of gas usually being sufficient for 9 tanks. The cost of spraying in the work under observation was slightly more than 22.3 cents per tree.

Wakefield, July 1, 1907.

In the hilly section of the town off Chestnut Street there were treated during the forenoon on this date 100 cedars 20 to 25 feet tall, 10 pines, 6 fruit trees, 4 maples and about ¾ of an acre of brush and scrub growth. While the cost of spraying the latter was not great, the time spent on it increased the net cost of the work per tree.

Outfit.

The outfit used here consisted of a 3½ horse-power Church air-cooled gasoline engine, with direct connection to a Douglas triplex pump. The tank was of 300 gallons capacity, with propeller agitator. A steady pressure of 80 pounds was easily maintained on about 1 gallon of gasoline per day. Two lines, 300 feet long, of ½-inch hose Siamesed to make 4 lines all told, and equipped with an extension spray pole and double Vermorel nozzle, completed the outfit.

Cost.

1 foreman, ½ day,	$2 50	$1 25
1 engineer, ½ day,	2 50	1 25
5 men, ½ day,	2 25	5 63
1 horse, ½ day,	1 50	75
30 pounds arsenate of lead,	12	3 60
½ gallon gasoline,	20	10
Oil, grease and waste,		05
Total,		$12 63

Average cost of treatment, 10.5 cents per tree.

Malden, July 1, 1907.

On this date two sprayers were in operation in the woodland of Pine Banks Park, the spraying being done under the direction of Mr. A. M. Cobb, contractor. In this work it was necessary to haul water a considerable distance. Trees being treated were principally oak, birch and hickory, averaging about 30 feet in height. In all 150 trees were sprayed during the forenoon, about one-third of them being climbed. Two hundred gallons of spraying mixture were applied.

Outfit.

This outfit consisted of a 100-gallon galvanized-iron tank, connected with a double-cylinder Gould Monarch pump. Three lines of ½-inch hose with Bordeaux nozzles were used.

Cost.

1 foreman, ½ day,	$2 50	$1 25
4 men, ½ day,	2 25	4 50
1 horse, ½ day,	1 50	75
1 water wagon and team, ½ day,	5 00	2 50
20 pounds arsenate of lead,	12	2 40
Total,		$11 40

Average cost of treatment, 7.6 cents per tree.

MALDEN, JULY 1, 1907.

In Pine Banks Park on this date there were sprayed 160 hardwood trees of mixed growth averaging about 25 feet in height, and some 2 acres of sprout and brush land in which the trees stood. About 25 per cent. of the trees were climbed.

Outfit.

A single-cylinder hand pump, connected with a 100-gallon tank and 3 lines of ½-inch hose, equipped with Bordeaux nozzles, completed the outfit. Arsenate of lead at the rate of 10 pounds to 100 gallons of water was used.

Cost.

1 foreman, ½ day,	$2 50	$1 25
4 men, ½ day,	2 25	4 50
1 horse, ½ day,	1 50	75
1 water wagon and team, ½ day,	5 00	2 50
25 pounds arsenate of lead,	12	3 00
Total,		$12 00

Average cost of treatment, 7.5 cents per tree.

ARLINGTON, JULY 2, 1907.

An infested wood lot, in which pines represented one-third and mixed hardwood growth two-thirds of the number of trees, ranging from 30 to 50 feet in height, was treated during four successive days. It was necessary to climb 80 per cent. of the trees. During the spraying operations 1 acre of undergrowth among the trees and 3 acres of brush land and sprout land were sprayed. Water could only be obtained at a considerable distance, and about one-third of the time was spent in hauling it.

Outfit.

A 2 horse-power Olds gasoline engine, with double-acting pump and 300-gallon tank, composed the outfit. Five lines of ½-inch hose, with 8-foot extension rods and Bordeaux nozzles, were used. Arsenate of lead was applied at the rate of 15 pounds to 100 gallons of water.

Cost.

8	men, 4 days,	$2 25	$72 00
1	man, 4 days,	2 00	8 00
1	team and driver, 4 days,	5 00	20 00
360	pounds arsenate of lead,	12	43 20
8	gallons gasoline,	20	1 60
	Oil, grease and waste,		20
	Total,		$145 00

Average cost of treatment, $36.25 per acre, or, if figured on basis of trees, 76.3 cents per tree.

ARLINGTON, JULY 2, 1907.

A mixed hardwood growth, ranging from 40 to 50 feet in height, was treated on this date. Sixteen trees were sprayed in one hour with one tank of spray, and from the difficulty of obtaining water near by, one hour was required to refill the tank.

Outfit.

A 100-gallon tank, in which was mounted a Ware double-acting hand pump, supplied 2 lines of ½-inch hose, to which spray-holes and Bordeaux nozzles were attached. Fifteen pounds of Swift's arsenate of lead were used to 100 gallons of water. Two men were required to operate the pump.

Cost.

3	men, ¼ day,	$2 25	$1 69
2	men, ¼ day,	2 00	1 00
1	horse, ¼ day,	1 50	38
15	pounds arsenate of lead,	12	1 80
	Total,		$4 87

Average cost of treatment, about 30.4 cents per tree.

ARLINGTON, JULY 2, 1907.

In spraying the hospital lot two Pomona hand pumps were used in treating 1,800 mixed hardwood trees, averaging 30 feet in height. About 30 per cent. of the trees were climbed, and 3 men were employed in supplying water for the tanks.

Outfit.

Each pump was mounted in a 50-gallon barrel, carried on a wheel truck. Two lines of ½-inch hose with Bordeaux nozzles were used with each outfit.

Power Sprayer used at Medford. — 1907.

Cost.

4 climbers, 6½ days,	$2 25	$58 50
5 men, 6½ days,	2 00	65 00
425 pounds arsenate of lead,	12	51 00
Total,		$174 50

Average cost of treatment, 9.7 cents per tree.

LEXINGTON, JULY 3, 1907.

The woodland along each side of a badly infested road was treated to a depth of 150 feet. All told, 3 acres of mixed growth, ranging from 20 to 60 feet in height, and 1 acre of underbrush not included in the area covered by the trees, were sprayed in one hour's time by employees of the United States Department of Agriculture. Arsenate of lead was used, at the rate of 10 pounds to 100 gallons of water.

Outfit.

A 7 horse-power Olds gasoline engine, with double-acting pump, was supplied by a 600-gallon tank mounted on a substantial truck. A single line of 1½-inch hose and a ¼-inch nozzle applied spray under a pressure ranging from 150 to 175 pounds.

Cost.

1 engineer, ⅛ day,	$2 80	$0 35
7 men, ⅛ day,	2 00	1 75
1 team and driver, ⅛ day,	5 00	63
1 supply team and driver, ⅛ day,	3 00	38
60 pounds arsenate of lead,	11	6 60
Gasoline,		10
Oil, grease and waste,		01
Total,		$9 82

Average cost of treatment, $2.46 per acre, or 3 cents per tree.

CHELMSFORD, JULY 3, 1907.

The spraying on this date consisted in treating a strip of shade trees and sprout land where gypsy moth caterpillars had been found in considerable numbers. The trees were mainly oak, ranging from 50 to 55 feet high, with a few pines and birches. Two men were used on the pump, while the driver assisted in the spraying operations. All told, 36 large trees and about ½ acre of brush land were treated.

Outfit.

A Friend pump, mounted on a barrel, supplied two lines of ½-inch hose equipped with Vermorel nozzles. Disparene was used, at the rate of 12 pounds per 100 gallons; and 50 per cent. of the trees were climbed.

Cost.

4 men, ½ day,	$2 00	$4 00
1 horse and driver, ½ day,	3 00	1 50
24 pounds arsenate of lead,	12	2 88
Total,		$8 38

Average cost of treatment, about 23 cents per tree.

LEXINGTON, JULY 4, 1907.

A steep hillside, covered with a mixed growth of about 250 trees ranging from 40 to 60 feet in height, was sprayed on this date with the two hand outfits previously mentioned.

Cost.

1 foreman, 1 day,	$3 50	$3 50
5 climbers, 1 day,	2 25	11 25
1 climber, ½ day,	2 25	1 13
3 men, 1 day,	2 00	6 00
120 pounds arsenate of lead,	12	14 40
Total,		$36 28

Average cost of treatment, 14.5 cents per tree, or $36.28 per acre.

GLOUCESTER, JULY 5, 1907.

A private estate covering between 4 and 5 acres, with numerous walks and drives, was treated. All told, 60 tall shade trees averaging 80 feet in height, and 100 tall shade trees from 25 to 50 feet in height, were climbed and sprayed. These were scattered over 1½ acres of ground. In addition, ½ acre of underbrush was sprayed. The trees were mainly pine, beech, and red and white oaks.

Outfit.

The Niagara gas engine, with a 100-gallon tank connected with lines of hose and with single Vermorel nozzles, was used. The pressure ranged from 60 to 125 pounds, 50 pounds of gas being required per day. This amount was sufficient to expel 500 gallons of poison. Disparene was applied at the rate of 15 pounds to 100 gallons of water.

Cost.

1 foreman, 1½ days,	$2 50	$3 75
3 men, 1½ days,	2 25	10 13
1 horse, 1½ days,	2 00	3 00
7½ pounds gas,	50	3 75
113 pounds disparene,	11	12 43
Total,		$33 06

Average cost of treatment, 20.6 cents per tree, or $16.53 per acre.

Beverly, July 5, 1907.

On this date a long, narrow strip of woodland near a river was sprayed, under the direction of the local superintendent. The water supply being near at hand, the cost of treatment was notably reduced. All told, 6 acres of woodland, averaging 100 trees, 45 to 65 feet in height, per acre, were sprayed in six hours with 2,100 gallons of spraying mixture, containing 14 pounds arsenate of lead to 100 gallons of water.

Outfit.

A 4½ horse-power Olds gasoline engine, with double-acting pump and 350-gallon tank, was the essential feature of the outfit. A single line of 1½-inch hose and ¼-inch nozzle delivered the spray under a pressure of 125 pounds.

Cost.

1	foreman, ¾ day,	$2 50	$1 88
1	team and driver, ¾ day,	5 00	3 75
5	men, ¾ day,	2 00	7 50
294	pounds arsenate of lead,	11	32 34
2	gallons gasoline,	18	36
	Oil, grease and waste,		04
	Total,		$45 87

Average cost of treatment, 7.6 cents per tree, or $7.65 per acre.

Swampscott, July 5, 1907.

The spraying operation in this case is of interest since it was done with the ordinary outfit used in oil-burning of infested walls and brush land. It was necessary to carry the water in buckets a considerable distance. Twelve apple trees, ranging from 20 to 35 feet in height, together with about ¼ acre of brush that had grown up in the old orchard, were treated. Six tanks of spray, containing arsenate of lead at the rate of 23 pounds to 100 gallons of water, were used.

Outfit.

On a 20-gallon cask a common Johnson hand pump was mounted, and connected with 50 feet of ½-inch hose with extension rod and single Vermorel nozzle.

Cost.

2	men, ½ day,	$2 25	$2 25
27½	pounds arsenate of lead,	12	3 30
	Total,		$5 55

Average cost of treatment, 46 cents per tree.

LEXINGTON, JULY 6, 1907.

An orchard of 61 apple trees 15 to 20 feet in height was sprayed on this date in three hours' time, arsenate of lead being used at the rate of 16 pounds to 150 gallons of water. Two hand outfits described below were used.

Outfit.

Two Morrill & Morley Eclipse pumps, mounted in barrel trucks and each supplied with two lines of ½-inch hose connected with Bordeaux nozzles, were used. A crew of 3 men operated each pump.

Cost.

1 foreman, ⅜ day,	$3 50	$1 31
4 climbers, ⅜ day,	2 25	3 38
2 men, ⅜ day,	2 00	1 50
26½ pounds arsenate of lead,	12	3 18
Total,		$9 37

Average cost of treatment, 15.3 cents per tree.

WALTHAM, JULY 6, 1907.

Miscellaneous spraying along roadside. The work in this case was quite badly broken up by reason of the frequent moving of the spraying outfit, but is of interest because similar conditions are frequently met with in all cities and towns. The first spraying was that of a white oak 35 feet in height and a red oak 55 feet in height, near the railroad station. The outfit was then moved ⅛ mile to treat a very large white oak 55 feet in height. One-half mile from this point 4 large oaks 55 feet in height were sprayed; and in the fourth locality, ¼ mile distant, 10 maples averaging 50 feet in height were also sprayed. All the trees were climbed, and 200 gallons of spray, containing arsenate of lead at the rate of 18 pounds to 100 gallons of water, were used during the half day the outfit was under observation.

Outfit.

The spraying rig consisted of a 4½ horse-power Olds gasoline engine, a double-acting pump and a 350-gallon tank. Two lines of hose, equipped with extension rods and 3-way Vermorel nozzles, were used. All the trees were climbed.

Cost.

1 engineer, ½ day,	$2 00	$1 00
3 climbers, ½ day,	2 00	3 00
1 team and driver, ½ day,	5 00	2 50
36 pounds arsenate of lead,	12	4 32
2 gallons gasoline,	20	40
Oil, grease and waste,		05
Total,		$11 27

Average cost of treatment, 66 cents per tree.

Somerville, July 6, 1907.

Spraying of 12 small shade trees averaging 30 feet in height, 90 per cent. being climbed.

Outfit.

Two lines of ½-inch hose 100 feet long, equipped with Bordeaux nozzles, were supplied by Pomona hand pump mounted on a 50-gallon barrel. Arsenate of lead was used at the rate of 18 pounds to 100 gallons of water.

Cost.

1 horse and wagon, ⅙ day,	$2 00	$0 33
3 men, ⅙ day,	2 00	99
13½ pounds arsenate of lead,	11	1 49
Total,		$2 81

Average cost of treatment, 23 cents per tree.

Danvers, July 10, 1907.

During the day this outfit was under observation, 91 large shade trees, 14 evergreens, 7 small trees and 12 shrubs were treated. The trees, principally maple, averaged nearly 60 feet in height, and 50 per cent. were climbed.

Outfit.

This outfit consisted of a 4½ horse-power Olds gasoline engine, a double-acting pump and a 350-gallon tank. Three lines of ½-inch hose, with extension rods and 3-way Vermorel nozzles, were in use. Disparene was applied at the rate of 11 pounds to 100 gallons of water, using a pressure of from 100 to 125 pounds.

Cost.

1 engineer, 1 day,	$2 00	$2 00
3 men, 1 day,	2 25	6 75
1 team and driver, 1 day,	5 00	5 00
50 pounds disparene,	11	5 50
2½ gallons gasoline,	20	50
Oil, grease and waste,		50
Total,		$19 80

Average cost of treatment, 17.6 cents per tree.

Lynn, July 13, 1907.

Work along parkways in the Lynn Woods. During the day that the two outfits described below were in operation, a strip of road 1 mile long was sprayed to a depth of about 150 feet on both sides of the road. On one side of the road the underbrush had been removed, but on the opposite side no pruning or cutting had been done. The ground cov-

ered was about 36½ acres, the trees averaging about 100 per acre and ranging from 30 to 40 feet in height. The growth was principally oak, with other species of hardwood intermingled. But few trees were climbed. Water was hauled in one of the city sprinkling carts.

Outfits.

Each of the two outfits consisted of a 4½ horse-power Olds gasoline engine, a double-acting pump and a 300-gallon tank. A single line of 1½-inch hose equipped with a 3/16-inch nozzle applied the spray, which contained arsenate of lead at the rate of 14 pounds to 100 gallons of water. The pressure was quite uniformly at 125 pounds.

Cost.

2	engineers, 1½ days,	$2 40	$7 20
12	men, 1½ days,	2 25	40 50
1	man, 1½ days,	2 00	3 00
2	teams and drivers, 1½ days,	5 00	15 00
1	water team and driver, 1½ days,	5 00	7 50
5	gallons gasoline,	20	1 00
1,152	pounds arsenate of lead,	11	126 72
	Oil, grease and waste,		20
	Total,		$201 12

Average cost of treatment, about 5.5 cents per tree, or $5.51 per acre.

LYNN, JULY 13, 1907.

Spraying operations in Lynn Woods Park. During the period this outfit was under observation 6 pines ranging from 60 to 75 feet in height and a small amount of undergrowth were treated with 200 gallons of poison, carrying arsenate of lead at the rate of 15 pounds to 100 gallons of water.

Outfit.

The outfit consisted of a 2½ horse-power Olds gasoline engine, a double-acting pump and a 300-gallon tank. Three lines of ½-inch hose were used, and 3 of the trees were climbed.

Cost.

1	engineer, ⅛ day,	$2 40	$0 40
4	men, ⅛ day,	2 25	1 50
1	team and driver, ⅛ day,	5 00	83
30	pounds arsenate of lead,	11	3 30
½	gallon gasoline,	20	10
	Total,		$6 13

Average cost of treatment, $1.02 per tree. This work was done under great difficulties, chief of which were defective pressure on the pump and loss of time in climbing.

Brookline, July 15, 1907.

About 800 feet of hedges on private estates and 7 elms 35 feet in height were treated during the forenoon that this outfit was under observation. The work was done in three different localities, and about 400 gallons of spray were applied. Arsenate of lead was used at the rate of 13 pounds to 100 gallons of water.

Outfit.

A 2½ horse-power Olds gasoline engine, a double-acting pump, a 300-gallon tank and 5 lines of ½-inch hose were used in this work. Three lines of hose were equipped with single Vermorel nozzles and two with 3-way Vermorel nozzles. The pressure ranged from 30 to 80 pounds.

Cost.

1 foreman, ½ day,	$2 50	$1 25
1 engineer, ½ day,	2 00	1 00
1 climber, ½ day,	2 25	1 13
4 men, ½ day,	2 00	4 00
1 team, ½ day,	4 00	2 00
52 pounds arsenate of lead,	11	5 72
1 gallon gasoline,	18	18
Oil, grease and waste,		05
Total cost for ½ day,		$15 33

Woburn, July 16, 1907.

Spraying of street trees. Fifteen large elms were treated with 300 gallons of spray, containing arsenate of lead at the rate of 20 pounds to 100 gallons of water. All the trees were over 60 feet in height, and were climbed.

Outfit.

A Niagara gas sprayer supplied two lines of ½-inch hose, to which extension poles and Bordeaux nozzles were attached.

Cost.

4 men, ½ day,	$2 50	$5 00
1 horse, ½ day,	2 00	1 00
60 pounds arsenate of lead,	11	6 60
Gas,		1 00
Total,		$13 60

Average cost of treatment, 90.6 cents per tree. It should be noted that an excessively large quantity of arsenate of lead was used.

Boston, July, 1907.

Spraying of the Common and Public Garden. Exact data of a single day's run of the spraying outfit used here were not obtained. The local superintendent, Mr. D. H. Sullivan, kept accurate records of the total cost of spraying the trees in these park spaces. The shade trees, numbering about 2,000, ranged from 50 to 70 feet in height. About 2,500 shrubs were also sprayed. The outfit was an 8 horse-power Olds gasoline engine, with 600-gallon tank, a single line of 1½-inch hose and a ¼-inch nozzle. Arsenate of lead was used at the rate of 15 pounds to 100 gallons of water. No division was made of the cost of spraying shrubs and trees, but figured on the basis of trees alone, the expense averaged 21 cents per tree.

The data given on the preceding pages cover typical spraying operations carried on under varying conditions in surface treated and style of outfit. Their value lies in the fact that the figures of cost were not obtained from estimates, but from the actual records made in the field, and include not only the time and material used, but also the cost of delays incident to hauling water, breakdowns of machinery, and time spent in moving outfits from place to place. The cases cited cover nearly all the different problems the local superintendents are called on to solve in spraying to destroy the gypsy and brown-tail moths.

The only items not possible to figure accurately are those of repairs, depreciation of outfit and interest on investment. The latter might have been computed with a fair degree of accuracy, but, since the spraying outfit question is yet in an experimental stage, the items of repairs and depreciation for this year would not hold good for succeeding seasons. Already manufacturers are perfecting notable improvements to be available for the 1908 trade.

This careful study of actual field spraying operations shows that, all things considered, best and cheapest results are obtained by the use of high-power rigs throwing a small solid-stream spray. While these outfits have their good points, their field of usefulness is limited by their weight, and depends largely on the proximity of good roads and abundant water supply to the areas to be sprayed. It is not feasible as a rule to use the high-pressure solid stream near houses, because of the discolorations caused by the spray, although in some cases house

walls can be immediately washed down with clear water applied from the lawn hose. For the same reason it is difficult to use this kind of spray in cemeteries, although much can be done in protecting monuments, etc., by covering with light-weight duck cloth.

The medium-weight outfits, with a 4 to 5 horse-power engine, triplex pump and 300-gallon tank, seem to have the greatest field of usefulness in the average city and town. They can be used for both solid-stream and mist sprays, and with the exercise of due care can be used in woodlands where the grades and conditions of roads make it impossible to use the heavier spraying rigs. These outfits are also most useful in treating orchards.

The hand outfit of whatever type is the most expensive of all, tested by cost of results, yet it will always have a field of usefulness in treating the odds and ends of spraying operations. There are numerous small jobs of spraying to be done in every city and town, such as the treatment of fruit trees and back yards, infested shade trees and shrubbery, or small orchards where large power outfits cannot be economically used, and in this work the small spray tank finds its greatest usefulness.

The same considerations apply to the use of the gas sprayer, where carbonic acid gas furnishes the pressure for the expulsion of the spray. With this outfit the saving of the labor of one or two men at the pump is effected; yet this in a measure is more theoretical than actual, since the team transporting the outfit requires a driver, and considerable attention must be given to maintaining a constant pressure. A good point in connection with this kind of spraying apparatus is its light weight, thus making possible its use on hillsides, rocky ground, etc., where the heavier power outfits cannot be used to advantage.

Table of Theoretical Discharges.

In selecting a spraying outfit and in planning for spraying operations, it is often important to know the quantity of fluid discharged or required to be discharged in a given time. The principal factors involved in such a determination are pressure and diameter of nozzle.

The Goulds Manufacturing Company, O. D. Hogue, manager, have kindly supplied this office with a table showing the

discharge of different-sized nozzles under varying pressures. The figures given in the following table are those of theoretical discharges. The actual discharges or constants are 64 per cent. for ring nozzles and 82 per cent. for taper nozzles.

Theoretical Discharges (in U. S. Gallons of 231 Cubic Inches).

Pressure Head.		Velocity in Feet per Second.	Diameter of Orifices.					
Pounds	Feet.		1/16 Inch.	1/8 Inch.	3/16 Inch.	1/4 Inch.	3/8 Inch.	1/2 Inch.
10	23.1	38.58	.37	1.48	3.30	5.90	13.2	23.6
15	34.7	47.25	.45	1.81	4.02	7.23	16.2	28.7
20	46.2	54.55	.52	2.09	4.66	8.35	18.7	33.4
25	57.8	60.99	.58	2.33	5.23	9.33	20.9	37.2
30	69.3	66.82	.64	2.56	5.71	10.20	22.8	40.9
35	80.9	72.16	.69	2.76	6.16	11.00	24.7	44.2
40	92.4	77.14	.74	2.95	6.60	11.80	26.4	47.2
45	104.0	81.83	.78	3.13	6.99	12.50	28.0	50.2
50	115.5	86.26	.82	3.30	7.37	13.20	29.5	52.8
55	127.1	90.46	.86	3.46	7.73	13.80	30.9	55.4
60	138.6	94.49	.90	3.62	8.08	14.50	32.3	57.8
65	150.2	98.35	.94	3.77	8.40	15.10	33.6	60.2
70	161.7	102.06	.97	3.91	8.73	15.60	34.9	62.5
75	173.3	105.65	1.01	4.04	9.03	16.20	36.1	64.6
80	184.8	109.11	1.04	4.18	9.33	16.70	37.8	66.6
85	196.4	112.46	1.07	4.31	9.62	17.20	38.5	68.8
90	207.9	115.72	1.10	4.43	9.89	17.70	39.6	70.8
95	219.5	118.89	1.13	4.55	10.20	18.20	40.7	72.8
100	231.1	121.98	1.16	4.67	10.40	18.70	41.7	74.6
105	242.6	125.00	1.19	4.78	10.70	19.10	42.8	76.5
110	254.2	127.94	1.22	4.90	10.90	19.60	43.8	78.3
115	265.7	130 82	1.25	5.01	11.20	20.00	44.8	80.1
120	277.3	133.63	1.27	5.12	11.40	20.40	45.7	81.8
125	288 8	136.38	1.30	5.22	11.70	20.90	46.7	83.5
130	300 4	139.08	1.33	5.32	11.90	21.30	47.6	85.1
135	312.0	142.00	1.34	5.37	12.10	21.50	48.5	86.2
140	324.0	144.00	1 37	5.50	12.30	22.00	49.5	88.2
145	335.0	147.00	1.40	5.62	12.60	22.50	50.5	90.0
150	347 0	150.00	1.43	5.72	12.80	22.90	51.5	91.7
175	405 0	162 00	1.55	6.20	13.90	24 80	55.7	99.2
200	463 0	172.00	1.64	6.57	14.80	26.30	59.2	105.2
250	578 0	193.00	1.84	7.37	16.50	29.50	66.2	118.0
300	693 0	211.00	2.01	8.07	18.10	32.30	72.7	129.2

Nest which Orioles were forced by the Caterpillars to abandon. — Lynn, 1907.

Spraying *v.* Bird Life.

It has been often asked of the superintendent if the immense spraying operations having for their object the poisoning of the gypsy and brown-tail moth caterpillars would not also result in the poisoning of the birds which feed upon these insects. Until recently evidence bearing on this point has been only of a negative character. It is well known that certain birds like the cuckoos, the oriole, vireos and a few others are quite partial to a diet of hairy caterpillars; and it is not at all unnatural to suppose that in the case of a bird consuming a large number of partially poisoned caterpillars a considerable amount of poison might be acquired accidentally, and the sickness or death of the bird ensue. Additional reasons for this assumption are found in the well-known resistance of the large gypsy moth caterpillar to arsenical insecticides, and the relatively large quantities of this insect consumed by the birds above mentioned. It is doubtful if any of these birds feed to any extent on dead insects; hence, the quantity of poison which a bird might accidentally take in is restricted to that contained in the bodies of the caterpillars which, at the time of being devoured, had not fed sufficiently to be killed by the insecticide.

During the summer of 1906 a yellow-billed cuckoo, which had its nest in a very badly infested section of West Medford, was found dead in a pear orchard which had been heavily sprayed with arsenate of lead. The bird was turned over to Mr. John A. Farley of this department, who carefully removed the stomach. Later, the superintendent sent it for analysis to Mr. H. D. Haskins, chemist at the Massachusetts Agricultural Experiment Station, with the request that it be tested both for arsenic and for lead. Under date of Oct. 1, 1906, Professor Haskins wrote: —

My Dear Mr. Kirkland: — I have carefully tested stomach and contents of the American cuckoo that you forwarded to me, and found the presence of lead and traces of arsenic. The lead was present in considerably larger quantities than the arsenic, and I was able to isolate it in minute globules. I was unable to make a quantitative determination of the two elements, on account of the small quantity of material with which to work. To make a satisfactory quantitative determination of the two elements, the chemist should have several of these specimens.

This shows conclusively that in the case of this single bird, since the body had no evidence of other injuries, death was probably caused by feeding upon caterpillars which had consumed sprayed foliage. The fact that the lead was found in much greater quantities than the arsenic is readily explained by the fact that arsenic, being a soluble substance, is rapidly eliminated from the system; while the lead after decomposition in the stomach becomes practically insoluble, and its elimination is a very slow process.

We have given quite fully the facts bearing upon this particular case, because of its great scientific interest. We are not disposed to consider it of any great economic importance, although it must be a source of regret to all nature lovers that the very necessary spraying operations should cause the death of even a single beneficial bird. That such occurrences are not common is apparent from the fact that this is the only case reported by the field employees, whose numbers run above one thousand in each spraying season, and whose work daily includes the examination of hundreds of infested orchards and woodland areas where spraying has been done. Furthermore, were the killing of insectivorous birds in this way of even noticeable proportions, it is an open question if the gypsy moth caterpillars, by destroying the foliage of woodlands and orchards in sections where no spraying was done, and thus exposing the young nestling birds to the hot rays of the sun and causing the old birds to forsake their nests, do not cause a much greater injury to bird life than any of the spraying operations made to date.

Dangerous Banding Materials.

The general practice of banding trees which have been cleared of gypsy moth eggs or brown-tail moth webs, in order to prevent their reinfestation during the caterpillar season, has naturally made a considerable demand for sticky banding materials. The relatively high price of certain of these proprietary substances has induced certain manufacturers to enter the market from time to time with cheaper substitutes, whose usefulness in stopping caterpillars and whose effect on the trees has not been fully tested. As might be supposed, many of these materials, al-

though most ingeniously worked up, are worthless; and, as with many other nostrums, the greater the promoter's ignorance of the situation to be dealt with, the more marvelous are the mysterious properties of his own preparation.

It is not our purpose to discourage the investigation and manufacture of these materials; in fact, this field should be further exploited by the manufacturer. A few banding materials are now in successful use, and we should be glad to examine and test out others that promise well, particularly if there is a prospect of a reduction in the prices prevailing at present.

The folly of rushing into the market with a preparation not thoroughly tried out in field work was never better shown than in the case of a banding material bearing the euphonious name of "Razzle-Dazzle," of which a considerable amount was used in Winchester and vicinity in 1906–07. This substance was fairly effective in stopping the ascent of the caterpillars; it also stopped the flow of the sap by girdling the trees, and, as a result, many fine shade and fruit trees have been needlessly sacrificed. No banding material yet offered which contains mineral oil or its derivatives, such as vaseline, etc., has been used on trees without seriously injuring them.

The Gypsy Moth *v.* White Pine.

The fact is well known that the available supply of the white pine, a most valuable timber tree, is being rapidly exhausted. It is equally well known that one stripping of the white pine by gypsy moth caterpillars results in its death. After the gypsy moth swarm has swept through white pine or other coniferous woods they cannot be cut over and the timber marketed any too soon. The trees die quickly, and the borers and bark beetles soon come in to ruin them for lumber.

From certain field observations in the past we have been led to question the extent to which the newly hatched gypsy moth caterpillars would feed on the white pine. No exact or definite laboratory experiments had been made to test this point previous to this year, yet field observations extending over some years seemed to indicate that the moths did not multiply rapidly on pine alone; in fact, we have never yet had a serious gypsy

moth outbreak in woodland where nothing but pines were standing. Wherever the pines have suffered there have always been scattering white oaks or other deciduous trees, and a considerable quantity of broad-leafed underbrush, which was defoliated before the pines were attacked. As the gypsy moth is getting more and more prevalent in the pine-growing sections of the State, particularly in Plymouth County, it seemed desirable to make further studies of the feeding habits of the caterpillars with reference to this most valuable species of tree. To this end, the entomologist in charge of the laboratory, Mr. F. H. Mosher, in the spring of 1907 took some 1,500 newly hatched caterpillars from 3 gypsy moth egg clusters, and placed them on white pine foliage contained in suitable breeding jars. The foliage was changed every other day, yet all the caterpillars died without attacking it. This experiment was repeated with about 4,500 more caterpillars hatching from 9 egg clusters, and with the same result; in other words, not one of the some 6,000 newly hatched caterpillars was able to feed upon the pine needles.

Following this work, between 300 and 400 larvæ in the second stage (first molt) were placed on pine foliage in breeding jars. The food supply was kept fresh by repeated changings, yet all the caterpillars died. This experiment was continued with a similar number of caterpillars in the third stage (second molt), and of these about 40 per cent. fed and molted. An examination of the pine twigs under the lens showed that feeding in this stage was done in small places along the edges of the needles.

While these experiments were in progress, a favorable opportunity was presented to check the laboratory work by a wholesale experiment in the field. In a certain badly infested woodland section in Saugus, on the property of Mr. Benjamin Johnson, there was a beautiful pine grove interspersed with numerous hard-wood trees and containing a considerable amount of underbrush. The underbrush and hard-wood trees were cut and burned, and the pines well banded with sticky materials. As a result of this treatment, the caterpillars hatched from the many thousands of egg clusters in the pines, and, not finding suitable food, spun down to the ground and starved to death,

or else were destroyed by hand in great numbers below the sticky bands on the tree trunks. In this case the experiment worked out most satisfactorily. The gypsy moth was thoroughly suppressed in this grove, and at a minimum expense.

Careful observations made by Mr. C. W. Minott on 7 newly hatched caterpillars in 1893 showed that they crawled from 36 to 144 feet, with an average of 91 feet, without food before being overtaken by death.[1]

In 1895, 50 newly hatched gypsy moth larvæ were under observation at the laboratory to determine the average length of time spent in each stage of growth. Of 47 caterpillars that molted once, the average time spent in the first stage was 18.4 days; 46 molted twice, average for second stage 6.8 days; 43 molted three times, average for third stage 6.95 days. These observations previously of scientific interest only now have a practical value since it has been shown that the first and second stage caterpillars cannot survive on pine only. While the work of cutting deciduous growth in the infested pine lands and the banding of the trees should be done before the eggs hatch, it may be continued to advantage up to the time of the second molting of the caterpillars. Furthermore, the pine is but little if at all injured by the ordinary banding materials, including raupenleim and bodlime, materials that cannot always be used with safety on thin-barked, hard-wood trees.

The superintendent realizes that the data at hand both from field and laboratory experiments are too small to warrant a sweeping general conclusion at this time. The results obtained, however, are most interesting and suggestive. It is greatly to be hoped that they will be confirmed by the more extensive field experiments now planned along this line for 1908. We plan to treat several badly infested areas of coniferous woodlands by cutting and removing hard-wood growths and shrubbery, banding all remaining trees with sticky materials, and following up the care of the bands diligently throughout the caterpillar season. We are of the opinion that this plan will work out satisfactorily; if so, a relatively simple and cheap means of handling the moth problem in pine lands will be at hand. In places where the growth is much mixed with hard-wood species,

[1] The Gypsy Moth, Forbush-Fernald, 1896, p. 310.

the vigorous thinning of the latter and the cleaning and banding of the remaining oaks, etc., followed up by a thorough spraying of these trees, should suffice to hold the insects in check. Where infested hard-wood growth adjoins pine woods, the thinning and spraying of a protective belt, together with the banding of the pines up to a hundred feet from the border of the woods, should be an effective control measure.

A Disease of the Gypsy Moth.

It is a well-known law of nature that starvation induces weakness, and weakness favors the inroads of disease. When any species of animal life suffers from lack of sufficient or suitable food, that species becomes an easy victim to disease. This principle applies as strongly to insects as to the higher forms of life. There have repeatedly come under the observation of the superintendent, in recent years, numerous cases where somewhat isolated gypsy moth colonies have completely consumed the foliage available for food, and after many days of fruitless wandering have been attacked and decimated by one or more bacterial diseases. This was notably the case in the Lynn and Saugus woodland colonies during midsummer, 1907. While these colonies were not isolated, and while the caterpillars on their borders could still find food, in the central part of the wide-spreading defoliated area no foliage was available for them, and here the inroads of the disease were as remarkable as gratifying. Where the trees were banded with sticky materials to prevent the ascent of the caterpillars, at their base could often be found masses of the dead insects in quantities running as high as half a bushel or more, while throughout this large colony the bodies of hundreds of dead insects could be seen hanging on almost every tree. So notable and important was this unexpected assistance on the part of natural causes, that it seemed worthy of scientific investigation, particularly with the view of determining if it were possible to propagate the disease, and use it as an additional means for destroying the moth pests. To this end we have fortunately secured the services of Prof. Herbert P. Johnson of the University of St. Louis, a man thoroughly qualified to make the necessary investigations. Although

this work cannot be done until the opening of the caterpillar season in 1908, the preliminary arrangements for a study of the disease have been completed, and Professor Johnson will take up the main problem as soon as insects are available for inoculation experiments.

In the case of most insect diseases, which often serve as notable checks on the increase of undesirable species, much depends upon weather conditions, particularly upon the relative decrease of heat and moisture. A warm, damp season usually favors the development of such diseases, while a cool or dry season acts adversely upon them. In the case of the gypsy moth disease now being investigated, our observations so far go to show that its potency depends largely upon a semistarved condition of the insects. This leads to the conclusion, possibly erroneous, that, if the gypsy moth colonies in the cheap scrub woodland can be thoroughly isolated and prevented from spreading, after one complete stripping of the trees has occurred the disease will come in to reduce the insects below the danger point. If this is proved to be the case, one of the most difficult problems in connection with the moth work will have been solved.

The Fungous Disease of the Brown-tail Moth.

In the two previous reports we have called attention to a fungous disease of the brown-tail moth caterpillars, which has been most effective in certain localities in holding this insect in check. This disease was abundant throughout the district in the summer of 1906, destroying the large caterpillars by the thousands, notably in the infested white oak woodlands, where nothing had been done in the way of the applications of hand methods. As a result, the numbers of moths emerging in midsummer from these woodlands was greatly reduced, and there naturally followed a consequent reduction in the degree to which orchards and shade trees were reinfested by the insect.

Still later in the fall of 1906 it was found that the disease had notably attacked the small brown-tail moth caterpillars, with the result that in 1907, although certain localities were generally infested by the moths, the condition of the entire brown-tail moth district in Massachusetts was greatly improved.

That our comparative freedom from the brown-tail moth plague during the year just closed was not due entirely to this disease is evident from the fact that in a few cities and towns where, because of local complications, the campaign against the insect was not vigorously prosecuted during the winter of 1906–07, there was a considerable amount of damage and annoyance caused by the caterpillars during the late spring and early summer. This fact alone is sufficient to indicate the wisdom of continuing the work against the moths by the use of those methods which have been tried and found to be effective.

During the spring of 1907, before any of the caterpillars had an opportunity to emerge, a large number of brown-tail moth webs were collected at various points in the district, to determine the death rate from the fungous disease, cold or other causes. At the suggestion of Prof. E. D. Sanderson, Durham, N. H., we also secured data as to the relative death rate on high land *v.* low land. The results so obtained are presented in the following table: —

Death Rate of Brown-tail Moth Caterpillars in Webs, 1907.

Locality.	Date collected.	Total Webs.	Total Caterpillars.	Highland.			Lowland.		
				Alive.	Dead.	Per Cent. Dead.	Alive.	Dead.	Per Cent. Dead.
Amesbury,	March 14,	25	10,936	5,806	475	7.6	1,413	3,242	69.6
Bridgewater,	March 28,	25	8,543	–	–	–	6,710	1,833	21.5
Chelmsford,	March 16,	25	9,508	3,229	1,887	36.9	935	3,457	78.7
Dracut,	March 16,	25	10,594	20	5,049	99.6	1,357	4,168	75.4
Georgetown,	April 14,	27	10,103	8,441	1,662	16.5	–	–	–
Lowell,	March 16,	24	9,162	1,437	3,481	70.8	2,227	2,017	47.6
Lynn,	March 5,	25	4,018	1,676	540	24.4	1,306	496	27.6
Marblehead,	March 5,	25	4,239	1,371	290	17.5	1,471	1,107	43.0
Marlborough,	March 16,	25	12,421	5,633	454	7.5	5,233	1,101	17.4
Middleborough,	March 28,	25	6,458	4,965	1,493	23.2	–	–	–
Nahant,	March 5,	25	4,706	4,347	359	7.7	–	–	–
Pembroke,	March 17,	13	2,396	–	–	–	486	1,910	79.8
Saugus,	March 10,	25	3,955	1,777	199	10.1	1,773	206	10.5
Stoneham,	March 10,	25	3,976	1,456	232	13.8	1,807	481	21.1
Swampscott,	March 5,	25	5,219	1,971	356	15.3	2,595	297	10.3
Wakefield,	March 10,	25	5,021	356	2,285	86.5	312	2,068	86.8
	–	389	111,255	42,485	18,762	30.6	27,625	22,383	44.7

Recapitulation.

Total webs examined,	389	Number alive, "lowland,"	27,625
Total caterpillars,	111,255	Number dead, "lowland,"	22,383
Average number per web,	286	Percentage dead, "lowland,"	44.7
Number alive, "highland,"	42,485	Total number alive,	70,110
Number dead, "highland,"	18,762	Total number dead,	41,145
Percentage dead, "highland,"	30.6	Percentage of total dead,	36.9

The Parasite Work.

Work in importing parasites of the gypsy and brown-tail moths has continued steadily during the year. The excellent corps of foreign collectors organized by Dr. L. O. Howard has made large shipments of parasitic material at frequent intervals throughout the year. All stages of the gypsy and brown-tail moths have been collected in various parts of Europe at the proper seasons, and forwarded by fast steamers to New York or Boston, at which ports arrangements with the United States customs authorities permit the prompt examination and forwarding to the laboratory. Egg clusters of the gypsy and brown-tail moths and winter webs of the latter insect have reached us usually in good order. The early stages of gypsy moth larvæ and the predaceous caterpillar-eating beetles have been shipped to us with a fair degree of success. The experiments in importing full-grown caterpillars and pupæ have not been entirely successful, but with the experience gained, particularly during the last season, we shall be able to improve our shipping methods greatly.

Early in the summer Mr. E. S. G. Titus of the Bureau of Entomology, specially detailed by Dr. Howard for the work at the parasite laboratory, was obliged, because of ill-health, to seek a new field of labor. During the period Mr. Titus was with us many valuable and important discoveries in connection with the imported parasites were made, and it is to be regretted that the severe and painful illness to which he was subjected because of the poisonous effect of the brown-tail moth hairs made necessary the loss of his services. The work he had in hand was promptly taken up by another of Dr. Howard's assistants, Mr. W. F. Fiske, who has shown great skill and ability in carrying on the necessary operations. Mr. Fiske's excellent work on forest and parasitic insects peculiarly fits him to deal with the important problem of propagating and disseminating the imported parasites of the moth pests. In giving us the benefit of his services Dr. Howard has again placed us under important obligations. During the summer months such large quantities of parasitic material were received from abroad that the services of a large number of assistants were required at the

laboratory. To meet this need a number of students from various colleges were employed, experience having shown that this class of help was particularly efficient. Our permanent force has been increased by the employment of Mr. Frederick B. Lowe, an entomologist favorably known in England and in western Australia, where he was actively engaged in the work of propagating parasites of injurious insects. It will probably be advisable to make further additions to the permanent force at the laboratory, as the work is now in such shape that a few well-trained entomologists can be profitably employed throughout the year. Now that we have a better knowledge of the most important species of parasites of the moths, more attention must be given to studying carefully the life history of these parasites and improving the methods for their propagation and dissemination. This work calls for a high grade of technical skill, and only well-trained entomologists should be employed.

The trip to Europe made by Dr. Howard last summer was more productive of valuable results than either of the two previous trips. Not only was he able to give important directions to collectors already employed, but he also secured the services of a considerable number of additional assistants, and arranged for the first time for the shipment of parasitic material from Russia, — a source of supply previously unexplored. The important details of his journey are given elsewhere in this report.

It was only too apparent during the summer season of 1907 that the facilities for work at the Saugus laboratory had become badly outgrown. The proper examination and rearing of the parasites requires absolutely tight rooms of considerable size, — a condition not available at the Saugus building; while the rapid accumulation of valuable parasitic material there emphasized the need of better fire protection. To meet this condition of affairs, a large house with ample grounds, at Melrose, Mass., close by a badly infested region, has been leased for a term of years. The building has been remodeled as far as necessary to fit it for our work, and two suitable outdoor laboratories, properly screened and ventilated, have been built under the direction of Mr. Fiske. Here excellent fire protection obtains, while the accessibility of the laboratory to the central office will effect a considerable saving in the time formerly required for forwarding shipments received from abroad.

All told, there were received during 1907 from our European agents, according to Mr. Fiske's notes, as follows: brown-tail moth, — webs, 111,473; larvæ and pupæ, 154,760; egg masses, 27,041; gypsy moth, — small larvæ, 48,000; large larvæ and pupæ, 143,950; egg masses, 262. Predaceous beetles were received as follows: *Calosoma sycophanta* and *inquisitor*, 1,911; *Carabus violaceus*, 54; *C. auratus*, 600.

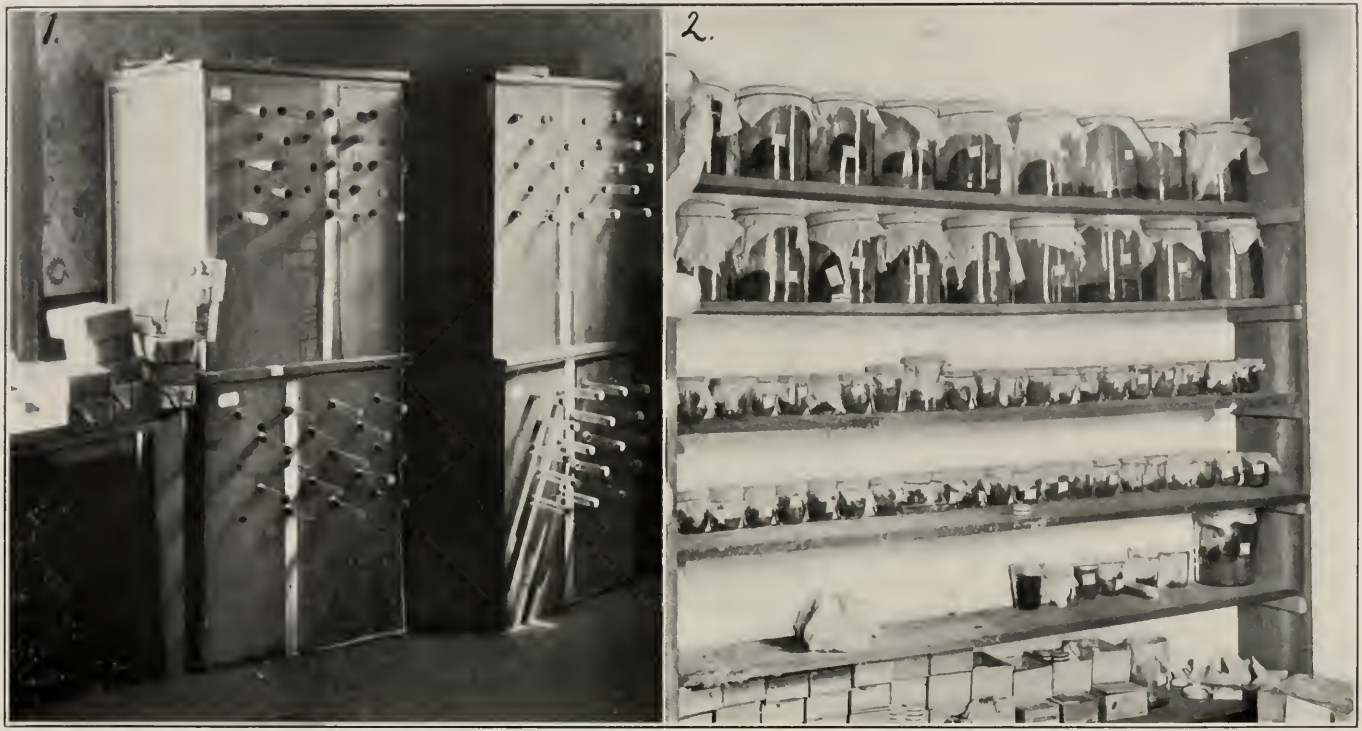
From the various forms of the gypsy and brown-tail moths imported there were obtained 485 specimens of *Pimpla instigator* and *examinator*, of which 251 were released in 1 colony; *Apanteles viminetorum*, 995 obtained, 410 released, 3 colonies; *A. fulvipes*, 3,065 (dead); *Meteorus sp.*, 433 obtained, 33 released, 1 colony; *Pteromalus egregius* and *nidulans*, 40,300 released, 7 colonies; *Telenomus* sp. 5,000 (estimated) obtained, 4,560 released, 4 colonies; *Trichogramma*, 11,600 released, 5 colonies; *Calosoma sycophanta* and *inquisitor*, 1,911 obtained, 578 released, 4 colonies. The very obvious discrepancy between the number of parasites obtained and the number released is principally due to the fact that a large percentage of the parasites died en route. With certain of the large forms, in which the males predominated, only mated pairs or fertilized females were released. Of the Tachinid parasites, we now have on hand in hibernation upwards of 15,000 puparia. The list of parasites bred from imported material during the year, as far as determined, has been furnished by Dr. Howard, as follows: —

HYMENOPTERA.

Rogas bicolor Spin.
Rogas pulchripes Wesm.
Habrobracon brevicornis Wesm.
Phanerotoma dentata Panz.
Schizopyga podagrica Grav.
Polysphincta multicolor Grav.
Spilocryptus incubitor Strom.
Apanteles viminetorum Wesm.
Apanteles fulvipes Hal.
Hemiteles areator Panz.
Hemiteles pulchellus Grav.
Phygadeuon perfusor Grav.
Pteromalus egregius Foerst.
Pteromalus nidulans Foerst.

DIPTERA.

Thryptocera sp. aff. *latifrons* Meigen.
Bigonichacta setipennis Fallen.
Bigonichacta spinipennis Meigen.
Pales pavida Meigen.
Compsilura concinnata Meigen.
Tricholyga grandis Zetterstedt.
Phorocera sp.



Parasite Breeding Cages and Jars. — Saugus Laboratory, 1907.

Dexodes nigripes Fallen.
Hemimasicera sp. aff. *ferruginea* Meigen.
Parexorista cheloniae Rondani.
Parexorista susurrans Rondani.
Parexorista gnava Meigen.
Parexorista sp.
Nemorilla sp.
Blepharidea vulgaris Fallen.
Blepharipa scutellata Rondani.
Argyrophylax gilva Hartig.
Argyrophylax sp. (*non galii* B. & von B.)
Chaetolyga sp. aff. *ciliicrura* Rondani.
Sisyropa lucorum Rondani.
Myxexorista libatrix Panzer.
Tachina larvarum Linne.
Tachina sp. (*non glossatorum* Rondani.)
Eupeleteria magnicornis Zetterstedt.

Report on Parasites, by Dr. L. O. Howard.

At our request Dr. L. O. Howard has prepared the following summary of his efforts in introducing parasites of the moths during the year just ended: —

United States Department of Agriculture,
Bureau of Entomology, Washington, D. C., Jan. 20, 1908.

Mr. A. H. Kirkland, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

Sir: — I have the honor to submit a brief report of my efforts during the period since I submitted my last report to you, on Nov. 24, 1906, to import the foreign parasites of the gypsy and brown-tail moths into Massachusetts.

Respectfully yours,
L. O. Howard, *Chief of Bureau.*

During the winter following the last report many thousands of nests of the brown-tail moth were received from agents engaged by me in different parts of Europe. These nests were cared for in the large breeding cages which had been found successful the previous winter, and from them large numbers of parasites were reared. They issued mainly during the month of May. As it happened, the month of May in New England, as well as in other parts of the United States, was phenomenally cold and wet. As a result of this unlooked-for condition, very many of the parasites refused to leave the nests until they were so weakened as to be unable to survive the close confinement and careful scrutiny to which they were necessarily subjected in order to eliminate the danger of introducing secondary parasites. As a result, a smaller number of this group (*Pteromalus*) was colonized than in the summer of 1906, but 40,000 specimens were put out in several localities, the principal colonies consisting respectively of 13,000, 11,000 and 7,000 individuals.

In this important work with the introduced hibernating nests of the

brown-tail moth it was early found most difficult to preserve the health of the laboratory assistants. The irritating and poisonous hairs of the brown-tail moth larvæ, of which the nests are full, soon penetrated the skin of the assistants handling them, entered their eyes and throats, and the atmosphere of the laboratory became almost filled with them. It was necessary that the rooms should be kept thoroughly closed; double windows and screens were used, and the doors of the rooms were darkened, in order that a possible secondary parasite, if accidentally liberated, should have no chance of escape. This made the rooms very warm, and increased the irritating effect of the larval hairs. Some of the assistants employed could not stand the work, and resigned. One of the best and most experienced helpers was induced to continue the present year only upon the promise that he would be relieved from this especial class of work. Spectacles, gloves, masks and even head-pieces were invented to avoid this difficulty, but these, while greatly increasing the suffering from the heat, were not entirely effective. The most serious result of this trouble was the breaking down in health of Mr. E. S. G. Titus of this Bureau, in charge of the laboratory at Saugus, who was obliged to resign in May, 1907, on his physician's advice, in order to save his life. The difficulty in Mr. Titus's case was the intense irritation to his lungs from the entrance of the barbed hairs. Mr. W. F. Fiske of the Bureau force in Washington, a man who had made especial studies of the parasitic Hymenoptera, and who had done a large amount of breeding of parasites in the course of his other work, was sent from Washington to replace Mr. Titus, and has since had charge of the laboratory. Since then new methods of handling the brown-tail moth nests have been invented, and it seems reasonably sure that this difficulty will be measurably obviated in the future.

I visited Europe again during May and June, 1907, and engaged new voluntary assistants among European entomologists, and succeeded in establishing a very effective corps of observers in Russia, — a country which has not before been called upon. At Kiew a very effective station was established, under the supervision of Prof. Waldemar Pospielow, who voluntarily gave his important services without compensation. An orchard in the suburbs of the city was rented for the season at 20 rubles per month, and a well-trained assistant, to have charge of rearings and collections, was engaged at 34 rubles per month. The results, as evidenced by shipments from this locality, have been excellent. Two species hitherto unknown as parasites of the gypsy moth have been reared, and one of them, being a rapid breeder, promises to be of much assistance. From Kiew I proceeded to Kischinew via Odessa, and started work under Mr. Isaack Krassilstschik, chief of the entomological station at that point, and he acts for the State of Massachusetts without compensation, sending in through the summer a number of important shipments. Returning to Odessa, and proceeding thence to Simferopol in the Crimea, I spent two days with Prof. Sigis-

mond Mokshetsky, director of the Museum of Natural History at that place. Professor Mokshetsky is a trained economic entomologist, well informed upon all American methods, and in the most courteous way volunteered his energetic assistance without compensation. From him also has been received during the summer important material. Returning by the way of Constantinople (where it was found impossible to secure assistance) to Vienna, later proceeding from Vienna to various points, including Dresden, Halle a. S., Berlin, Eberswalde and Zurich to Paris, I was able to give additional instructions to Fritz Wagner in Vienna, E. Schopfer in Dresden, Miss Marie Rühl at Zurich, and to engage the active co-operation of Dr. M. Holrung at Halle a. S., Dr. R. Heymons in Berlin, Dr. Carl Eckstein at Eberswalde and Prof. A. Séverin at Brussels. To each of these gentlemen I am greatly indebted for courtesies and advice, as well as active assistance. On the return trip to France I arranged with Mr. René Oberthür of Rennes for a regular station at Rennes, in charge of Prof. C. Houlbert of the University of Rennes, which will be in charge of an especial assistant chosen by Professor Houlbert. In this especial work I was assured of the good will and co-operation of the University of Paris by Prof. Alfred Giard.

As a result of this trip, much more material was received at the North Saugus laboratory than ever before, — so much, in fact, as to demand a great extension of laboratory space. Especial efforts were made to arrange for the importation of larger numbers of the egg parasites of both species, and to introduce in living condition the important parasites of the genus *Apanteles,* which, according to my field observations in Europe, are among the most important of the European enemies of the gypsy moth. Previous importations of these parasites had failed, owing to the fact that the adults emerged and died on the journey. The present year, however, specific directions were given to agents to send in young larvæ of the second stage, and by this means living specimens of the parasites in considerable numbers have been reared at North Saugus. These, on issuing, laid their eggs in the gypsy moth larvæ in their first stage, and from these were secured the cocoons and adults of a second generation, which was reared through all of its stages on American soil. It is hoped to repeat this experience on a more extensive scale next year, and thus to secure a very large number of the adult parasites for colonization.

An important result of this year's work has been a successful experiment in rearing from the imported brown-tail moth nests of a very large number of caterpillars which gave out in their later growth a second lot of parasites entirely different from those reared in May from the very young hibernating larvæ. Last year, after the May parasites had issued, the brown-tail larvæ were destroyed. Among the later parasites were at least two species of the genus *Apanteles.*

Another important result of the work of the early summer was the

rearing of a species of the genus *Meteorus* from the imported brown-tail moth nests. From the larger larvæ a second generation was reared after a very brief interval, the cocoons appearing in about ten days in cages in which the adult parasites were confined with their host insects. This indicates a very short breeding period during the summer time, and, although this parasite has not been reared in great numbers, its quick breeding indicates that it is a very desirable introduction. What is probably the same species was occasionally found in boxes in which the nearly mature brown-tail caterpillars were shipped, and a few emerged from some of these caterpillars, which arrived alive and in apparently a healthy condition. After the parasite emerged the larger caterpillars seem not to have been fatally affected, but all have died after transforming. The encouraging part of this introduction, aside from the quick-breeding habits, is our knowledge that a native species has been known to destroy 90 per cent. of the larvæ of a native moth infesting the western pines.

The egg parasites this year have been reared in considerable numbers from the brown-tail moth eggs, in lesser number from gypsy moth eggs. Two species have been reared and have been carried through several generations in artificially retarded egg masses. One is a Proctotrypid of the genus *Telenomus,* and the other a Chalcid of the genus *Trichogramma.*

In addition to the sending of brown-tail hibernating nests above referred to, during the fiscal year ending June 30, 1907, there was received from Europe a total of 1,375 boxes, containing the matured caterpillars and pupæ of the gypsy moth and the brown-tail moth. Of these, 872 boxes of the brown-tail were received during June, 1907, and 82 of the brown-tail and 425 of the gypsy during July and August, 1906. The percentage of parasitism varies considerably, according to the different localities from which the nests were sent, but it must be remembered that in these European localities the percentage of parasitism is constantly fluctuating, being smaller in some years and almost exterminative in others. A part of the parasites sent over do not emerge from the caterpillars or pupæ until after they arrive at the laboratory; others are found in the boxes in the pupal condition; and a few, especially toward the latter part of the season of sending, transform into adults and die on the journey.

Of these parasites, about 90 per cent. have been Tachinid flies, and perhaps 12 species have been reared from the two host insects, most of them being common enemies of both species. About 40 per cent. of these flies emerge as adults at nearly the time of the emergence of the moths of the species which they attack, while the remainder pass the winter in the pupal condition, emerging the following spring. Seventeen hundred adult Tachinids were colonized in July and August, 1906, and more than 2,000 during June, 1907. It is now obvious that a very large number will be on hand hibernating during the winter of 1907–08,

and the problem of caring for them is a serious one. They are considerably parasitized by hymenopterous secondary parasites, so that it will be necessary to keep them well protected, at the same time under conditions as near the normal as possible. At the close of the fiscal year between 6,000 and 7,000 puparia were already on hand. With one of the smaller species of Tachinids breeding experiments were very successful, and the species reproduced freely under these conditions, indicating that it will be the part of economy to handle it in this manner, liberating only after having bred large numbers.

The large predatory beetles of the genus *Calosoma,* referred to in previous reports, have been successfully introduced in considerable numbers. *Calosoma sycophanta* was discovered in several of the field colonies in the spring of 1907, having established itself, survived the winter and reproduced. It is a valuable importation, but whether it will prove in itself sufficient to reduce the numbers of the gypsy moth and the brown-tail moth to an appreciable extent is undetermined.

In the report for last year the writer drew particular attention to two species of the genus *Pteromalus,* small parasites of the super-family Chalcidoidea. Some 60,000 were reared in the early summer of 1906, and the great majority of them were liberated. That the species has established itself, at least temporarily, has been shown by the fact that specimens were bred in the spring of 1907 from nests collected in colonies of the year before. Throughout a considerable portion of the territory directly north of Boston, within which all of the larger colonies were planted last year, the caterpillars of the brown-tail moth died very generally from a fungous disease, and as a result there was a scarcity of the hibernating nests; therefore it was not considered desirable to collect for breeding purposes many of these nests, and it is confidently expected that the species will be found more abundantly in the collections of nests made this winter. Several new colonies have been planted in quite widely separated localities.

The difficulty of determining the exact names of these European parasites, nearly all of which are very common members of the European fauna, is scarcely to be believed. The two species of *Pteromalus,* for example, mentioned in the last report, have been a source of great difficulty. The writer was unable to find them represented in the large museums at Vienna, Dresden, Berlin, Brussels and London, nor did they occur in the type collections of Ratzeburg at Eberswalde, where, on account of that writer's important work on the parasites of European forest insects, one would naturally expect to find them. At last, in the Museum of Natural History in the Jardin des Plantes at Paris, specimens of both species were found that had been reared many years ago by the French entomologist Sichel, and had been named for him by the eminent authority on parasites, Arnold Foerster of Germany. They will therefore in the future be known definitely as *Pteromalus nidulans* Foerst. and *Pteromalus egregius* Foerst.

The naming of the Tachinids has been done by Messrs. Coquillett and Townsend of this Bureau, by Mr. Kértesz of the National Museum at Budapest, and by Dr. Handlirsch of the Royal Museum of Natural History at Vienna. Such of the Ichneumonids and Braconids as could not be named by comparison with the large museum series in Europe have passed through the hands of an eminent European authority, Prof. O. Schmiedeknecht of Blankenburg, Germany.

Purchases of Supplies.

The purchase of supplies for use in the work against the moth pests has been made by the local superintendents of each city and town, the cost of the same being certified to the central office on blanks furnished for the purpose. Each schedule of bills forming a part of the account on which the State reimbursement is based is required to be accompanied by receipted bills, and is duly attested by the city or town treasurer, as in the case of pay rolls. During the first year of our work, while the enforcement of the law was, as it were, in the experimental stage, the selection and purchase of supplies was largely left to the local authorities. It soon became apparent that widely varying prices were being paid for many articles, and that in some cases unnecessarily large sums had been paid for tools, insecticides, etc., thus reducing the amount available for labor. To systematize this feature of the work, a list of supplies needed in the field operations was prepared and submitted to a large number of responsible dealers, requesting bids from them, with the assurance that the lowest bidder would be recommended to the city and town authorities, for the particular class of goods offered. In this way we have been able to secure a notable reduction in the cost of the materials needed, and to furnish local superintendents with a list of dealers and prices at which the supplies could be obtained. Furthermore, this system has put all the municipalities on the same basis as far as tools, etc., are concerned. The local superintendents of moth work have also been instructed that they are at liberty to purchase their supplies of local dealers offering the same grade of goods at the prices given in the printed list.

Goods bought at prices in excess of the list are credited only at list price, unless some satisfactory reason to the contrary is given, such as emergency work, where delay might prove more

expensive than the excess cost of the supplies needed. To check up the itemized purchases of supplies used in the field has formed an important part of the work of the central office, and the controversies which have arisen from time to time where the superintendent has felt obliged to disallow certain items have been most unpleasant as well as undesirable.

Under the present system, while we have been able to make a notable saving through securing competitive bids, it is apparent that further economies might be made if all the supplies needed for the year's work were bought in bulk quantities. Burlap and insecticides, for example, can be bought cheaper in carload lots than when bulk shipments are broken by the dealer and shipped in bale or keg lots. Hose in lots of 10,000 feet can be bought closer than in 100-foot lots; a larger discount is given on axes by the gross than by the dozen or half dozen; and so on throughout the list. It is an open question in the mind of the superintendent if it would not be in the interest of economy for the department to establish a central warehouse at some convenient shipping point near Boston, buy the goods in large quantities, ship them on orders from the local superintendents, and charge same against the town or city ordering them; the supplies so furnished to stand to the credit of the State in computing reimbursements due. The superintendent is of the opinion that this plan is entirely feasible, and that, while adding somewhat to the duties of the central management, it would result in obtaining a better and more uniform class of supplies, and at more advantageous rates than now prevail. In the work against the moths, labor is the all-important item, and the amount saved in buying materials would then be available for increasing the number of employees in the field; while the benefit to the local organizations in being able to procure at short notice from a single source any supplies required needs but to be mentioned to be appreciated.

Recommendations.

As pointed out elsewhere, the largest problem in dealing with the gypsy moth now is found in the widespread serious infestation of the woodland. The pest is well under control in residential districts; it must be kept in this condition. To prevent

reinfestations of the sections already cleared, the woodlands must have most vigorous treatment. To continue the expensive operations now under way for the treatment of woodlands and the protection of the thickly settled districts, more funds than those provided by the appropriation made in 1907 for the purpose of continuing the 1908 work ($150,000) will be needed. In following up the plan made last May, when the full appropriation for 1907 became available, a considerable sum has been held in reserve for use in clearing woodlands the present winter. The large force of men now at work clearing private estates and street trees will be transferred to woodland work whenever snow interferes with the efficiency of the work now in progress. In Waltham, Lexington, Woburn, Burlington, Wakefield, Reading, Lynnfield, Saugus, Peabody, Beverly, Manchester and elsewhere there are most serious woodland problems to be dealt with. Other towns, like Georgetown, Concord, Lincoln and Brookline, — to mention but a few, — have woodland infestations that should be thoroughly treated without delay, to prevent their increase.

The work of importing parasites, while requiring much time and patient effort, is now well organized, and important results have been obtained in establishing in Massachusetts certain natural enemies which are known to be important checks on both species of moths in their natural regions in Europe. How long it may be before these parasites show effective results in the field, no one can accurately predict; it may require five or ten years, it may not require two years. The work is a very large experiment, with very great prospects of success. In view of the relatively small expense required to continue the operations now under way, — small, indeed, compared with the great cost of field work, — suitable provision should be made for further importing and studying the parasites of the gypsy and brown-tail moths.

Owing to the peculiarly hazardous nature of the field work against the moths, involving, as it does, much climbing of tall trees, the superintendent early advised the cities and towns to insure their employees against accidents, and further to insure against accidents to the persons and property of the public through falling of apparatus, branches of trees and the dropping

1, Assistants at Work on Brown-tail Moth Webs under Glass Case.

2, Breeding Cages in Outdoor Tent. — Saugus, 1907.

of creosote or other insecticides necessary in the work, — experience having shown that such accidents were of frequent occurrence. It is greatly to be regretted that several employees are killed and from 20 to 25 seriously injured in this work annually. When such accidents can be shown to be due to defective apparatus, the municipalities may become liable to legal action, followed by heavy damages, and the latter would fall heavily on many towns of low valuation. For this reason the superintendent, until the matter was officially ruled upon by the Honorable Auditor of Accounts, had approved the premiums paid for insurance covering these expenses along with other expenditures as a basis for reimbursement by the State. The question having arisen whether such an expenditure might properly be included as a basis for reimbursement, the matter was officially submitted to the Honorable Auditor of Accounts, Henry E. Turner, who ruled, under date of July 9, 1907, that: —

> Since the language of the law apparently limits the purposes for which the money can be expended and reimbursement be made by the Commonwealth, I must, therefore, decide that contingent expenses and accidental damages cannot be taken into account in establishing a basis for reimbursement. Allowances for damages caused by spraying must be a matter to be determined by each municipality in its dealings with its citizens; and while I believe it wise action on the part of cities and towns to insure themselves against their liability as employers in such hazardous work as is done by employees in the gypsy and brown-tail moth departments, certain other departments of said cities have equally hazardous work, and the matter of insuring is one for each municipality to determine for itself, as is the case in other forms of insurance.

If, in the opinion of the Legislature, the premiums paid for liability insurance should be included as a basis for reimbursement on the part of the State, the act should be so amended as to specifically include this class of expenses.

In treating the gypsy moth infestations, particularly in woodlands, it often becomes necessary to remove or thin standing trees. The suppression of the moth is of such manifest benefit to the property owners that as a rule they are very glad to have work of this kind done, and often co-operate freely in its execution. Occasionally cases occur, however, when claims for loss or damage have been set up, although as far as is known to the

superintendent none have taken the form of a suit against the municipality in which the work was done. The superintendent is of the opinion that legislation should be enacted to recognize the possible rights of property owners to compensation where it becomes necessary to destroy such property. If such an amendment to the existing laws, permitting compensation, is enacted, there should also be taken into account the benefits derived by the property owner through the work of having the moth suppressed on his property.

Under existing legislation, the property owner receives a notice requiring him to clear the moths from his estate, and a reasonable period is allowed him in which to do the work, the date of notification usually being November 1, and the expiration of the time limit December 1 or January 1. While employees of the central and local organizations now have the right to enter upon all lands for the purpose of suppressing the moths, it has been held by one judge of a municipal court and by eminent lawyers that under the law local employees of cities and towns have no legal right to enter on lands during the period given their owner in which to clear them of the moths. This matter is of small importance except in the work of scouting or inspecting property, to determine if either of the moths are present. A few stubborn property owners now prevent a thorough inspection of a town or city by refusing the local employees admittance to their grounds during the time allowed for clearing the trees. When the time limit expires, the trained scouting gang may be miles away, and must be brought back at a considerable expense to complete the work. Since the fall and winter scouting furnishes the data on which is based the plan for future work in any town or city, the difficulty above described should be removed by an amendment to the existing legislation.

Summary of Recommendations.

1. For the effective prosecution of the field work against the gypsy and brown-tail moths, an additional appropriation of $150,000 is recommended for the fiscal year of 1908.

2. To continue the work of importing and breeding the nat-

ural enemies of the gypsy and brown-tail moths, the superintendent recommends an appropriation of $15,000.

3. An amendment to existing legislation, clearly giving properly authorized employees of the central and local organizations, while engaged in the work of suppressing the moths, the right to enter on property at all times, is desirable.

4. The superintendent also presents for your consideration, but without specific recommendations, the questions of insuring employees engaged in the moth work; the desirability of establishing a central storehouse of supplies; and the compensation to property owners when it becomes necessary to destroy property of value in connection with the field operations. These latter matters are treated elsewhere in this report, and the superintendent believes that the action desirable with reference to them can best be determined by a frank discussion of the several subjects by the parties in interest before the proper committees of the Legislature.

Respectfully submitted,

A. H. KIRKLAND,
Superintendent.

SPECIAL REPORT ON IMPORTING PARASITES.

By A. H. Kirkland, *Superintendent.*

The study of insect parasitism opens up one of the most interesting fields in the whole domain of nature, — a study full of interest and surprises, and often of great practical value in its results. Nearly every insect has enemies of its own kind, remote relatives, they may be called, which prey upon it and attempt to destroy it. The result of their work is shown by the abundance or scarcity of their unwilling hosts. We note that some years are "caterpillar years," for example, and that others are not. The abundance or scarcity of any caterpillar depends in large measure upon the presence or absence of the parasites which attack that particular insect. Other factors, such as the work of insectivorous birds, bacterial and fungous diseases, also play an important part, but the influence of insect parasitism in the long run controls the situation.

The army worm, a pest of grass and grain fields, gives a good illustration. This insect at long intervals appears in tremendous numbers, only to disappear for many more years. It is notably attacked by a certain fly, which lays its eggs on the "worms," these eggs in turn hatching into grubs, which enter the bodies of their hosts and kill them. When the worms are abundant, there is offered a wealth of food for the parasites. They multiply prodigiously, destroy their hosts, and in a season the army worm outbreak becomes a thing of the past. The following year there is a multitude of parasites, and but little food for them.

As a result, the parasite flies die off; the few remaining army worms increase slowly in swamps and along the banks of streams, until after the lapse of years their numbers are sufficient to lay the foundation for another army worm outbreak, and this in turn is followed by the development of a multitude

Original Packages of Parasitic Material from Abroad.

of parasites, which check it. This shifting relationship is an illustration of the "balance of nature," so called, — the tilting adjustment of an insect to its enemies.

The canker worm and tent caterpillar are equally good illustrations, except that the period of their ravages often extends over two or three years before it is checked. Practically the same thing holds good in Europe, with the two notable imported caterpillar pests with which we in New England, particularly in Massachusetts, are contending, — the gypsy and brown-tail moths. The mid-temperate zone of Europe is their natural home. Wherever the apple, pear and oak flourish, there they may be found. They do not occur in the frozen north; they are not found in the tropics; but in the life zone mentioned their periodical ravages are notable, and equally notable is the fact that, no matter how severe may be their attacks on orchard and forest trees, in a given year they soon subside and for many years the insects are harmless, if not practically unnoticed. This state of affairs is brought about by the same controlling influences that govern the army worm, the canker worm and the tent caterpillar in America; viz., the silent but mighty work of parasitic enemies, which soon develop in multitudes wherever the natural host is abundant. This increase of both these important enemies of fruit and forest trees is eventually checked and their ravages stopped by their parasites.

While the work of exterminating the gypsy moth in Massachusetts was in progress from 1890 to 1900, no effort was made to secure the importation of parasites, since from the very nature of the case such an effort would be an anomaly. The former State work was for absolute extermination. Parasites require a host to feed upon, and the State was bending all its energies to absolutely destroy the host. When the work was stopped in 1900 the case became an altogether different one. It was known by those best qualified to judge that the moth was bound to increase and spread, and that after a few years control measures would be the only ones available to protect our trees; hence the desirability of employing every such measure possible was apparent. Among these none seemed to offer greater promise of aid than the importation of the parasitic and predaceous enemies of the moths in their native home. The moth pests in Europe

were under many natural checks. Transported across the sea, freed from all natural restraints on their multiplication, they had increased to greater numbers and caused greater damage than had been known in the old world. Hence the logical thing to do under the circumstances, in addition to remedial measures to stop the damage by, and check the spread of, the insect, seemed to be to bring to Massachusetts as many as possible of the foreign natural enemies of the moths in the shortest possible time. This view, strongly presented to the Legislatures of 1903–05 by many intelligent and public-spirited citizens, finally resulted, in the latter year, along with the resumption of the work against the moth, in a special appropriation for the purpose of introducing the European natural enemies of the moths. At the same time the Massachusetts delegation in the National Congress, particularly the Hon. Ernest W. Roberts of the Seventh District, were endeavoring to obtain national aid in solving this great problem, since it was realized by all who were familiar with the ravages of the moths in Massachusetts and the cost of combating them that could they be held in check by their imported natural enemies, such a state of affairs would scarcely fall short of being ideal. The National Congress finally appropriated the small sum of $2,500 for this work, and this was soon followed by the more liberal action of the Massachusetts Legislature, which appropriated (May 8, 1905) for the same purpose $30,000, to be expended as needed over a period of three years.

When the present superintendent was appointed, with this large sum of money at his disposal for this special work, he fully felt the responsibilities as well as the opportunities of the occasion. Nothing of the kind had ever been attempted before in the world. True, indeed, two imported scale insects in California had been notably checked in their increase by the importation of parasites from their native region; but each of these insects had a *specific* parasite. The case of the gypsy and brown-tail moths is altogether different. There is no *specific* parasite of either of these insects. Their multiplication is checked by a large number of parasites, many of which apparently may be of equal value. It seemed desirable, in fact absolutely necessary, that this unique and important experi-

ment — for it was and is yet an experiment only, in a new field — should be placed in the hands of a man of the highest technical training, with experience in this particular class of work, and wide acquaintance with European entomologists and the entomological conditions of that country. From a somewhat extensive acquaintance with American workers on insect parasites, there seemed to the superintendent to be but one man equal to this work, viz., the recognized American authority on parasites, Dr. L. O. Howard, Chief of the Bureau of Entomology of the Department of Agriculture at Washington, D. C. Dr. Howard is without question the best-known worker on certain important groups of parasitic insects, has had large experience in their successful importation and dissemination, and, what in this case is most valuable, has a wide acquaintance with the entomologists of Europe. After a conference with Governor William L. Douglas, who heartily approved of the arrangement, the superintendent visited Washington and secured the consent of the Honorable Secretary of Agriculture, James Wilson, as well as that of Dr. Howard himself, that the latter should supervise and direct the work of importing parasites of the moths to Massachusetts.

The arrangement made was substantially that Dr. Howard should direct the work, organize and care for European collectors, and furnish one or more assistants at the Massachusetts laboratory; that the State of Massachusetts should finance the operations, provide laboratory and supplies, and as many assistants as were needed to attend to the work of breeding and disseminating the parasites. In this way the cordial co-operation of national and State governments under the best possible conditions was secured, and this hearty co-operation has continued to the present time.

Dr. Howard immediately left for Europe, and engaged a number of collectors of parasitic material; while the superintendent organized and equipped a suitable laboratory for its proper care. Dr. Howard's European trip was repeated in 1906 and again the present year, each time with increasing success, until now we have some forty or fifty foreign collectors at work gathering material in all important sections where the moths are known to occur. The laboratory, first established in Mal-

den, was transferred in the fall of 1905 to the wooded and badly infested section of North Saugus, where the work was carried on during the seasons of 1906–07. It being well demonstrated the present fall (1907) that the Saugus building had become outgrown, by reason of the large number of employees necessary during the busy season and by the lack of certain almost indispensable requisites, arrangements have now been made for a larger and more convenient building at Melrose Highlands.

As might be expected, methods of packing and shipping the insects so that as many as possible of them should reach America alive was one of the first details to require attention. The shipments of 1905 were of little value; in 1906 a very large amount of material arrived in good condition, and upward of 54,200 parasites and 850 predaceous beetles reached us alive, and a large part of them were liberated in infested districts. The figures for 1907 are not completed as yet, but the number of living parasites was larger and of a much richer variety than for 1906. As 1907 draws to a close, we can safely say that at least two, if not more, of the species liberated in 1906 have thoroughly established themselves in this country, and are at work on American gypsy and brown-tail moths. A certain minute parasite determined by Dr. Howard as belonging to the genus *Pteromalus,* which attacks the small brown-tail moth caterpillars in the fall, later hibernates in their webs, and attacks them and also the small gypsy moth caterpillars the following spring, was liberated in very large numbers in 1906. Webs collected in the winter of 1906–07 in the localities where these insects were allowed to escape in the spring of 1906 contained a substantial number of the *Pteromalus,* thus showing that the insect had established itself.

Again, in all European literature particular stress is laid on the value of a certain predaceous beetle, *Calosoma sycophanta,* as an enemy of the gypsy moth caterpillars. This large beetle climbs the infested trees, seizes the caterpillars and devours them. There is hardly a European treatise on the gypsy moth but mentions and praises the good work done by this rapacious insect. Prof. C. H. Fernald tells the writer that some years ago, when he was in the Thiergarten at Berlin, it was a very

1, Parasite Breeding Jars. 2 and 3, Parasite Boxes just received from Abroad.
4, Opening the Boxes and Sorting their Contents.

common occurrence to see large gypsy moth caterpillars drop to the ground under the trees with the Calosomas firmly attached to them. In the "plantings" of this beetle in 1906 the insects were carefully marked, by Dr. Howard's direction, with white enamel paint. This year in the same localities several bright, fresh-colored specimens, *without* paint marks, were taken feeding eagerly on the gypsy moth caterpillars, while later numerous larvæ or young of the beetles were so found, thus showing that this valuable check on the larvæ had become well established in many localities. In addition to this, a large number of species of every parasitic form has been liberated, and we have reason to believe that several of them have now become established.

In order to give an adequate idea of the scale on which this work has been conducted, the following summary of the expenditures by the State of Massachusetts for this purpose during the period covered by this brief report, June 1, 1905, to Nov. 30, 1907, will be of interest: —

Receipts.

Appropriations, 1905,	$10,000 00	
Appropriations, 1906,	10,000 00	
Appropriations, 1907,	25,000 00	
		$45,000 00

Expenditures.

Wages of employees,	$8,902 50	
Travelling expenses,	3,805 80	
Rent,	746 00	
Supplies,	2,442 18	
Stationery and postage,	68 37	
Services of experts,	2,116 28	
Sundries,	1,001 33	
Importation of parasites,	15,591 66	
		34,674 12
Balance Nov. 30, 1907,		$10,325 88

In spite of all the thought, energy and skill that have been brought to bear on this most important problem of introducing the natural enemies of the moths, — a problem entirely novel in the field of entomology, — it was apparent during the winter of 1906–07 that several of our influential citizens had expected immediate results from the importation of the parasites, and

were beginning to get restive because such results had not been obtained. Several expressed a doubt if everything possible was being done to secure the successful introduction of the parasites. Others became enthusiastic over the specious proposition put forward by a certain western horticulturist (not an entomologist), who offered to suppress the gypsy moth in Massachusetts by means of parasites for the sum of $25,000, — " no cure, no pay." This state of affairs was no doubt a natural outcome of the desire to avoid a repetition of the great damage to property caused by the moth in past years. Again, men without any technical knowledge of entomology or of the life histories of the parasites, not realizing the difficulties in securing, shipping, breeding and disseminating these beneficial insects, and equally ignorant of how long it takes an imported insect to become established even under the most favorable conditions, might well be pardoned for expecting almost immediate results from the introduction of the relatively small number of parasites, — small indeed in comparison with the tremendous numbers of the moths.

These citizens expressed the feeling before the Legislative committee that we were not going ahead fast enough in this important work, and desired that the superintendent secure additional counsel and advice in the matter, to determine, if possible, whether the best lines of procedure were being followed, and for this purpose an additional appropriation of $15,000 was made available. It was first suggested that consultation be had only with certain California men who had had experience in the matter of importing parasites of scale insects. The superintendent, however, pointed out that such a reference of the matter to those whose experience had been confined to a single group of insects (not caterpillars), while no doubt helpful, would not be sufficiently broad to throw much light on the Massachusetts problem in dealing with the moth pests.

It seemed to him much wiser and certainly more thoroughgoing, since this entire work might be called in question at any time, and in view of the large amount of money Massachusetts was expending in securing parasites, to consult not with the trained entomologists of a single State, but with as many entomologists of national or even world-wide reputation as possible.

In other words, that a large number of entomologists of the highest possible scientific standing, and particularly those having practical experience in dealing with parasitic insects, should be invited to visit Massachusetts, learn of our difficult problems on the spot, examine into the methods of importing, rearing and distributing parasites, and then give us the benefit of their criticism and counsel, based on a full knowledge of the facts at hand. He also suggested that, since by some this movement might be taken as a criticism on his management and on his judgment in placing the direction of the work in the hands of Dr. Howard, it would be well to have some outside board or commission take charge of the matter, so that it should be entirely an *ex parte* affair, free from any suggestion of influence by the present administration of the work. The suggestion to authorize the superintendent to invite the entomologists was heartily endorsed by the legislative committee which had the matter under consideration, while the arrangement of the entire affair was left in his hands.

After looking over the list of prominent entomologists of other countries, and conferring with Prof. C. H. Fernald at Amherst, Mass., the list given below was made up. There are numerous other workers in this field of science, who from training and experience would no doubt be equally able to render competent opinions and give sound advice, but it is believed that the list is a thoroughly representative one. Those invited from America were: —

Prof. Edward M. Ehrhorn, Deputy Commissioner of Horticulture, State of California, a man of large practical experience in importing, breeding and disseminating insect parasites, particularly those of scale insects, and also a man well trained in applied entomology.

Prof. Herbert Osborn, Ohio State University, one of the country's best known teachers of entomology, and of large experience in investigation and laboratory work.

Dr. John B. Smith, Entomologist, New Jersey Agricultural Experiment Station, an investigator of the highest order, a successful teacher and the author of numerous standard works on insects.

Prof. S. A. Forbes, State Entomologist, Illinois, a most successful teacher and investigator and one of the most prominent entomologists of the middle west.

Prof. E. P. Felt, State Entomologist of New York, a well-known

writer on and investigator of insect pests, and particularly ingenious in devising laboratory methods.

Prof. H. A. Morgan, Director of the Tennessee Agricultural Experiment Station, of large experience, and one of the best-known entomologists of the southern States.

Prof. M. V. Slingerland, Cornell University, New York, an investigator hardly without an equal, and one who has had great success in studying life histories of beneficial and injurious insects.

Naturally, we have sought among foreign entomologists, particularly those familiar with the moth pests, and those of practical experience in importing parasites for the largest measure of help, and in so doing have been particularly fortunate in securing the counsel of some of the best known workers in other countries. The list includes: —

Prof. Charles P. Lounsbury, Entomologist, Cape Town, South Africa, one who has had great experience as well as great success in importing beneficial insects.

Prof. Walter W. Froggatt, Government Entomologist, New South Wales, and also investigator for Victoria and Queensland. Professor Froggatt's work has been practically along the same lines as that of Professor Lounsbury, and has met with a large measure of success.

Dr. James Fletcher, Dominion Entomologist, Canada, well known for his success in working out difficult points in the life histories of insects, and more particularly in dealing with a wide range of injurious species.

Prof. R. Blanchard, University of Paris, and member of the Academy of Medicine.

Dr. G. Horvath, Director of Zoölogical Section, National Hungarian Museum, member of the Academy of Science of Hungary and formerly Director of the Entomological Station of Hungary. The last two gentlemen are entirely familiar with the two moths and their parasites.

Dr. Richard Heymons, Extraordinary Honorary Professor and Custodian at the Zoölogical Museum of the Royal Institute of Berlin. Dr. Heymons has made a large study of the injurious insects of central Europe, and particularly of their natural enemies.

Prof. A. Séverin, Conservator at the Royal Museum of Natural History of Belgium, and member of the Superior Council of Forests. Professor Séverin's position is naturally that of one of the best-posted entomologists, particularly with reference to dangerous forest insects.

It will be seen from the foregoing that the work of importing parasites of the gypsy and brown-tail moths in Massachusetts

1 and 2, Outdoor Tents and Breeding Houses.
3, Breeding Cages in Outdoor Tent.

has been thoroughly examined by practically a congress of the world's leading entomological experts. And it is believed that their consensus of opinion, which is, in the main, that everything possible to secure the successful importation of these insects is being done, will be taken as authoritative and final. It would seem that the last word has been said on this matter, and that there should be no further occasion for that kind of adverse criticism, whose sole effect is to harass those who are giving their best thought and most sincere effort to the accomplishment of the desired result. Destructive criticism of scientific work, by the amateur or dilettante, is absolutely valueless. Constructive criticism, such as these reports make on certain minor details of this important work, is helpful, and of public good. Wherever in the reports of visiting scientists helpful and practical suggestions have been made, they will be adopted, and applied to this great problem as soon as opportunity permits. The expert opinions follow.

REPORT OF PROF. CHARLES P. LOUNSBURY,

GOVERNMENT ENTOMOLOGIST OF THE COLONY OF CAPE OF GOOD HOPE, SOUTH AFRICA.

LONDON, ENG., Aug. 19, 1907.

Prof. A. H. KIRKLAND, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

SIR: — In response to your request that I examine into the work of introducing insect natural enemies of the gypsy and brown-tail moths, during my visit to America, and that I submit to you a memorandum conveying my opinion of its organization and management, and also making any comments or criticisms which might prove helpful, I take pleasure in reporting as follows: —

For the purposes in view, I paid three visits to the parasite laboratory at Saugus: one in late April, one about the middle of June and the last in early August. On the first occasion I discussed the work in detail with Mr. E. S. G. Titus, then the federal officer in immediate charge of the introductions; and on the two latter I had similar converse with Mr. W. F. Fiske, the federal officer now in charge. I was in the company of Assistant Superintendent Worthley on the first trip, and from him gleaned a fair notion of the position as a whole in regard to the pest as it stands at present; and more was learned later from yourself while motoring through a large section of the most infested area. On my last visit to the laboratory I was accompanied by Professor Fernald and yourself. Altogether, I think I have obtained a

comprehensive and fairly accurate knowledge of the position. I may mention that I was not an entire stranger to the gypsy moth problem. In 1891 I had direct connection with the extermination work carried on under Mr. E. H. Forbush; from 1892 to 1895, as assistant to Prof. C. H. Fernald at Amherst, I was kept in touch with the operations conducted in that period; and though since 1895 resident in South Africa, the problem of the pest has continued to interest me. The control of injurious insects by introduced natural enemies is also a subject which has long interested me, and one to which I have given much time and thought. South Africa, like California, suffered severely by the cottony cushion scale (*Icerya purchasi*), and found relief with the introduction of the Australian ladybird (*Novius cardinalis*). My office is now concerned with the introduction of parasites for the red scale and codling moth, brought to notice by Mr. George Compere; and a few years ago I obtained for California *Scutellista cyanea,* the now famous parasite of the black scale.

In my opinion, the project of securing the establishment in Massachusetts of the leading over-sea insect natural enemies of the gypsy and brown-tail moths is unreservedly commendable from the standpoint of public economy; and I think that in the public interest the work now undertaken should be kept up *continuously* under the ablest supervision procurable, and with unstinted funds, until the object appears to have been attained, or until it is established beyond any doubt that there are insurmountable difficulties to success. I do not think hope of getting efficient enemies should be abandoned even should a decade of continuous endeavor yield little positive result. But if the present standard of work is faithfully maintained, I shall be surprised if gratifying success is not attained well within that time, and I deem the chance of failing to secure good results ultimately commensurate with the expenditure only a remote possibility. So confidently do I look forward to efficient parasites being finally established successfully, that I regard the parasite phase of the work of your office more important than any other feature, however necessary measures undertaken are to the preservation from almost certain destruction of almost innumerable valuable trees. To my mind, the introduction of natural enemies of the pests is a work of priceless and permanent value, and no lack of funds should at any time be allowed to interfere with its prosecution to a finish.

It seems to me quite reasonable to expect that by the successful establishment of natural enemies both the gypsy and brown-tail moths will before many years be brought to a degree of subjection similar to that which exists in the over-sea countries of similar climate where they are indigenous. They may both continue to be reckoned as "pests" and in abnormal years may bring about serious defoliation of favorite food plants, unless what are termed "artificial" measures are practised against them. It is quite probable that at the best they will give more trouble than the tussock moths, tent caterpillars and canker worms; at

any one acquainted with their prodigious potentiality for damage under present circumstances will appreciate that the improvement in conditions here suggested would be enormous, and of inestimable value. Some persons fear that the insect natural enemies which may be obtained will fail to adapt themselves to the New England climate, and therefore prove of little practical utility. The gypsy moth, however, is known to occur in Europe and Asia over an immense area in many parts of which the climatic conditions must be quite as rigorous as they are in New England; and that it is nowhere else the formidable pest that it has proved in New England may be reasonably attributed to its insect enemies. Should it appear in a few years that the leading European parasites give no promise of efficiency, I think that arrangements should be made to try parasites from eastern Asia. The vastly greater difficulties of getting material in a satisfactory condition to Massachusetts from the latter part of the world than from Europe naturally make it advisable that European sources of supply be exhausted before much time and money are expended there; and, besides, parts of European Russia that are now being exploited experience almost if not quite as severe a climate as New England.

The plan which has been devised to obtain parasitized material from over-sea and to rear and breed from it in America appears to me to be exceedingly praiseworthy, both in general arrangements and in details. I have no suggestion to offer for its improvement, further than that more trained entomologists, if they can be procured, be employed in the laboratory and breeding work, and that lay assistants who are valuable through natural inclination for their work and by acquired experience be encouraged to remain from season to season by liberal wages, and, when necessary, continuous employment. Work of such great and permanent importance to the State and nation should not be allowed to suffer through any lack of expert assistance; and it seems to me preferable, on the ground of ultimate economy, to have highly paid qualified men for months together doing work for which their special skill and knowledge may not be of practical advantage, rather than that such men be wanting at critical moments, when their services may be necessary to insure proper treatment of some parasite. As in many respects the work undertaken is entirely without precedent, and as by its nature it bristles with minor technicalities, unforeseen problems that demand immediate solution by specialists in entomology may arise at any moment. Incidentally, if trained entomologists are engaged on the details of this unique work, the science of entomology will benefit to no mean extent. Such men would observe and record innumerable hitherto unknown particulars regarding the insects handled that would quite escape the attention of others; and, while it is true that such information might have no immediate practical significance, occasions might later arise when they would elucidate problems that would otherwise prove difficult and expensive.

The arrangement whereby the federal Bureau of Entomology secures

the co-operation of entomologists and collectors abroad in obtaining material and making helpful observations, is, to my mind, wise and admirable from all points of view. One advantage lies in the fact that the successful establishment of natural enemies may speedily remove to a very great extent the necessity for the control measures at present practised, and thus throw the staff now engaged out of employment. If State employees alone were concerned, and all that is hoped for from natural enemies not be realized speedily, it might be argued plausibly, though utterly without truth, that the lack of success was due to failure being in the private interest of the parties supervising the work. Such an argument might lead to a serious delay in getting an appropriation, and jeopardize such progress as had been made. Because officers of the federal Bureau have nothing to gain by a continuance of the pests, and on the other hand will achieve much honor in their branch of science if through their assistance these pests are brought under the control of natural checks, their entire honesty of purpose cannot be questioned. Another advantage in having federal aid is the prestige it secures in dealing with the helpers abroad. Personal experience leads me to emphasize the fact that foreigners as a whole are more inclined to stand on etiquette than Americans, and it is nearly always desirable, in approaching them for assistance on any public matter, to be able to represent one's mission as connected with the highest power, the central government, and to have credentials to that effect. The fact that the United States is not one country, but "many in one," is not well understood over-sea; and service on behalf of the State might be half-hearted, when on behalf of the nation it would be eagerly rendered. For the reasons given, the State is, I think, fortunate in having secured federal aid in the form it has; and it is particularly fortunate in that Dr. Howard, the Chief of the Bureau of Entomology, is giving the subject his personal attention, — he having been to Europe during three successive seasons for purposes of investigation, and to arrange with numerous parties for the collection and forwarding of material from various localities. Dr. Howard has long been a leading authority on certain groups of parasitic insects, and, by virtue of his occupancy of the foremost position in economic entomology in the world, he is better known amongst foreign official entomologists than any other American entomologist; and much that has been simple for him to accomplish in organization would, I feel sure, have proved difficult to any one else to whom the task might have been entrusted.

While in the west a few weeks ago, I heard that Hon. Elwood Cooper, Horticultural Commissioner of California, had been in extensive correspondence with interested parties in Massachusetts with reference to natural enemies of the two pests concerned, and that he made an offer, a few years ago, to have an effective parasite for each found and introduced for a specified amount. It was his intention, I was told, to have Mr. George Compere, a professional searcher for insect natural enemies,

now engaged jointly by California and West Australia, assume the undertaking. Mr. Cooper probably felt, and may still feel, that Mr. Compere is better fitted than any other man in or out of America for such a task, and he doubtless made the offer in full sincerity and believing that its acceptance would be in the best interest of Massachusetts; yet all who have studied the gypsy and brown-tail moth position in America and abroad, and have much knowledge of Mr. Compere and the work he has done, must realize that the nonacceptance was fortunate. Mr. Compere's extensive experience in searching for natural enemies of various insects would not be of much value if applied to the problem of suppressing these caterpillar pests. It is not as if the original home was unknown, and as if a single species of parasites from there was thought likely to prove capable of suppressing the host. The gypsy and brown-tail moths are known to be indigenous in Europe, and both were studied there by entomologists long before they reached America. It has been found that numerous species of parasites of several distinct groups attack them; and, as there is no way to determine which of these enemies is most effective without extensive rearing work, and as in all probability several species together will answer the purpose better than any one alone, it is certainly advisable to try to get all that seemed promising, as is being done. Under Dr. Howard's organization, presumably parasitized specimens in large numbers are obtained from widely separated parts of Europe through the aid of many expert collectors resident in and familiar with the districts in which they work. This plan is incomparably superior to having Mr. Compere collect alone, however excellent a collector he may be; and, no matter who collects, reliable experts are required in America to rear out and breed the parasites, and to see that no injurious insects are incidentally introduced. It may be contended that Mr. Compere, because of his lengthy experience at collecting in foreign countries, should be better qualified to organize and supervise a collecting force abroad than Dr. Howard, whose chief work for some years has been in an office at Washington; but any one who knows both men would not for an instant doubt Dr. Howard's vast superiority in this field, even irrespective of the considerations discussed in foregoing paragraphs. Ability to impress foreign entomologists favorably seems an essential factor for satisfactory progress, and such ability involves a high degree of education, scientific standing, tact and judgment. I make these remarks because there seems a chance that well-meaning but ill-informed parties may yet insist that he be engaged for the work, and thus occasion a needless flood of discussion and perhaps costly delay in getting an appropriation to continue with the scheme as now arranged. Mr. Compere has many qualifications for obtaining natural enemies. He has had a unique experience in transporting insects on long journeys, is a good collector, a tireless and industrious worker in the field and a keen natural-enemy enthusiast. His unbounded faith

in there being effective enemies somewhere for every insect pest may have considerable value in connection with the problems upon which he is engaged for California and West Australia; but I am convinced, as I have said above, that these qualities would have little value in dealing with the collection and establishment of enemies for the gypsy and brown-tail moths.

In discussing the position as a whole with others, I have heard the criticism made frequently that the officials who have been concerned with the fighting of the pests were grossly negligent in not long ago taking action to obtain natural enemies. I myself think it a great pity that steps were not taken when State work first began; but considering the circumstances, I do not feel that any blame attaches to the officers. It was known that in Europe the gypsy moth committed great ravages from time to time, despite its natural checks; and hence its total extermination was adjudged worth a large expenditure, and vastly preferable, all things considered, to accomplishing its suppression. The aim of the operations was made to eradicate the insect absolutely, and this project was considered feasible by the leading entomological experts of the States. To trouble with natural checks seemed quite unnecessary, — indeed an uncalled-for waste, since before the time in which the most sanguine would have expected introduced enemies to multiply sufficiently to be of appreciable benefit could elapse, it was anticipated that the pest would be exterminated, and any natural checks thereby rendered utterly useless. The battle with the pest was stopped by the cessation of appropriations while the issue was still considered in doubt. When it was taken up again, the idea of total extermination was abandoned, and then, I understand, no time was lost in seeking natural aids to effect suppression.

In conclusion, I have pleasure in summarizing what I have expressed at rather great length by stating that I consider the arrangements for obtaining the natural aids admirably planned, their fulfillment entrusted to safe hands, and that satisfactory progress is being made. I regard gratifying success as highly probable, and expect to see it achieved within a decade, if the work gets no set-back by a lack of funds at any time, or by any ill-advised alteration in plan or personnel of staff.

REPORT OF DR. RICHARD HEYMONS,

Ausserordentlicher Honorarprofessor und Kustor am zoologischen Museum der Koeniglichen Universität in Berlin.

Boston, Mass., Aug. 22, 1907.

I made use of my stay in Boston, in August, 1907, in visiting the Massachusetts parasite station in Lynn, in order to learn the methods which are used in the United States of North America in combating injurious insects. In this subject European countries are also interested, as in Germany and other European States great outbreaks of injurious insects have taken place repeatedly, when every wood and field is devas-

Breeding Cages used in Outdoor Tent.

tated, and damage is caused to the amount of many hundred million marks.

The progress which during the last decade has been made in Germany in fighting injurious insects has at present shown that in very many cases man can accomplish with technical expedients relatively little against the insects. The most effective means of fighting them is found in nature itself, for all great disasters which, for instance, have been caused by caterpillars in Germany in the course of the last generation have found their natural end through parasites, which have destroyed the injurious insects.

In New England now you are concerned chiefly with the fight against two European pests which have been accidentally introduced, namely, the gypsy and brown-tail moths. Both insects are in Europe relatively harmless, while in America they do dreadful damage. The reason that these insects are of so great economic importance in America is principally that in America the parasites of the gypsy and brown-tail moths are still lacking, while in Europe these parasites prevent the great damage of these pests.

I consider it a special service of Dr. L. O. Howard, that he has realized the importance of the parasites in the destruction of the gypsy and brown-tail moths, and that he has tried to find a means to render possible the importing of European parasites into America by efficient methods.

The method which is practised in the Massachusetts parasite station I have examined in Saugus. I am of the opinion that these methods are wholly efficient, and that they will give the best results in the future. I am of the opinion, after being in Saugus, that the cultivation of parasitic bacteria in large numbers is of doubtful value, and that instead of this the main efforts should be devoted to the breeding and propagating of parasitic insects, namely, of Hymenopterous and Tachinid parasites. The arrangements and apparatus for this work which have been perfected and put in practice at Saugus I consider best and most suitable, and worth imitating in every respect. I intend to recommend similar arrangements in Germany.

My opinion is that for the economic interests of agriculture parasite stations are of great importance, and the troublesome and lengthy work of breeding and naturalizing European parasites gives the best help and advancement. As to scientific entomology, I wish to say, in conclusion, that from the experiments which are being made in the parasite station for the destruction of the gypsy and brown-tail moths a real enrichment of our knowledge of the life history and biology of parasitic insects is to be expected.

In addition to the practical economic work, which is without doubt of paramount interest to the American people, a good piece of scientific work is being carried on under the management of Dr. L. O. Howard and his assistants, the conclusion of which all civilized nations will await with thankfulness.

JOINT REPORT OF PROF. R. BLANCHARD,

(Université de Paris) Membre de l'Académie de Médécine, Secrétaire Général du Comité permanent de Congrès. internationaux de Zoologie,

AND

DR. G. HORVATH,

Membre de l'Académie des Sciences de Hongrie, Directeur de la Section Zoologique du Musée National Hongrois, Ancien Directeur de la Station Entomologique de l'Etat de Hongrie.

Dr. L. O. Howard, *Chief, Bureau of Entomology, Department of Agriculture.*

Dear and Honored Colleague: — European entomologists are following with the liveliest interest the efforts which for three years you have been making looking toward the destruction of two species of European Lepidoptera, unfortunately introduced into the United States.

We knew by the reports already published upon this subject the grave character of the devastations done in American plantations by the gypsy moth (*Porthetria dispar*) and by the brown-tail moth (*Euproctis chrysorrhœa*); we knew also what persevering efforts were being put forth by you, and by the other distinguished entomologists placed under your orders, in the struggle against this plague.

However, it has been very pleasant to be able to visit the laboratory at North Saugus, directed with so great competence by Mr. Kirkland. The excursion which we have made through the country has allowed us to estimate the extent of the damage, and we were further confirmed in our opinion that it was necessary to take the most energetic measures to stop the pest. These measures, we are convinced, are planned in the most rational and most intelligent manner by the new processes put in operation. The destruction of the eggs of the caterpillars, or of the nests, in the forests and orchards is surely an excellent method; but it demands a considerable force of men, and necessitates very heavy expenses; it is only an artificial proceeding, and is useful only on condition that it is continuous.

In European countries, where the Lepidopterous insects in question live and multiply without causing loss to an unnecessary degree, there is established a kind of equilibrium, thanks to the struggle which exists among injurious insects and their natural enemies. It should be possible to establish a quite entirely similar equilibrium in other countries. You have had the ingenious idea of attempting to bring this about, and you have the ability to realize by experience the necessary biological conditions. That is why you have undertaken to introduce in America, in the five States of the Union which are directly concerned, the insects which normally in Europe attack the two injurious species and limit their destructive action.

The visit to the laboratory at North Saugus has benefited and edified us. The truly ingenious methods which are applied there are adapted perfectly to the end which you propose, and we have been able to see that the acclimatization of the insects in question can be considered now as an accomplished fact, at least for a good part of the species upon which the experiment has been made. Such results obtained in so short a time permit us to think that the acclimatization of the other species will also be accomplished. The warfare against the injurious insects will thereafter be undertaken under the same conditions as in Europe, and we have a certain belief that it will be as efficacious.

One point which has particularly struck us is the minute precautions which are taken in the laboratory at North Saugus to avoid the introduction into America of insects other than those which it is necessary to introduce. The methods of rearing and of selection which you have chosen, and which Mr. Kirkland and his assistants carry on in such a conscientious way, give every surety against the legitimate apprehensions of those who may fear the introduction of species not useful in the struggle undertaken, but, on the other hand, injurious to certain American crops.

We have thought, dear and honored colleague, that you should authorize us to express to you all the satisfaction which our visit to-day to the laboratory at North Saugus has given us, and all our admiration for the conscientious intelligence and persevering energy which you have shown in this novel work. The States of the Union owe you much already; you are rendering them an actual and new service of truly inestimable value.

Please believe, dear and honored colleague, in our most affectionately devoted sentiments.

REPORT OF PROF. WALTER W. FROGGATT,

Government Entomologist of New South Wales and Investigator for Victoria, South Australia and Queensland.

Washington, D. C., Oct. 14, 1907.

Dr. L. O. Howard, *Bureau of Entomology, United States Department of Agriculture, Washington, D. C.*

Dear Dr. Howard: — I have been very much interested in my visit last week to the districts infested with the brown-tail and gypsy moths. The area they have spread through is so vast that I do not think that with mere mechanical methods, such as spraying, burning, etc. (and even they must be continuous), they will ever be more than kept in check. Therefore, the question of introducing into these infested districts all the parasites that can be found attacking these destructive moths in their original home appears to be a very rational one. With an unlimited food supply around them, and no danger of liberating the secondary parasites that probably destroy a very large percentage in

Europe, these parasitic Hymenoptera (from which I expect the most benefit) should rapidly increase in numbers, and in a very short time spread from one end of the district to the other. Under the scientific and practical methods, carried out by your staff of trained entomologists, you should succeed, unless some unforeseen conditions arise. The effects of these parasites may not be apparent for several years, but I can assure you that I shall follow your work with the keenest interest, as will all the scientific entomologists in the world who have studied the possibilities of parasitic work.

As I understand that there are certain people in Boston who would like to pass the work of dealing with the parasites of the brown-tail and gypsy moths over to the State Board of Horticulture of California, and obtain the services of Mr. George Compere, I would like to state, as official entomologist of New South Wales, that I have had many opportunities of knowing the work that Mr. Compere has done in western Australia, and have also studied his work in California, where I find that no efficient parasite of any kind has ever been introduced into California during all the time Mr. Compere has been there. I should therefore strongly advise these people to have nothing to do with Mr. Compere's work, and to leave the business in the able hands in which it is at present, of the United States Department of Agriculture at Washington.

REPORT OF PROF. A. SÉVERIN,

Conservateur au Musée Royal d'Histoire Naturelle de Belgique, Membre du Conseil Supérieur des Forêts.

Boston, Aug. 21, 1907.

My Dear Dr. Howard: — The Administration and Superior Council of Forests of Belgium has been occupied for several years with the unhappy situation often created by the unusual development of certain insects injurious to wooded estates and domains. I have been officially charged by the Belgian government with the study of this especial situation, with a view to its remedy. After having studied the action of the governments of the different European States, and having visited the institutions devoted to these especial studies, after having made myself familiar with the means employed by them or by private enterprise, I have had adopted in Belgium, suiting them to local conditions, the best preventive and destructive measures which I have been able to find.

It goes without saying that I have followed with great interest at the same time the numerous enterprises of the American entomologists against the most important enemies of their forests; but I must acknowledge that these efforts seemed to me often carried on extravagantly, — that is, that the importance of the damage reported seemed not comparable to the efforts made to stop the injuries, so that the costly carrying out of remedial measures must surpass the importance

of the loss sustained. Thus these undertakings have appeared to me to have an experimental value rather than an economic one, for we cannot understand this extensive destruction when we consider the ravages caused by these same insects in Europe.

I have no longer any such feeling, after having seen, hastily, it is true, your country, for I can testify to the enormous development of the pests which you are trying to combat. I am therefore led, my dear Dr. Howard, after having compared our methods with yours, with the confidence of a man especially prepared for this comparison, to tell you of the admiration which I have felt for the scientific and economic results which have already been obtained, and which your willing perseverance will still obtain. These results will be kept up by the work of the intelligent men who are your assistants and whom you have been able to gather around you.

The examination of the fine experiment station at Saugus, near Boston, and the explanation which you have given me of the fight carried on, will greatly modify my views on economic entomology and on the methods to follow to make application of it. The program is up to the present the most vast and the best established, while the station is the largest that I have seen. It is also the only station in the world which permits the serious study of the development of the necessary means for fighting in an efficacious and natural manner an invading pest. It has been necessary to conduct these experiments on a large scale, as you have been able to do, in order to put these agents in a state as near as possible to nature.

It is necessary, however, in order that your experiments have all their value and all their weight, that they should continue without ceasing during years; and I hope that the State of Massachusetts, as well as the intelligent taxpayers who have consented to the sacrifice of the indispensable money for the founding and equipment of the station, will continue to place you in a position to carry on these experiments for that time.

I shall follow your work in the future with the greatest attention, as I shall better understand your reports; and I shall make known your methods of work, which depend upon the weapons which nature gives you, but which we are not always able to use. Your experiments have a great value for us, for the replanting of forests now going on in Europe is a source of anxiety to the specialists in forest entomology, as we foresee much damage by pests when the extent of forest land, comprising only a few varieties of species, shall become greater and greater. You will have shown us the way, and we can from now hope that your experiments will constitute our surest guide in our future struggle.

Your enterprise, my dear Dr. Howard, is no longer an American one, — it is world-wide, and I hope that the wealthy country of America, which has in you the man capable of carrying on this great work to a

successful end, will continue the honor of sustaining you generously in your efforts. It will have merited, then, the gratitude of humanity, which will owe to your country an important part of its well-being.

In a recent very extended article on the "Utilization of the Parasitic and Predaceous Insects in the Struggle against Insects Injurious to Agriculture," published in the Annals of the National Agronomical Institute of France, second series, volume VI., 1907, pages 282–354, Dr. Paul Marchal discusses in a most competent way all of the attempts that have been made in the past along this line, as far as literature has described these efforts. He has given us an admirable summary of the whole work with parasites. He devotes much space to the gypsy moth parasite undertakings, and in stating his conclusions says: —

And to what practical results will all this work lead us? It is still difficult to state in a decisive way the answer to this question. The experiments have, however, been carried on under the very best conditions to bring success to the enterprise; and it was impossible to confide the work to a savant of higher scientific standing than the eminent director of the Bureau of Entomology at Washington. Given the great number of parasites imported, the abundance of food which they find at their disposition, a climate analogous to that of Europe, it does not appear doubtful that many of the species will become acclimatized; and once acclimatized they cannot fail to strongly influence the balance of nature to the prejudice of the injurious species.

The time necessary for this movement of the seesaw may be long, and it does not seem that we can have appreciable results before four or five years; but what matter, in any case, since we are trying to obtain a result which is of indefinite duration, and which will dispense with the expensive process of destruction by insecticides and by hand, and which will mark the end of a public calamity menacing the trees of the whole United States?

REPORT OF DR. JAMES FLETCHER,

Dominion Entomologist, Ottawa, Ont.

Central Experimental Farm,
Ottawa, Ont., Canada, June 27, 1907.

A. H. Kirkland, Esq., *Superintendent for Suppressing the Gypsy and Brown-tail Moths, Boston, Mass., U. S.*

Dear Sir: — I have the honor to report that in response to your invitation I had, on June 24 and 25 last, the pleasure of inspecting some of the work which has been done under the superintendency of Dr. L. O. Howard and yourself in Massachusetts in importing and establishing parasites, with the object of controlling the brown-tail and gypsy

moths, and also of seeing the results of the work which has been done to destroy these pests on the shade trees and other trees along high roads and streets and in ornamental grounds over an extensive area in the State of Massachusetts around the city of Boston.

Leaving your office at 9 o'clock on the morning of June 24, in an automobile, we passed through Cambridge, Somerville, Malden, Melrose and Wakefield to Saugus. I was much pleased and surprised to note the excellent condition of the trees which had been kept free of injury by caterpillars by means of the measures which your commission has adopted, viz., the spraying of the trees with the arsenate of lead mixture, the burlapping and banding of trees with tanglefoot, and by a discreet cutting out and burning of useless trees and undergrowth. The destruction of the eggs of the gypsy moth by creosoting and the effectiveness of this method were plainly visible by the masses of dead eggs on many trees.

At the parasite laboratory at Saugus we were received by Mr. F. H. Mosher, the entomologist in charge, and shown through the various rooms, where the large consignment of parasitized material from Dr. L. O. Howard and his agents in Europe was being unpacked and cared for. I knew of this work in a general way, but had no idea, before I visited the laboratory, of its great scope or of the skill and care with which the details are being carried out at Saugus by a body of enthusiastic scientific assistants, all of whom, although suffering more or less from the painful "brown-tail rash," continued their investigations with unabated interest. The painful irritation caused by the barbed hairs of the brown-tail moth caterpillars complicates this problem considerably, making it necessary to adopt special means to prevent to as large a degree as possible the poisoning of the hands and faces of those engaged in opening, examining and sorting the boxes of parasitized material which are constantly coming to hand, and which must be promptly attended to.

At the time of my visit the work with the *Pteromalus,* which was called provisionally *processionece* when received, and upon which Dr. Howard based much hope, was practically finished for this season. I was able to see the cases in which these parasites were reared, and the great amount of care which was necessary in examining the insects so as to destroy secondary parasites when liberating the beneficial species. It is satisfactory to know that large numbers of this important enemy of the brown-tail moth in Europe have been successfully reared and liberated in several localities. It is hoped with reason that by this insect both the brown-tail and gypsy moths will be much reduced in numbers.

On visiting the breeding cages out of doors we found that Tachina flies of nearly a dozen species were emerging in large numbers and in a healthy condition. These also, as soon as all species which were not actually known to be primary parasites of the moths had been de-

stroyed, were turned out in infested districts where it was thought that they could do most good.

The large and handsome predaceous beetle, *Calosoma sycophanta,* which is known to prey on the caterpillars in Europe and which was imported last year, had not yet appeared in numbers; but I was fortunate enough to see, on the day of my visit, the first American-reared specimen of this species. It closely resembles our native *Calosoma scrutator,* and will doubtless be confounded with it by many until the differences are pointed out by entomologists.

There are some special features of this experiment in importing beneficial parasites to control such well-established enemies as the brown-tail and gypsy moths which must be borne in mind, and from which greater success may be anticipated than from any previous efforts. The extensive scale on which the work is being prosecuted reduces the chances of error, and allows parasitized material to be imported at all times of the year and from a large number of different localities in Europe whenever the parasites may be observed to be abundant. The fact that the planning and carrying out of the details of the scheme have been done by some of the best-trained economic entomologists in the world, resident both in America and in Europe, and that ample funds were provided by the State for any suggested plan of action which was thought reasonable, all combine to render this one of the most important efforts in the annals of economic entomology.

I have no suggestions to make with regard to this work. The greatest care seems to have been taken in carrying out the many difficult operations which are necessary in rearing parasites, in keeping accurate records and in distributing the insects.

After leaving the parasite laboratory, we passed through Swampscott, Salem, Beverly, Manchester, Essex, Rowley, Ipswich, Newburyport and many other places. This gave another opportunity of seeing the good work which has been done in controlling the caterpillars along the main highways and in cities. The work of the spraying outfits in woodlands and parks was also examined. That 8,000 miles of streets should have been practically freed of devastating caterpillars of two of the worst known pests of shade trees in only two seasons is a triumph of applied science which must be of great encouragement to all engaged in such work, and is an indication of what may be hoped for in the near future in Massachusetts if the same plan of action is persisted in.

From what I saw during the journey now reported upon, and during an extended trip taken the following day in company with Prof. J. B. Smith of New Jersey and Prof. E. P. Felt of New York, I feel confident that the vigorous campaign now being carried on under your management, including the systematic colonizing of the parasites under Dr. Howard's direction, must result in the control of the two chief enemies against which it is directed, and, if continued, in their complete

eradication. A hopeful sign in this warfare is the sympathy manifested in the work by many public-spirited citizens, such as Gen. Samuel Lawrence, Col. Wm. Sohier, numerous residents of the North Shore district, of Brookline, Winchester, Belmont, and in fact of all the badly infested towns, who have not hesitated to spend large sums of their own money for the public weal. The enterprising spirit which seems to be actuating the officials of the infested towns and cities to cooperate with the State and the federal government is a new development which is an example to the whole world.

In passing through infested parks and woodland roads, the danger of the caterpillars being carried from place to place by passing vehicles was plainly demonstrated, and showed the wisdom of clearing a 100-foot protective belt by thinning out and spraying the trees, which is being done both by officials of the federal Bureau of Entomology and by your force. The advent of the automobile has certainly increased enormously the difficulties of preventing the spread of these caterpillars, which spin down over the roadways from the trees, and are thus carried long distances in a very short time. Any one looking into this matter at the present day must regret deeply that the work of extermination should have been stopped in 1900, when there were practically no automobiles.

From what I saw of the work as now being done under you and Dr. Howard, I am deeply impressed with the careful and methodical management of this whole campaign, and of the wisdom of the Legislature of the State of Massachusetts in providing funds so that the work may be prosecuted vigorously now.

In the whole of this work I have only one suggestion to make, viz., that the fungous disease which we found to be very prevalent in some localities may be watched closely, so that, if practicable, its services may be directed against the caterpillars in some places where this is practicable. This of course is a very difficult friend to control. It is a native species, and at times has done good service in limiting outbreaks of injurious insects; but on the whole has been less effective than insect parasites.

REPORT OF EDW. M. EHRHORN,

Deputy Commissioner of Horticulture, California.

San Francisco, Cal., Aug. 15, 1907.

Mr. A. H. Kirkland, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

Dear Sir: — In accordance with your kind invitation to visit Massachusetts, and examine into the various phases of the introduced parasites of the gypsy and brown-tail moths, as per your letter of May 29, and having received permission from my chief, Hon. Elwood Cooper, State Commissioner of Horticulture of California, as well as the approval of Hon. James M. Gillett, Governor of California, I

left San Francisco on July 16 and arrived in Boston on July 20, in the evening, where I found your kind letter with instructions awaiting me. During the period I was with you I made several trips to the laboratory at Saugus, and visited the whole infested area, and in this way I have been able to realize the stupendous work with which your office has been battling since May, 1905.

We in California have dreaded the two pests for years, and have been on the constant lookout lest one or the other should find its way to our great State. Very few of California's citizens have any idea of the magnitude and severity of either pest, and I for one must confess that I was greatly surprised at the conditions I found. I can realize what a serious mistake it was to have discontinued the work in 1900, which reduced the pest to a minimum at that time.

I am told by honest individuals that conditions are greatly improved since the new appropriation for suppressing these pests began, and from my own observations I certainly believe this is true. In my opinion, you have done the very best work to check these pests; and during my stay I witnessed the constant and thorough work of killing the caterpillars under the bands, the burning over of wood lots and the establishment of protective belts which are to prevent the pest from spreading from badly infested wood lots to the public roads, to be carried thence on cars and other vehicles, as they pass, into new sections. These organized efforts with the various methods are, as I can judge, the very best, and if thorough co-operation is carried out, should go far towards reducing the pest to a minimum. It is to be hoped that in sections where there is a lack of interest, and where the authorities have been remiss in their duties, new interest will manifest itself, especially when the good work of other sections stands as a lesson and shows the result of thorough workmanship.

I can readily see the great benefit which you will derive from the protective belts, as well as from burning over the badly infested wood lots.

I have been deeply interested in the rearing of the several parasites, which is being carried on in co-operation with the United States Department of Agriculture. The work of introducing and rearing beneficial insects is one that constantly presents new phases and odd problems; and one of the most important matters in conjunction with the work is to eliminate secondary parasites, so as to give the primary or true parasites full swing. I am pleased to say that I find that every precaution has been taken for this important work. You have certainly taken pains to prevent any questionable species from escaping, and the tight rooms in which the unpacking takes place and in which all the materials are handled are very safe places for this work. While you are, so to speak, only at the threshold of this work, you have to a certain extent laid a good foundation, and the methods you employ are much the same as are used in California. I particularly refer to the breeding cages, and I understand that these were made from our models. Your

out-door breeding houses are well built, and apparently serve their purpose. The success of your parasite work will in a great measure depend on the study of the life cycle of the pests in the laboratory, as well as in the field, combined with the closest study of the life and habits of the parasite; this I note you are doing.

I commend your work of destroying by fire all materials, boxes, etc., received, as well as the used-up materials after the parasites have emerged, and all food used in propagating larvæ, when this food becomes stale and worthless. In this connection I would recommend the disinfection of all breeding cages as soon as vacated, and before new lots are introduced into them. In doing this you obviate the possible introduction of fungous spores, as well as members of the mite family.

From the materials examined which were brought in from the field there remains little doubt but that several species of imported parasites are now established in your State. *Calosoma sycophanta* is especially promising, both beetles and larvæ are such voracious feeders. Several showings of the Braconids are very good; the *Meteorus* species has great possibilities, although mostly so far on the brown-tail moth. A *Pteromalus* species appears to have established itself, and this season's observations will settle all doubt in the matter. According to your record at the laboratory, some 50,000 individuals were liberated in 1906 and upward of 40,000 this year, and it would seem unreasonable not to expect some results from this showing. *Pimpla examinator* seems to breed quite freely in the cages, and, as this species resembles our *Pimpla conquisitor,* there seems hope of it doing well out of doors. Your record shows that so far about 200 healthy specimens have been liberated this season. Most remarkable are the sendings of the various species of Tachinid flies. These seem to stand the long journey, and are apparently easily handled. Of the large quantities liberated (your record shows 7,000 up to date) you should have some very fine results in another year. From the egg parasites received and liberated in 1906 nothing has so far been recorded. If these parasites should turn up, it would indeed aid materially in the work. I am pleased to note that you are using the cold-storage plan for your egg masses, and that you are making good preparations for next year's sendings. Mr. Fiske also informs me that he is trying other experiments with pupæ, etc., which no doubt is worth while on account of prolonging the season by maintaining a longer food supply for parasites.

In looking over the various shipments of imported material, and examining your records, it is apparent that the arrangements for importing parasites from abroad have been ably organized, and, in my judgment, thoroughly cover the field. While no one at this writing can predict the outcome of your labors with the parasite question, you surely have made a good start, and are using the very best methods in your propagation. I may say that the whole has a very promising future.

REPORT OF DR. E. P. FELT,

STATE ENTOMOLOGIST OF NEW YORK.

ALBANY, N. Y., July 1, 1907.

Prof. A. H. KIRKLAND, *Superintendent of the Work for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

DEAR SIR: — It gives me great pleasure to submit the following report on my investigations, made June 25–27, 1907, of the work with parasites of the gypsy and brown-tail moths.

Since a few general considerations are essential to a full understanding, I wish first of all to submit a brief résumé of the situation. The State of Massachusetts began operations against the gypsy moth in 1890, at which time the area badly infested by the moth was quite restricted. The work was prosecuted vigorously, and, though much had to be learned by costly experience, substantial progress was made; during the latter part of the decade a remarkably extensive campaign of extermination was in full swing, and the gypsy moth was very scarce in many places where it had previously swarmed. Unfortunately, nothing was done in 1900 to 1905, and during this period there was a great extension of the infested territory, a marvelous multiplication of insects, and the extremely unfortunate conditions of 1890 were duplicated over a much larger area. The work of recent years, now in progress, is avowedly repressive in nature, and consequently the earlier methods have necessarily been adapted to present needs. It is very gratifying in this connection to note the wonderful change that has taken place in the last two years, despite the fact that badly infested areas were much greater in extent and more widely distributed than ever before. Though there are still badly infested woodland tracts, as a general rule, the residential districts, including practically all lands adjacent to public highways, are very free from both gypsy and brown-tail moth caterpillars.

The moment the policy of the Commonwealth changed from one of extermination to that of repression, the question of obtaining natural checks of one kind or another became of prime importance. This is particularly the case when it is remembered that some $750,000 were expended in 1906, under State supervision, in order to bring about the present condition. Even greater expense may be necessary in subsequent years if the services of parasites cannot be enlisted, since there is bound to be some increase in the infested territory from year to year, in spite of most rigorous care. This practical consideration alone forces us to conclude that no expenditure of either time or money should be spared to bring about a result which would be beneficial not only to the afflicted communities in eastern Massachusetts, but also to those in other States already infested by the gypsy moth, and less directly to all having property interests in the northeastern United States, if not to those throughout the entire country.

First of all, as is well known, the work of obtaining parasites has most wisely been placed in the hands of Dr. L. O. Howard, Chief of the Federal Bureau of Entomology, — a man eminently fitted to discharge this duty, since he is a recognized authority on insect parasites, and has at his command the vast technical resources of the general government. Furthermore, Dr. Howard's extensive acquaintance with European entomologists has been of untold benefit in securing their co-operation in the collection of parasitized brown-tail and gypsy moth material. Our investigations show first of all that shipments of parasites were being received daily from representative areas throughout Europe, where the gypsy moth was known to be more or less abundant and destructive at periodic intervals. They also disclosed the fact that, owing to conditions some of which were probably beyond human control, there was no adequate representation of the Asiatic fauna. We are informed that an important parasite is known to prey upon the gypsy moth in Japan. Several attempts have been made, through the co-operation of consuls and Japanese entomologists, to introduce this insect, but all have failed. Inasmuch as many of the plants and animals of Japan thrive exceptionally in the eastern part of this country, we deem it extremely important that another effort be made to introduce this species, even though it involve the expense of sending a special agent to Japan in order to secure the insect. The experience of the last two seasons has shown that European parasites can be brought into this country successfully; and at the present time they are being received in large numbers by mail, taken promptly to the Saugus laboratory, the boxes opened, the contents inventoried, the different species separated, special care being exercised to destroy all dangerous hyperparasites, and the beneficial forms liberated under the most favorable conditions. We wish particularly to commend the care which has been given to this aspect of the problem. The areas where the various parasites have been planted are widely separated one from the other, so that the relative efficiency of the different species imported can be determined without great labor. Furthermore, the extensive distribution of the parasites throughout the infested territory reduces very largely the peril of importations being annihilated by forest fires, unfavorable climatic conditions or other agencies beyond the control of man. Many of the parasites have purposely been placed in badly infested sections burned over only a year or two earlier, as there is considerably less danger of a forest fire occurring in such woodland. A valuable predaceous beetle has passed through one generation and lived through the winter, while certain parasites, liberated in the open last year, have been found this spring in young brown-tail moth caterpillars. These two facts alone are very encouraging.

There has been for several years at least one or more fungous diseases destroying both the gypsy and brown-tail moth caterpillars, occasionally causing the death of large numbers. We were actually in

localities where thousands were dead or dying from a disease. Inasmuch as the control of these insects by natural agencies is of greatest importance, we would recommend that careful and extensive studies and experiments be conducted, with a view of determining whether, under any conditions, these diseases could be made more efficient by artificial means.

Recommendations and Conclusions.

In the first place, we wish to place on record our opinion that the condition of the infested territory has been marvelously improved in the last two years, and residents of the Commonwealth as well as those responsible for this condition are to be congratulated thereupon. The progress already made in importing parasites of both the gypsy and brown-tail moths is exceedingly gratifying; and, judging from what we know of other insects which have been imported from foreign lands, free from their natural checks, as is true of the species under consideration, we deem the situation distinctly encouraging. There is a very good prospect of one or more of these natural enemies multiplying enormously, and becoming correspondingly efficient checks on the depredations of these two very destructive and annoying leaf feeders.

Secondly, we would urge most seriously the importance of careful biological studies of the parasites of both the gypsy and the brown-tail moths. It appears upon inquiry that comparatively little is known concerning the habits of any of these species, and, as experience has shown repeatedly, in the case of injurious forms, that apparently insignificant factors in the life history may prove to be the vital point in successful control, so in the case of these parasitic forms habits at present unsuspected may possibly be taken advantage of to bring about a most gratifying multiplication and corresponding efficiency so far as suppressing the gypsy and the brown-tail moths is concerned. These investigations, furthermore, should be conducted on a comprehensive basis, and could hardly be planned to cover a period of less than three to five years, if the best results are to be obtained. A biological study of these forms, in our opinion, should not be confined to this country, as there may be determining factors in Europe which do not exist in this country, or are not readily apparent here. Consequently, we would suggest that, in a certain sense at least, parallel biological investigations of all parasites of both the gypsy and the brown-tail moths be undertaken along comprehensive lines in both Europe and America, as no time should be lost in determining the vital points in the habits of the beneficial forms.

Thirdly, we would emphasize most strongly the advisability of studying the apparently rare or inconspicuous natural enemies of both the gypsy and the brown-tail moths, since experience has repeatedly shown that European species, rarely noticeable on account of their depredations in their native country, may become the most destructive pests in another part of the world. Therefore, it would not be surprising if

some of the rarer imported forms should prove far more effective parasites than those commonly abundant in Europe.

Fourthly, we would reiterate the importance of making a serious attempt to obtain parasites from Japan, as noted above.

In conclusion, we wish to call attention, in an incidental way at least, to the fact that considerable of value in control work could undoubtedly be gained by a careful and practical study of repressive forestry measures now in vogue in European countries. It is true that a wide discrepancy exists between the conditions obtaining in America and those in Europe; nevertheless, certain general principles would undoubtedly apply to both countries. We would include in this recommendation not only the advisability of studying the practical aspects of European control work against these two species in particular, but would also suggest that a careful ecological study of the gypsy and brown-tail moths in Europe, with special reference to the relative value of the various natural checks, would prove of great value in determining future lines of work.

REPORT OF PROF. H. A. MORGAN,

Director, University of Tennessee Agricultural Experiment Station.

Knoxville, Tenn., Aug. 1, 1907.

Mr. A. H. Kirkland, *Superintendent for the Suppressing of the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

Sir: — In response to your invitation, dated May 29, 1907, to inspect the work of importing parasites of the gypsy and brown-tail moths, I arrived in Boston July 23. At this time the conditions were most favorable for an examination and inspection of the habits and ravages of the gypsy and brown-tail moths, and of the methods in operation by your office and the Bureau of Entomology, United States Department of Agriculture, for the restriction and suppression of these pests.

In submitting this statement I wish to acknowledge the facilities tendered by you and your assistants for a careful examination of much of the territory involved in the spread of the gypsy and brown-tail moths, of the various degrees of infestation and ravage, and of the opportunity for the comparison of results obtained where remedial measures were actively enforced, and where conditions were such as to warrant a postponement of remedial action until later, or for the colonization of predaceous and parasitic insects. This general view of the situation is essential to a due appreciation of the magnitude of the problem you have in hand, and the knowledge and technique required for its proper and economical solution.

There was a time in the history of the campaign against these moths that entomological opinion might have favored an attempt at extermination; but as this opportunity may be regarded as past, control by the best-known methods, based upon an exhaustive study of the life histories and habits of these moths and their parasites, is the most economical

avenue of relief. Among the important methods for control you have sought the assistance of predatory and parasitic forms, and it is upon this particular phase of the work that outside opinion has been invited.

From the experience of entomological investigators throughout the world, there cannot be any doubt of the absolute warrant for extensive effort in the introduction and colonization, under expert supervision, of predatory and parasitic insects of the gypsy and brown-tail moths. In placing this work in the hands of the Chief of the Bureau of Entomology of the United States Department of Agriculture, you have shown an appreciation of the many problems involved in such an undertaking, and have made sure that the best service of the country will be given to accomplishing the most helpful results in an economical manner. Dr. Howard, by virtue of his ability, studies, experience and position, has the confidence of the scientific world in this undertaking. The introductions already made, and the manner in which the entire work of collecting, breeding and colonizing has been outlined, cannot but stimulate the utmost regard for the methods in vogue, and encourage the hope that this biologic effort will bring relief to the territory now suffering from the ravages of two such serious pests. While the introduction and distribution of parasites is not new to entomological endeavor, its full significance is not understood by all entomological students, or by the people to whom it is of the most benefit. From the results to be accomplished in the more extended study of the life cycles and habits of the various forms of parasites introduced in the fight against the gypsy and brown-tail moths, much greater possibilities for the control of these and even other pests will be brought to light. There can be little doubt of the outcome of such active and well-planned methods.

Having watched the progress of these moths for some time, by visits to the infested areas and through published reports, I have become greatly interested in the investigations connected with them and the means developed for their control; and I do not hesitate to state that in your present campaign you have shown a very definite knowledge of conditions and of the problems therein, and your efforts should merit the confidence and support of your people, as well as the people of the nation.

REPORT OF PROF. HERBERT OSBORN,

Professor of Zoölogy and Entomology, Ohio State University.

Columbus, O., Sept. 24, 1907.

Mr. A. H. Kirkland, *Superintendent.*

Dear Sir: — In accordance with your invitation to visit the laboratories and witness operations in connection with the efforts to introduce parasites of the gypsy and brown-tail moths, I spent several days in the first part of August in going over the ground, making observations, and examining into the work as thoroughly as possible.

I may state at the first, as a result of this examination, that I was greatly pleased with the thoroughness of the work, and am fully convinced that it is being done with the utmost care possible and that the methods seem to be adapted as perfectly as possible to secure the desired results. One of the first questions that arises in the mind of an entomologist is whether there may be danger that with the desired parasites there may be introduced other insects that may be detrimental either as pests in general or as a hindrance to the most successful activity of the desired parasites. The importance of the first is fully shown by the devastation caused by the two species which it is your special effort to control, as well as by numerous other instances of introduced species that have proven destructive pests in various parts of the country. For the latter it is only necessary to realize the great activity of hyperparasites to appreciate that their exclusion is a matter of the greatest concern if the work of the primary parasites is to be made effective. With regard to precautions taken against undesirable insects, I failed to discover any point in which it seemed to me that there should be any reason for changes in the methods adopted. From the time that the insects are gathered in their native haunts in Europe until they reach Saugus there is evidently the greatest care not to permit the opening of packages or the possible escape of insects *en route*. The packages coming from Russia, which are opened by the postal authorities there, are the only exceptions that I could discover to the rule to guard against the escape of the insects. The possibilities of any serious introduction in this connection are very remote, however, since the packages after leaving the vessels in which they are transported are transferred so directly to the laboratory in tight bags, that even with broken packages the escape of any insect so that it could survive is nearly impossible. The methods of liberating and separating the desired parasites are so perfect, the precautions against their escape so complete, that it seems impossible that the introduction of any pest could be possible. At any rate, I could not imagine any more perfect system that could be devised for the purpose. The one source of danger, that of carelessness by some indifferent employee, must be guarded against by the continued employment of thoroughly trustworthy individuals, who appreciate the responsibility of the work in which they are engaged.

That great success is secured in obtaining parasites is shown in the securing of various kinds that were under observation at the time of my visit. After securing the parasites, the next serious problem, of course, is their multiplication and establishment in such locations and under such conditions that their survival may be assured. This problem has evidently received the most careful attention, and in the placing of parasites it is evident that the greatest care has been taken to secure such locations and such favorable conditions as may furnish the very best opportunity for the successful establishment in the field.

This is distinctly evident in the planting of colonies at widely different points, so as to avoid their destruction or loss by any local condition, and the placing of colonies at such distances from points under artificial treatment that they will not be lost by various methods of artificial destruction. I was specially impressed with the advantages in this selection, since it will serve a double purpose, — that of controlling the insect in places in which its artificial control is impossible, thereby lessening the power of overproduction and consequent migration, while at the same time giving the greatest promise of permanent establishment of parasites. I may say that, while my own hope with regard to the value of the introduction of parasites for this purpose heretofore has been rather slight, the plan and methods adopted in your work have given me much greater confidence in its value. It certainly is deserving of the most careful and extended trial that can be given.

While it was not specified as a part of my program, it was a matter of much interest to me to note the methods adopted in the control for these introduced pests; and I was very much impressed, in travelling through infested districts over some hundreds of miles, over roads the borders of which had all been cleaned and treated, with the extreme care and the great efficiency that has been attained in this work. Evidence is at hand at every point that a thorough study has been made, and an application of every known method by which the successful control of these insects may be reached. It was a matter of much interest to me, also, to see the system of accounts in your office, which has been so simplified and perfected that the expenditures in each district and for every purpose may be learned with the least expenditure of time and effort. This system must be a great satisfaction to the authorities both of the State and of the townships interested, inasmuch as it affords such complete information as to all classes of expenditures. While this report might be much extended were I to include all of the different features of your work which were of interest to me, it seems to me that nothing can be gained by such a statement of facts as are already familiar to those who have looked into your work and which must be well known to the residents of the locality.

To sum up in brief, therefore, I may say that the work of your department appears to me to be directed in a most intelligent manner toward the accomplishment of its purpose; and that, in the efforts to introduce parasitic enemies that will be of service in the control of these introduced pests, there is evident the utmost care and intelligent study of all the conditions which will favor the success of the undertaking. The success that it is hoped to attain in this direction, while undoubtedly of most particular interest to the region infested, is of extreme interest to the residents of the surrounding States; and it gives me extreme pleasure to find that the work of control is being so efficiently administered. With such work in progress there is certainly

much less of a menace to the surrounding country; and, even if absolute suppression is impossible, the retardation of the spread of the insect will result in an enormous saving and permit of the development of more perfect means of control, so that the future devastations of the insect may be greatly reduced.

In conclusion, I beg to express my appreciation of the favors extended by the authorities, and the excellent opportunity offered for the examination of every phase of the work.

REPORT OF PROF. S. A. FORBES,

Professor of Entomology, University of Illinois.

Urbana, Ill., July 24, 1907.

Mr. A. H. Kirkland, *Superintendent, 6 Beacon Street, Boston, Mass.*

Dear Mr. Kirkland: — In accordance with your invitation, I had the pleasure of a visit, July 10 and 11, to the laboratory near North Saugus, Mass., of your force engaged in a study of the parasites of the gypsy and brown-tail moths, as an experiment in the method of controlling those pests. I made a careful examination of the equipment, materials and methods of the work there in progress, receiving from Mr. Fiske and the assistants engaged with him every possible aid to a critical study of their operations and to a full knowledge of the results of their work, so far as these have as yet appeared. I examined the parasitized material as it arrives from Europe, following it through the various processes of inspection, assortment, maintenance, protection, experimental multiplication and release, and obtained the records of the season, showing the number of parasitic species obtained from the European collections, and the number of individuals of each species which had been liberated this year for their natural service as parasites of the destructive caterpillars. I also paid particular attention to the methods used for detecting and destroying secondary parasites of the beneficial species, and of making sure that no European insect other than the parasitic species you desire to multiply is permitted to escape from your importations.

My notes cover in detail the operations of the laboratory and the methods and results of its various lines of work. These notes were made, however, merely with a view to making sure that I understood the whole scheme of your work; and it does not seem to me worth while to expand them into a description of your methods or a statement of your present results, all of which have appeared, or will eventually appear, in full in your own published reports. It will serve the purposes of my visit completely, I am sure, if I give you my opinion of the methods, and make any suggestion which may have occurred to me looking towards their possible improvement.

With reference to your plan of operations, the equipment provided

for them and the manner in which they are being carried on, I am bound to say that I have little to offer by way of criticism or suggestion. The living parasites received are released, as a rule, as quickly as possible after arrival; the larvæ and pupæ alive on arrival are kept with great care under the most favorable conditions until they have disclosed such parasites as they come infested by, and these are released as promptly as consistent with scrupulous care that nothing else is permitted to get away.

The experimental operations for the infestation of American-bred specimens by the imported parasites and for the multiplication of the latter by that means are being carefully and very wisely carried on. A good deal of practical ingenuity and the results of much practical experience are shown in the various devices used in breeding-cage operations and in the assortment of living material. I believe that the whole procedure is thoroughly sound, and that the work is being most carefully and intelligently done.

It appears that there is a considerable loss of parasitic material, particularly of that emerging from the hibernating webs of the brown-tail moth brought over in winter, owing to the difficulty of getting the parasites separated from their hosts in the storage boxes used for that purpose. Mr. Fiske described to me, however, a proposed improvement of your present apparatus, which it seems to me will go far towards remedying this difficulty.

I was much interested by the evidences of extensive fatal fungous diseases among the caterpillars arriving from Europe, and I understand that these diseases are undergoing expert study, at least as to their causes. If I were to make any suggestion of change or development in your methods, it would be that you should have investigated, in every practicable way and as rapidly as possible, by men wholly under your control, the fungous diseases of these insects, with a view to their experimental increase and their spread in the field.

The muscardine of the brown-tail moth, according to statements made to me by your men, has done more to diminish the numbers and arrest the progress of that insect than any other agency, — seems likely, indeed, to reduce the pest to insignificance; and the gypsy caterpillars are also subject to serious disease, apparently of a bacterial character. The muscardines, dependent on spores formed in the open air for their spread, are more susceptible to weather conditions than the bacterial diseases, and are hence less reliable than the latter as a means to the economic end; but both these forms seem to me to be well worthy of thorough investigation and experimental trial.

I have to thank your commission for the opportunity to examine a situation so extremely interesting to an entomologist, and should be pleased if I might have found myself able to make suggestions of greater value in aid of your work, — important not only to your State and to New England, but to the entire country as well.

REPORT OF DR. JOHN B. SMITH,

ENTOMOLOGIST, NEW JERSEY AGRICULTURAL EXPERIMENT STATION.

NEW BRUNSWICK, N. J., July 1, 1907.

DEAR MR. KIRKLAND: — Permit me first of all to express to you my admiration of the wonderful results that you have obtained in your two years campaign against the gypsy and brown-tail moths in Massachusetts. The two days that I have just spent in the infested districts show a condition which two years ago I would have deemed it impossible to obtain.

As you are aware, my acquaintance with the campaign against the gypsy moth dates back far toward the beginning of the work under Fernald and Forbush, and nearly or quite ten years ago I made a careful study of conditions as they then existed and of the status of the work at that time. The effort then was to exterminate, and the brown-tail moth had not yet entered as a complication. The territory was then well in hand, practical extermination of outlying colonies had been effected, and there were only a few bad centers of infestation which were being treated vigorously.

The questions which I was then asked to answer were, whether in my opinion extermination was possible, and whether some attempt should not be made to obtain from the native home of the gypsy moth some of its natural enemies as aids in the work. In my report at that time I stated that in my opinion extermination was quite possible along the lines of work then being done, and I advised against any attempt to bring in natural enemies or to make scientific studies looking to control only. I urged a continuance of the work with equal thoroughness, and expressed a belief that the result aimed at was almost within grasp. For some little time thereafter the work was continued; but then, unfortunately, it was stopped by a failure of the State Legislature to continue appropriations.

For five years no effort to check the insects was made, and at the end of that time the gypsy moth had regained all its old territories and had spread considerably beyond them. The brown-tail moth had far outstripped the earlier arrival, and had extended into adjacent States. In 1905, when for the fourth time I went over the infested territory and looked over not acres but square miles of woodland stripped by the gypsy moth and webbed up by the recently hatched brood of brown-tails, it seemed as if even control was beyond human power, and it required courage of no mean quality to undertake a fight that seemed so hopeless. In 1906 I was out of the country, and learned of the results of the work by report only. My observations just made have enabled me to judge with some degree of accuracy of present conditions.

Matters are now quite different from what they were ten years ago; extermination of the brown-tail moth is scarcely within hope of attain-

ment, because the spread of the insect has been so great and is so easily accomplished. Extermination of the gypsy moth is almost as difficult to attain, and under the conditions would prove so very costly as to put it practically beyond reach. Control only is the aim of the present organization, and that this is possible it has proved to demonstration. But the cost has been enormous, and with present methods there seems to be no period to the expenditure. Under these circumstances all natural aids should be pressed into our service, and the line of study and investigation which I deemed inadvisable ten years ago is now essential. The work of securing parasites and other natural enemies is well under way, has been carried on for two full seasons, and after looking over the methods in use at the Saugus field laboratory, I do not see how they can be much improved.

There are several points, however, to which it might be well to call attention. A few species of parasites have been and are being received in great abundance, and these are no doubt among the most efficient agents for keeping their hosts in check in their native homes; but it does not follow that these same species will do as well here, under our climatic conditions, as their hosts have done. It is quite conceivable that those same factors which seem to favor the host with us may act unfavorably as against the dominant parasite. On the other hand, those species which in Europe merely maintain themselves may find our conditions to their liking, and may prove much more effective with us than they are at home. Special attention should therefore be paid to the minor parasites or those other enemies that are less numerously represented, and they should be given at least an even chance to develop under our conditions.

It has been shown in a number of instances that Asiatic species of insects do better on our Atlantic coast than do those from Europe; and, as the gypsy moth occurs also in Japan, I think it very highly desirable that at least as much attention be paid to securing Japanese parasitic and predatory species as to obtaining those from Europe. I would advise that, if necessary, a well-qualified man be sent to Japan to study the species there, and to send into Massachusetts such parasites and predatory enemies of the gypsy moth as are there obtainable. It is not possible to obtain too many of such forms, and among the orientals there may be one that is far superior to anything obtainable in Europe. No chance should be slighted in this connection, and a man acquainted with our conditions and in general with what has been already received from Europe could, in even a single year, determine what species should be collected and sent in.

Another branch of work that I would recommend is the study of the diseases of the caterpillars of both gypsy and brown-tail, and their dissemination, if possible, over the entire range of both species. I am quite aware that insect diseases are unreliable in many cases, and that they depend largely upon weather conditions; but when they are active

their effectiveness far exceeds that of any other natural agency. As I am informed, the brown-tail moth was almost exterminated by disease in a number of badly infested localities in 1906, and during the trip just completed I noticed that a very large percentage of the caterpillars seen — more than 50 per cent. — were obviously sick and dying. An epidemic may not come more than once in five or ten years, naturally; but each year there is some period during which weather conditions are favorable to the spread of disease, and if the disease germs are present in sufficient numbers everywhere, or can be placed promptly, good results may be secured which would not have come about naturally. One feature of this work which is in itself sufficient to authorize it is the following up the spread of the insects with the disease germs. Brown-tail moths may fly or be carried for long distances. A female may be carried and found a colony twenty miles or more away from the nearest infested point, and in a place where the disease of the brown-tail larva does not exist. It may be years before it gets there under natural conditions, and not until the insect has done great injury and has become plentiful. If in a case like this the disease can be artificially introduced as soon as the colony is discovered, a great advantage will be gained and an epidemic will await only proper climatic conditions.

My experience has been that as against some injurious species disease checks are far more important than any other; and, while I do not mean to say that this will be so in this instance, nevertheless, I do think there is sufficient probability of it to warrant a thorough study of the subject. To illustrate my point, I would refer to the elm-leaf beetle, an introduced species very abundant and in the past very troublesome in New Jersey and indeed in the New England States as well, which has been of late almost completely controlled in New Jersey by disease alone.

About six years ago the disease developed at New Brunswick, and in two favorable seasons so completely destroyed the pupæ that for two years thereafter no spraying was necessary. In the summer of 1905 the disease was not active, and in early 1906 the beetle occurred again in sufficient numbers to disfigure some foliage; but the late summer of 1906 again favored the disease, and this year (1907) there is scarcely a larva to be found. Not a tree has been sprayed, and even if every existing larva comes safely to maturity, there cannot be increase enough to make the insect troublesome in 1908.

It is not improbable, after the experience of 1906, that similar conditions may be brought into existence against the brown-tail moth, and not impossible that some influence may be obtained even against the gypsy moth. At all events, I consider the effort well worth while.

In the direction of field work I have no recommendations to make. The methods now in use seem to cover the ground as well as it can be covered, and the scheme of work devised seems to leave no point unguarded and no opportunity for effective applications missed. It goes

without saying that results from these natural checks will of necessity be slow in demonstrating their effectiveness. Where the caterpillars count by millions and the parasites by thousands merely, even the most favorable results will require a year or two to become perceptible even to the specialist, while they can hardly become obvious to general observation in less than five years. Until that time the work now in progress must be continued, unless the advantage thus far gained is to be again abandoned.

REPORT OF PROF. M. V. SLINGERLAND,

Assistant Professor of Entomology, Cornell University.

Ithaca, N. Y., Aug. 13, 1907.

To A. H. Kirkland, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, Boston, Mass.*

Sir: — Your invitation of May 29, 1907, "to inspect the work of importing parasites of the gypsy and brown-tail moths," was accepted with much pleasure, for it gave me an opportunity to see what progress had been made against these serious pests since last year, when I attended your field day in June. The invitation surprised me, for from what I saw last year of your methods of work, it seemed hardly possible that sufficient opposition could have developed to cause the Legislature to make an appropriation "for the purpose of securing opinions and information from expert advisers relative to matters in connection with parasites" of the gypsy and brown-tail moths.

Arriving in Boston July 2, 1907, I spent five days in carefully and critically investigating and studying the methods employed in connection with the introduction and colonizing of the natural enemies of the gypsy and brown-tail moths, and also in looking over the so-called "handwork" being done against these insects under federal and State supervision in the infested territory in eastern Massachusetts. Furthermore, I consulted with some of those who through their criticisms of the methods and work with natural enemies against these pests finally brought about the enactment of the law providing for this investigation and report.

Any one familiar with the ravages of the gypsy and brown-tail moths during the past few years must be impressed with the different conditions now prevailing, in the residential districts especially. I rode many miles through the suburban towns about Boston, and was much impressed by the thoroughness with which the State law and regulations were being carried out. Most of the trees along the streets and main highways had been banded and were being watched for caterpillars. Only a few years ago many of these trees were being defoliated; now one can see scarcely any signs of infestation in riding along hundreds of miles of shaded streets. These gratifying conditions in the residential districts have been brought about largely by the application of so-called "hand methods," and necessarily at much expense.

I was also impressed by the effective work being done by federal and State authorities to prevent the spread of these pests on vehicles passing along the main travelled roads outside the residential districts. The thorough cutting out of underbrush, and the thinning, pruning, banding and spraying of the trees on both sides of these roads for many miles, will do much to prevent the carrying of the caterpillars into new territory. The truly astonishing and very gratifying results which are thus being accomplished throughout the residential districts and along the main highways against these pests show wise legislation, and very efficient work by those employed to administer it.

A proposition to exterminate the gypsy and brown-tail moths with their natural enemies for the paltry sum of $25,000 is certainly very alluring. It is not surprising that sincere, thoughtful men should be caught with such a bait, and led to use their money and influence to investigate the proposition and its author, and to try to induce the State authorities to invest in such a cheap and alluring "cure-all." I talked with some of those to whom this proposition appeals very strongly, and I have carefully read the report of the lawyer sent to California to investigate the matter. I failed to get from these sources any convincing arguments or information which would appeal to a true scientist who is at all conversant with insect problems. The control of the gypsy and brown-tail moths presents a problem which is scientific in all of its aspects, and one which demands thorough knowledge of insects, their lives, their habits, their inter-relations, their enemies, and man's methods for checking their ravages. In brief, it is an *entomological problem, to be worked out by entomologists trained along economic lines.* This is especially true in the effort now being made to fight these pests with their natural enemies.

It is well known that many insect pests are held in check in their native countries by their natural enemies, so that their periods of destructiveness come at longer or shorter intervals, *but never entirely cease.* And we know from sad experience in America that insect pests introduced from other countries may be more destructive here than in their native home, due largely perhaps to the absence of their natural native checks, which may be other insects or different climatic or environmental conditions. It is an alluring thought that if we could only bring their native enemies here and get them at work the problem of the control of these pests would be accomplished. This is much more easily said than done, but much work has been and is being done along this line in various parts of the world. But as yet no "science of parasitology" for insects has been developed, and if there ever is, its successful practitioners must be entomologists in the broadest sense of the term, and not horticulturists or pseudo-scientists.

All insect pests are not alike in their inter-relations with local conditions and natural enemies, so that the successful control of one pest by the introduction of its enemies is not a guarantee that another insect with very different habits may be similarly controlled. The striking

success attained with the Vedalia lady-bird beetle against the cottony cushion scale in California should not obscure the fact that the Chinese lady-bird beetle failed to adapt itself to American conditions and control the San José scale, and also that there have been many similar failures.

It is well to note also that these alluring offers to control or exterminate insect pests do not come from well-trained entomologists familiar with the pests and conditions, even though they may have had some experience in this work, and are called expert "parasitologists." If such offers were made by true scientists, versed in insect lore; if the State of Massachusetts and federal government had not already provided for the thorough testing of this method of fighting the gypsy and brown-tail moths; and if the work was not now being carried on by trained economic entomologists, to the extent that many thousands of these natural enemies are being liberated in the infested territory, — then there would be some excuse for criticising and hampering the work being done, and asking that the State authorities turn loose the so-called "parasitological scientists" on the problem, and let them try to fulfill their absurd and unscientific proposition.

I found that all of the work with the natural enemies of the gypsy and brown-tail moths coming from foreign countries was being carried on near Saugus in a picturesquely situated dwelling house that was not especially well adapted for laboratory purposes. This temporary laboratory is near some of the worst-infested woodland areas, and thus affords ideal opportunities for planting out colonies of natural enemies. I spent two days at this laboratory in studying the details of the work and the methods employed in caring for the material constantly arriving from Europe. I never spent two more interesting and instructive days in insect work.

The problem of fighting the gypsy and brown-tail moths with their natural enemies from their native homes has been very wisely placed in the hands of Dr. L. O. Howard. No one in this country has had a wider experience with economic insects and is better trained in insect lore, especially that relating to parasitic forms. As the head of one of the great Bureaus of the federal government, he commands facilities and prestige that no one else could in dealing with foreign officials. This has enabled him to establish intimate relations with the leading entomologists and collectors in Europe, and this has resulted in his being able to arrange for and get larger quantities of the natural enemies of these pests from practically all of the infested European countries than could have been done at as little expense by any other American entomologist. Dr. Howard has put his best thought and energies into this work, and the large amount of material I saw coming in almost daily at the Saugus laboratory from several European countries is evidence of the success of his efforts in getting the enemies onto American soil in sufficient numbers to give this method of fighting these serious pests a thorough trial.

I saw more than a hundred small boxes of this foreign material come by mail to the Saugus laboratory in one day. This material is collected in various parts of Europe, and may contain few or many parasites of several very different kinds, and these may be accompanied by their own enemies in the form of secondary parasites. Thus the greatest care and expert attention are needed to properly handle this foreign material. I noted that very fine wire screens were used in all open windows, and the others were tightly closed with paper pasted over all cracks. All doors shut tightly, so that every precaution is taken to prevent the escape of undesirable material from the building, if by any chance it should get out of the cages into which it is placed soon after it arrives.

The many thousands of brown-tail hibernating nests which come from Europe by express in winter are placed in tight boxes, and thousands of parasites emerge and find their way into glass tubes inserted into one side of the box. All secondary parasites are carefully separated out and killed, and the true parasites liberated in badly infested localities. Many of the living larvæ from these winter nests are bred in cages, and when nearly full grown a different parasite develops which breeds freely in American larvæ in cages, and is thus allowed to multiply before being turned loose in the field.

During June and July hundreds of boxes containing later stages of brown-tail larvæ and gypsy caterpillars come by mail from several European countries. These are opened inside a small show-case arranged with armholes through the sides. Two men wearing tightly fitting sleeves and rubber gloves open the boxes through the armholes in the case, and by looking through the glass top of the case they can separate out the parasites and any living larvæ without any danger of their escaping. The tight sleeves and rubber gloves are necessary to protect one from the brown-tail hairs, which cause an irritating "rash." Many Tachinid flies and their larvæ and pupæ are found in these boxes of caterpillars from Europe. These parasites are placed in breeding jars, where they are kept till the flies mate and the larvæ and pupæ develop into the flies. After the flies mate, most of them are taken into badly infested localities and turned loose, while some of them are kept in large field cages or houses in which gypsy and brown-tail caterpillars are living.

The living caterpillars which are found in the European material are placed in cages and fed, with the result that more Tachinid flies are obtained and some Hymenopterous parasites, among which are some very promising enemies of these pests. Most of the parasitic material coming from these European caterpillars is carefully nurtured and multiplied in small cages on American gypsy caterpillars and belated or retarded European brown-tail larvæ from the winter nests, and it is finally turned loose in promising localities in the field.

A little later the European material consists largely of the pupæ of the brown-tail and gypsy moths, and from these emerge Tachinids and *Pimpla* parasites, which are just in time to attack the retarded European

brown-tail larvæ from the winter nests and the belated American gypsy caterpillars. As it is easier to get brown-tail material, like the winter nests, in Europe, many more natural enemies of this insect have been received and turned loose here than of gypsy moth enemies. But some of these enemies attack both the gypsy and brown-tail moths; and, owing to Dr. Howard's thorough work among collectors in Europe, much larger and constantly increasing quantities of gypsy moth material and enemies are now reaching America.

It was interesting to watch the opening of the European boxes containing the large predaceous *Calosoma* beetles, which climb trees to capture and eat the caterpillars. Each beetle came packed in sphagnum moss in a little pill or match box, and a dozen of these in a larger mailing-box. Often two-thirds of the beetles get here alive. Many of these are soon liberated in badly infested localities, and some are put in large house-like cages in the field, where they are kept supplied with caterpillars. These handsome beetles have maintained themselves here, and I saw American-bred beetles in the large cages, and also the first one that had been found in an infested locality in the field.

I was very favorably impressed with all the work being done at the Saugus laboratory with the natural enemies of the gypsy and brown-tail moths. Considering the limited facilities afforded by the improvised dwelling house, and the necessity of constantly working with material that keeps the air loaded with the minute brown-tail hairs which cause the exasperating "rash," I think that the sixteen to eighteen men required to properly care for the material are accomplishing most of the results desired. Detailed records are kept of all material received, and many notes made on the breeding habits and other details observed in the one hundred or more cages. Conscientious effort is made to get out of the European material all the enemies possible, and to try to care for and propagate this to the fullest extent.

At this point I wish to offer a suggestion or criticism. Only one or two of the men employed to care for this wealth of European material are expert entomologists who have had experience in insect breeding. As but little is known of the lives and breeding habits of these natural enemies, new conditions and problems are constantly arising in the work of handling this European material to get the most out of it. I think, therefore, that more entomologists well trained in insect lore should be employed at the Saugus laboratory during the breeding season. This European material is obtained with considerable difficulty and expense, and thus far provision has not been made to continue the work more than a year or so longer, thus every effort possible should be made to use it to the best advantage. Of course it would be interesting and well worth while to make detailed studies of the lives and habits of each of the many different enemies introduced, but the exigencies of a limited appropriation for a comparatively short period and the demands for quick results are sufficient reasons for not having undertaken such work to any great extent. Such studies can be made

at any time by those especially interested after the enemies are well established here. Those in charge of the work are justified in their efforts to get the European material at work in the field on American caterpillars as soon and in as great numbers as possible, leaving the more technical or scientific phases of the work to wait for more permanent appropriations and better facilities.

The work of collecting and introducing into America the principal enemies of the gypsy and brown-tail moths in most of the badly infested European countries is now well organized, and has already resulted in the liberation of many thousands of these enemies in Massachusetts, and is to be continued for another year at least. In spite of all this, and of the fact that never before has there been made and carried out so successfully such an extensive experiment in introducing nature's forces from a foreign country to help man fight his insect foes, yet to silence all critics it will be necessary to scour all other countries in which these pests are prevalent, to determine if other enemies cannot be found and introduced into America to further aid in this warfare. The few feeble attempts to get such material from Japan, where the gypsy moth is a pest, have resulted in the insects all dying *en route*. Enemies different from and said to be equally as effective checks to the gypsy moth as those in Europe are known to occur in Japan. To complete this world-renowned and greatest of all attempts to fight one of nature's pests with its own enemies, every possible effort should be made, without regard to expense, to get living material from Japan in sufficient quantities to give it a fair chance to see what it can do towards helping the already established European enemies in checking the gypsy moth in America. Possibly these Japanese enemies may take more kindly to American conditions, and thus render more efficient aid than those from Europe.

The Commonwealth of Massachusetts is worthy of much praise for the magnificent and costly fight it has made against the gypsy and brown-tail moths during the past fifteen years. Nowhere else in the world has there ever been made such a fight against an insect pest. The million-dollar fight for the extermination of these pests which the State made a few years ago, and unfortunately and unwisely allowed to lapse or cease, has finally resulted in such a widespread distribution of the insects that extermination is no longer seriously considered by those best qualified to judge. This means that the gypsy and brown-tail moths have come to stay, and will gradually extend their domain over more or less of the United States and Canada, taking rank wherever they go among the most destructive of the defoliators of fruit, forest and shade trees. Massachusetts has demonstrated, through the wise administration of its rather stringent but excellent and workable law, that these pests can be checked and their depredations reduced to the minimum by the use of man's devices or so-called "hand methods," at a sum, however, that but few other townships or States could be induced to spend. Now that federal aid has been secured, it is to be hoped that liberal appro-

priations will be continued from this source until all danger from the rapid spread of these pests is overcome, and everything has been done that man's ingenuity can devise and nature's forces can accomplish to reduce the gypsy and brown-tail moths to the rank of such common native pests as the tent-caterpillars, tussock moths, canker-worms and elm-leaf beetle. These native insects have their periods of increase and decrease, or "ups and downs," at longer or shorter intervals.

Massachusetts must not expect too much from the extensive and well-directed efforts now being made to introduce the natural native enemies of the gypsy and brown-tail moths from other countries where they are intermittent pests, due in part to their insect enemies, but also to conditions of environment developed through centuries of nature's changes. While remarkable results have already been obtained in successfully introducing many thousands of Europe's insect foes into the colonies of these pests in America, and while there is evidence that these enemies are breeding here, it may be several years before they make a noticeable impression upon their hosts. The people of Massachusetts must not look for a sudden and wholesale slaughter of these pests by their little European foes.

The work of finding and introducing these natural enemies is being successfully and thoroughly carried on by careful, conscientious and expert workers, at a minimum expense to Massachusetts. The more thoroughly I investigated this work, the more I became convinced that it was being well done, and the less I could find to criticise. If the final results prove of little value in helping to control these pests, it will not be because the work of scouring the earth for their natural enemies and introducing them was not thoroughly and successfully accomplished. This extensive experiment of attempting to control an insect pest with other insects brought from its native homes in various parts of the world will prove one of the greatest object lessons in economic entomology. It must be considered a success from an entomological standpoint, even if these little foes do not succeed in conquering their hosts. Several entomologists are employed by the Hawaiian government to scour the earth for insect enemies with which to fight insect pests in the islands. But the federal entomologist, Mr. VanDine, who has spent several years at the experiment station at Hawaii, and who is thus familiar with the conditions there and the work being done with these natural enemies, has well diagnosed the situation there in the following sentence: "The introduction of such beneficial species will, when they become established, help to solve the problem of Hawaii's insect pests, but cannot be relied upon to exterminate the pests, or render the use of insecticides unnecessary." So far as we know, no serious insect pest has ever been exterminated by its natural enemies, even when aided by man's ablest efforts with insecticides. The most that Massachusetts can hope for from the introduction of the enemies of the gypsy and brown-tail moths is that they will materially help in controlling these pests. Extermination by these little foes is impossible.