New York State Education Department

NEW YORK STATE MUSEUM

65th ANNUAL REPORT

1911

In 4 volumes

VOLUME 2

APPENDIXES 2-4

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1913

STATE OF NEW YORK

EDUCATION DEPARTMENT

STATE OF NEW YORK

No. 34

IN ASSEMBLY

March 18, 1913

65th ANNUAL REPORT

OF THE

NEW YORK STATE MUSEUM

VOLUME 2

To the Legislature of the State of New York

We have the honor to submit herewith, pursuant to law, as the 65th Annual Report of the New York State Museum, the report of the Director, including the reports of the State Geologist and State Paleontologist, and the reports of the State Entomologist and the State Botanist, with appendixes.

St Clair McKelway
Vice Chancellor of the University

Andrew S. Draper
Commissioner of Education

Appendix 2

Economic geology

Museum Bulletin 161

161 Mining and Quarry Industry of New York 1911

Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y. under the act of July 16, 1894

No. 522 ALBANY, N. Y. JULY 1, 1912

New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 161

THE MINING AND QUARRY INDUSTRY

OF

NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1911

BY

D. H. NEWLAND

New York State Education Department

Science Division, June 13, 1912

Dr Augustus S. Downing

Acting Commissioner of Education

SIR: I beg to transmit to you herewith the manuscript of our annual report on *The Mining and Quarry Industry of New York State*, covering the operations and production of the year 1911, and to recommend this for publication as a bulletin of the State Museum.

Very respectfully

JOHN M. CLARKE

Director

STATE OF NEW YORK

EDUCATION DEPARTMENT

COMMISSIONER'S ROOM

Approved for publication this 14th day of June 1912

Augustus S. Downing

Acting Commissioner of Education

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John M. Clarke, Director

Museum Bulletin 161

THE MINING AND QUARRY INDUSTRY

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REPORT OF OPERATIONS AND PRODUCTION DURING 1911

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D. H. NEWLAND

INTRODUCTION

The mineral industries of the State shared the general dulness and reaction which marked the prevailing course of business operations during 1911. Very few branches showed progress as measured in terms of production figures. The period of short-lived prosperity experienced in the preceding year left a condition of overextension in its wake and necessarily caused a more or less radical curtailment of activity during the past season. That the setback is of no serious import to the development of the industries seems certain; in fact the current trend indicates an improvement which if continued should soon reestablish them on the former basis.

The census of production now completed for 1911 shows that the value of the materials taken from the mines and quarries in that year amounted to $31,573,111. As in the preceding year the total reached $35,400,257, a decrease of a little over 10 per cent is indicated for the industries in general.

The figures are based on some 30 different substances in crude or first marketable forms, but can not be considered as representing the full share which the mineral industries have in the business activities of the State. They are serviceable, however, for standards to compare the conditions in these fundamental branches so closely allied with many other industries of chemical, metallurgical and manufacturing nature. It may be noted that the product of iron by the blast furnaces situated within the State alone is nearly equal in value to the output of crude ores and minerals on which the above totals are based.

The iron mines are among the first to feel the effects of market changes, and their contribution last year fell off considerably in response to the decreased demand and lower prices. The gross output was 1,258,873 long tons, as compared with 1,517,880 long tons in 1910. After allowance for concentration of the low-grade magnetic ores there remained for furnace use a total of 952,364 tons, which had a value of $3,184,057. The corresponding figures for 1910 were 1,159,067 tons valued at $3,906,478. The greater part of the product as usual came from the Adirondacks where are some of the largest mines in the East. Altogether there were 11 companies who reported a production, 2 less than in 1910.

The clay-working industries made an output valued at $9,751,659. This also represented a large decrease as compared with the return for the preceding year when the value amounted to $11,518,982. The loss was mainly in the branch that manufactures structural materials such as brick, building tile, terra cotta, fireproofing etc. for which the market was uniformly depressed in regard to both demand and prices. The output of these materials was valued at $6,473,857, against $8,067,008 in the preceding year. The number of brick for building purposes made in 1911 was 1,078,019 thousands, as compared with 1,404,345 thousands in 1910, of which the plants in the Hudson river region contributed about three-fourths. The value of the articles of pottery on the other hand showed a gain and reached the highest total — $2,196,054 against $2,136,518 in 1910 — ever recorded in the State. The number of firms and individuals engaged in the different departments of the clay-working industry last year was 189.

The lessened activity in the building trades also affected adversely the quarry industries which reported an aggregate value of $5,455,312 for their products, as compared with $6,193,252 in 1910. The total was divided acccording to various uses into building stone $632, 085; monumental stone $90,468; curb and flagstone $443,036; crushed stone $2,928,740; other uses $1,360,983. The output of slate, millstones and limestone used in making hydraulic cement is not included in these totals. All kinds of stone were quarried less extensively last year, though the falling off was particularly noticeable in granite, sandstone and marble which are used largely for structural purposes. The production of limestone and trap showed little change from the totals recorded in 1910.

For cement manufacturers the year was very unsatisfactory in that it witnessed the lowest prices known to the trade. That the output in the State should have been well maintained in the circumstances testified to the sound basis on which the local industry has been established. The aggregate production amounted to 3,691,373 barrels, as compared with 3,657,015 barrels in 1910. Portland cement constituted the main part of the total, in actual figures 3,416,400 barrels valued at $2,930,434. The natural cement mills contributed only 274,973 barrels, with a value of $134,900. Eleven plants in all were active, or 1 less than in 1910.

The production of salt from the mines and wells of the State amounted to 10,082,656 barrels, a little under the total of 10,270,273 barrels in 1910, but larger than that of any other year. The value of the output was $2,191,485. Rock salt was obtained from 2 mines in Livingston county, the other producers to the number of 28 obtaining salt from brine wells situated in Onondaga, Livingston, Schuyler, Wyoming, Genesee and Tompkins counties.

Gypsum, a material used principally for the manufacture of plaster of paris and wall plaster, is the basis of a large industry which has developed practically in the last 10 years. It is found in a belt which extends from Madison county on the east to Erie county, associated with the same rocks that yield the rock salt. The output last year, mainly by underground mines, was 446,794 short tons and the value of the marketed products totalled $1,092,598. In the year 1910 the output was reported as 465,591 tons with a value of $1,122,952.

The combined value of petroleum and natural gas, the only representatives of the class of mineral fuels obtained in the State, amounted last year to $2,745,945, against $2,869,893 in 1910. The decline in value was due to the smaller prices secured for petroleum, which more than counterbalanced an increased production of natural gas. The total quantity of oil produced was 915,314 barrels valued at $1,198,868, as compared with 1,073,650 barrels with a value of $1,458,194 in 1910. The gas production was 5,127,571,000 cubic feet with a value of $1,547,077 against 4,815,643,000 cubic feet valued at $1,411,699 in the preceding year.

Among the smaller industries in which local enterprise has a prominent share may be mentioned those of talc, garnet, graphite, and pyrite. The talc is mainly produced from a single district in St Lawrence county, which enjoys a practical monopoly of the trade in fibrous talc. The production last year amounted to 65,000 short tons valued at $552,500, or about the same as in 1910. Garnet for abrasive uses is obtained in Essex and Warren counties, and the quantity reported for last year was 4285 short tons with a value of $121,759. The graphite, all of it the more valuable crystalline variety, amounted to 2,510,000 pounds valued at $137,750, a little under the previous year's total. Pyrite for acid manufacture was produced to the extent of 53,453 long tons valued at $251,466.

The remaining mineral materials which had a place in the list of products for last year were apatite, carbon dioxid, clay, diatomaceous earth, emery, feldspar, marl, millstones, metallic paint, mineral waters, slate pigment, quartz, slate, sand, sand-lime brick and zinc ore. The collected value of these materials was $3,052,143, against $3,579,488 in 1910.

It is worthy of record that a new industry so far as concerns New York State came into existence during the year with the shipment of zinc ore from St Lawrence county, where some promising developments have been in progress.

Mineral production of New York in 1910

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	3 364 255	$2 939 818
Natural rock cement	Barrels	292 760	147 202
Building brick	Thousands	1 404 345	6 683 071
Pottery	....	....	2 136 518
Other clay products	....	....	2 699 393
Crude clay	Short tons	6 005	9 667
Emery	Short tons	978	11 736
Feldspar and quartz	Short tons	18 012	64 503
Garnet	Short tons	5 297	151 700
Graphite	Pounds	2 619 000	160 700
Gypsum	Short tons	465 591	1 122 952
Iron ore	Long tons	1 159 067	3 906 478
Millstones	....	....	6 613
Metallic paint	Short tons	8 063	70 841
Slate pigment	Short tons	1 400	10 900
Mineral waters	Gallons	8 432 672	675 034
Natural gas	1000 cubic feet	4 815 643	1 411 699
Petroleum	Barrels	1 073 650	1 458 194
Pyrite	Long tons	37 270	175 791
Salt	Barrels	10 270 273	2 258 292
Sand and gravel	....	....	2 129 708
Sand-lime brick	Thousands	14 053	82 619
Roofing slate	Squares	14 107	79 857
Slate manufactures	....	....	3 233
Granite	....	....	244 763
Limestone	....	....	3 245 807
Marble	....	....	341 880
Sandstone	....	....	1 451 796
Trap	....	....	909 006
Talc	Short tons	65 000	552 500
Other materials [1]	....	....	258 986
Total value	....	....	$35 400 257

[1] Includes apatite, carbon dioxid, diatomaceous earth, marl and lead ore.

Mineral production of New York in 1911

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	3 416 400	$2 930 434
Natural rock cement	Barrels	274 973	134 900
Building brick	Thousands	1 078 019	5 443 303
Pottery	....	....	2 196 054
Other clay products	....	....	2 083 405
Crude clay	Short tons	14 193	11 982
Emery	Short tons	769	8 810
Feldspar and quartz	Short tons	21 802	75 719
Garnet	Short tons	4 285	121 759
Graphite	Pounds	2 510 000	137 750
Gypsum	Short tons	446 794	1 092 598
Iron ore	Long tons	952 364	3 184 057
Millstones	....	....	13 177
Metallic paint	Short tons	7 237	68 870
Slate pigment	Short tons	1 646	12 864
Mineral waters	Gallons	8 923 628	756 147
Natural gas	1000 cubic feet	5 127 571	1 547 077
Petroleum	Barrels	915 314	1 198 868
Pyrite	Long tons	53 453	251 466
Salt	Barrels	10 082 656	2 191 485
Sand and gravel	....	....	1 727 367
Sand-lime brick	Thousands	15 178	92 064
Roofing slate	Squares	11 273	52 311
Slate manufactures	....	....	Nil
Granite	....	....	148 633
Limestone	....	....	3 174 161
Marble	....	....	278 041
Sandstone	....	....	955 063
Trap	....	....	899 414
Talc	Short tons	65 000	552 500
Other materials [1]	....	....	232 832
Total value	....	....	$31 573 111

[1] Includes apatite, carbon dioxid, diatomaceous earth, marl and zinc ore.

CEMENT

The cement trade in 1911 showed a continuance of the conditions which were noted in the review for the preceding year. Prices were on the same low level, in fact averaging somewhat less than in 1910, but as the demand remained active most manufacturers were able to maintain operations at about the normal rate and thus to secure the greatest economy in production. The local market for cement has been very large owing to the unusual amount of engineering work in the way of public improvements that have been in progress in the State.

The steady decline in the prices that has lasted now for several years has subjected the cement mills to a severe test of efficiency. Some of the mills which were not advantageously situated for economic manufacture or were inadequately financed have been forced out of business. As a consequence the number of producers has fallen off from year to year, though this loss, so far as the portland cement business is concerned, has been more than made good by enlarging the capacity of other plants and by the erection of one or two new mills. In the natural cement branch the effect of the adverse conditions has been very noticeable in the output which has shrunk to a mere fraction of the former quota. The Rosendale district of Ulster county was represented last year by a single producer.

The aggregate output of cement for the year amounted to 3,691,373 barrels, as compared with 3,657,015 barrels in 1910 and 2,610,383 barrels in 1909. The production last year has not been exceeded since 1906. The returns showed that 11 plants were active, or 1 less than in 1910. In 1905 there were 21 cement mills in operation.

As shown in the accompanying table the portland cement mills contributed a total of 3,416,400 barrels valued at $2,930,434, a slight increase over the 1910 figures which were 3,364,255 barrels valued at $2,939,818. The average value of the product was 85.8 cents a barrel, against 87.4 cents in 1910. Seven plants were reported as active, 1 less than in the previous year.

The output of natural cement amounted to 274,973 barrels valued at $134,900, the greater part contributed by the single producer in Ulster county. The total for 1910 was 292, 760 barrels with a value of $147,202. In addition to Ulster county there was a small output in Onondaga county by 3 companies. Erie county, formerly a large producer, was not represented.

Production of cement in New York

YEAR	PORTLAND CEMENT		NATURAL CEMENT	
	Barrels	Value	Barrels	Value
1891	87 000	$190 250	3 931 306	$3 046 279
1892	124 000	279 000	3 780 687	3 074 781
1893	137 096	287 725	3 597 758	2 805 387
1894	117 275	205 231	3 446 330	1 974 463
1895	159 320	278 810	3 939 727	2 285 094
1896	260 787	443 175	4 181 918	2 423 891
1897	394 398	690 179	4 259 186	2 123 771
1898	554 358	970 126	4 157 917	2 065 658
1899	472 386	708 579	4 689 167	2 813 500
1900	465 832	582 290	3 409 085	2 045 451
1901	617 228	617 228	2 234 131	1 117 066
1902	1 156 807	1 521 553	3 577 340	2 135 036
1903	1 602 946	2 031 310	2 417 137	1 510 529
1904	1 377 302	1 245 778	1 881 630	1 207 883
1905	2 117 822	2 046 864	2 257 698	1 590 689
1906	2 423 374	2 766 488	1 691 565	1 184 211
1907	2 108 450	2 214 090	1 137 279	757 730
1908	1 988 874	1 813 622	623 588	441 136
1909	2 061 019	1 761 297	549 364	361 605
1910	3 364 255	2 939 818	292 760	147 202
1911	3 416 400	2 930 434	274 973	134 900

The one new producer added to the list during the year was the Knickerbocker Portland Cement Co., which began operation in the summer at its plant near Greenport, Columbia county. The mill is equipped with three rotary kilns, each 10 by 175 feet, and under full headway is expected to turn out 3000 barrels a day. The limestone quarries are situated on Becraft mountain close by and in proximity to those of the New York-New England Company, in an outlier of the Coeymans and Manlius formations. The clay is obtained locally.

CLAY

The clay-working industries rank first in the value of annual output among the mineral industries of the State. Their prominence is chiefly due to the widely distributed deposits of common clays suited for building brick, drain tile and materials of that class and the very extensive local markets for such articles. As the whole area of New York lies within the zone of Pleistocene glaciation, residual clays are of rare occurrence and of little commercial importance.

Most of the clays that are utilized are modified glacial deposits.

They are commonly of blue color, weathering to yellow at the surface, and contain rather high percentages of iron and fluxing ingredients. Extensive deposits occur in the Hudson and Champlain valleys where they form terraces at different elevations, from near water level to several hundred feet above, and also in some of the large valleys in the interior of the State. These clays generally burn at a relatively low temperature to a red color.

Deposits of white-burning and refractory clays are restricted to Long Island and Staten Island. They belong to the Cretaceous, and occur as scattered, but in some places heavy, beds. They are adapted for fire brick, stoneware, terra cotta and the better grades of building brick.

The single example of any considerable accumulation of residual kaolin that has come to notice is found near Shenandoah, Dutchess county. The property known as Fowler's kaolin mine has produced small amounts of white but rather quartzose material which has found use as stove cement. It appears to be a disintegration product of pegmatite formed in place and by some chance has escaped the general erosion.

The use of shale which is abundant in many of the stratified rock formations has been of increasing importance of late years. The principal beds are found in the Devonic, Hamilton, Portage and Chemung groups. They are worked mainly in the western counties for the manufacture of paving brick, tile and pressed building brick.

PRODUCTION OF CLAY MATERIALS

Details of the production of clay materials in New York State during the last two or three years are given in the accompanying tables which are based on reports from practically every producer in the several branches of the industry.

The general condition of the industry during 1911 can hardly be described as prosperous. Building operations in most of the larger cities were on a scale below the average of recent years and consequently the market for clay structural materials showed little activity. The Hudson river brick industry made relatively the poorest record of any branch, owing to the fact that the yards had to carry over a very heavy stock from the previous year; on the other hand it benefited by a slight increase of the prices in the New York market. The pottery trade fared better than most lines, and the production was well maintained.

The output of clay materials of all kinds in 1911 was valued at $9,751,659. Compared with the total for the preceding year, which was $11,518,982, it represented a falling off of about 15 per cent. The number of firms or individuals engaged in the clay-working industry was 189 against 223 in 1910, and the product was distributed among 39 of the 61 counties of the State.

Production of clay materials

MATERIAL	1909	1910	1911
Common brick	$8 009 766	$6 563 212	$5 310 511
Front brick	149 330	119 859	132 792
Vitrified paving brick	207 970	333 511	307 529
Fire brick and stove lining	486 894	464 693	413 500
Drain tile	268 589	254 679	202 292
Sewer pipe	117 324	127 731	138 258
Terra cotta	962 497	1 062 017	718 700
Fireproofing	166 025	256 820	229 627
Building tile	54 397	65 190	82 217
Miscellaneous	101 497	134 752	20 179
Pottery	1 827 193	2 136 518	2 196 054
Total	$12 351 482	$11 518 982	$9 751 659

A comparison of the items entering into the production shows that the main part of the decrease came from building brick, the output of which was valued at $5,443,303 against $6,683,071 in 1910, a decline of $1,239,768. Common brick accounted for $5,310,511 in the totals against $6,563,212 in the preceding year, and front brick for $132,792 against $119,859. The vitrified paving brick industry showed a slight decline with a total of $307,529 against $333,511. Fire brick and stove lining amounted to $413,500 as compared with $464,693 in the preceding year. The output of drain tile was valued at $202,292 against $254,679, and of sewer pipe at $138,258 against $127,731. The production of terra cotta had a value of $718,700 against $1,062,017 in 1910; fireproofing of $229,627 against $256,820; and building tile, inclusive of roofing tile and floor tile, of $82,217 against $65,190. The miscellaneous clay manufactures, including such items as flue lining, fire tile and shapes, conduit pipes and acid-proof brick, amounted in all to $20,179, as compared with $134,752 in 1910. The potteries of the State reported an output valued at $2,196,054 against $2,136,518 in the preceding year.

Among the counties which contributed largely to the year's total Onondaga held first place and reported an output valued at $912,892. In the preceding year it was fourth in the list with a value of $833,892. The potteries at Syracuse were the most important factors in the production. Ulster county ranked second with a reported value of $829,035, represented entirely by common building brick. Erie county maintained its position as the third largest producer and returned a value of $755,602. Rockland county, which was second in 1910, moved to fourth place last year, contributing an output valued at $747,040. The other counties that reported a value in excess of $500,000 were Dutchess ($648,151) and Orange ($565,152).

Production of clay materials by counties

COUNTY	1909	1910	1911
Albany	$750 754	$641 227	$470 503
Allegany	22 601	*a*	9 000
Cattaraugus	*a*	63 887	90 153
Cayuga	15 400	20 675	15 724
Chautauqua	118 897	129 331	166 322
Chemung	61 000	*a*	76 169
Columbia	472 280	454 550	284 475
Dutchess	880 707	649 862	648 151
Erie	753 362	841 726	755 602
Greene	346 982	266 452	139 578
Jefferson	11 175	7 997	*a*
Kings	490 946	569 720	602 756
Livingston	6 900	*a*	70 295
Monroe	278 991	264 421	325 849
Nassau	136 375	111 650	105 740
Niagara	22 923	22 882	25 426
Oneida	83 500	126 907	95 605
Onondaga	834 111	833 892	912 892
Ontario	196 345	269 549	255 298
Orange	814 440	761 500	565 152
Queens	435 182	551 375	402 398
Rensselaer	317 559	348 172	173 564
Richmond	698 991	633 010	470 591
Rockland	1 488 457	1 080 117	747 040
Saratoga	335 670	388 428	393 490
Schenectady	322 549	505 966	486 327
Steuben	205 036	219 615	149 649
Suffolk	68 370	101 560	73 750
Ulster	1 620 468	1 121 460	829 035
Washington	10 950	3 685	10 350
Westchester	438 243	371 328	297 997
Other counties *b*	112 318	158 038	102 778
Total	$12 351 482	$11 518 982	$9 751 659

a Included under other counties.
b In 1909, aside from counties marked (*a*), are included Fulton, Genesee, Montgomery, New York, St Lawrence, Tioga, Tompkins, Warren and Wayne counties. In 1910, aside from counties marked (*a*) are included Genesee, Montgomery, New York, St Lawrence, Tioga, Tompkins, Warren and Wayne counties. In 1911, aside from counties marked (*a*) are included Clinton, Genesee, Montgomery, New York, St Lawrence, Tompkins, Warren and Wayne counties.

MANUFACTURE OF BUILDING BRICK

The total number of common building brick made in New York State last year was 1,066,982,000. This represented a large falling off from the total reported for 1910 which amounted to 1,396,606,000, the actual decrease being 329,624,000 or 23 per cent. The decline was attributable mainly to the dull conditions in the building trades of the larger cities, notably of New York. The brick yards along the Hudson river which depend almost solely upon the New York City markets for their outlet were operated on a much reduced scale, and their product showed a decrease of nearly 300,000,000 for the year.

The value of the common brick was $5,310,511, or an average of $4.98 a thousand, as compared with $6,563,212, an average of $4.70 a thousand, in 1910. The improved showing was due to the slightly higher prices that were obtained by the manufacturers in the Hudson river valley. In 1909 the average price was $5.31 a thousand. These prices represented the average received at the yards, not inclusive of carriage or selling commissions.

In addition to the common building brick there were manufactured last year 11,037,000 front brick with a value of $132,792. In the preceding year the number of front brick made was 7,739,000 valued at $119,859. The aggregate output of brick for building purposes was thus 1,078,019,000 valued at $5,443,303, against 1,404,345,000 valued at $6,683,071 in 1910. The manufacture of building brick was carried on in 31 counties by a total of 153 companies or individuals. In 1909 there were 32 counties represented in the list with a total of 172 producers. A tendency toward the restriction of the industry to fewer plants and more favorable centralized localities has been in evidence for a number of years. It is more apparent in contrasting the present situation with that for example of 1906 when there were 213 active producers distributed over 37 counties

Production of common building brick

COUNTY	1910 NUMBER	1910 VALUE	1911 NUMBER	1911 VALUE
Albany	74 496 000	$390 894	59 517 000	$319 503
Cattaraugus	612 000	5 984	1 088 000	8 109
Cayuga	2 403 000	16 075	1 813 000	11 724
Chautauqua	5 058 000	32 588	4 140 000	28 406
Columbia	92 700 000	454 550	57 695 000	284 475
Dutchess	147 696 000	649 862	133 229 000	648 151
Erie	51 244 000	283 207	35 975 000	222 673
Greene	30 374 000	137 452	28 779 000	139 578
Jefferson	1 068 000	7 997	....	....
Livingston	312 000	2 184	425 000	2 550
Monroe	19 531 000	111 758	21 100 000	116 600
Nassau	17 000 000	107 500	15 790 000	98 445
Niagara	3 434 000	22 882	3 178 000	25 426
Oneida	19 126 000	119 082	14 434 000	93 105
Onondaga	19 569 000	104 534	22 000 000	132 750
Orange	160 500 000	761 500	121 800 000	565 152
Rensselaer	14 600 000	72 800	13 352 000	67 760
Richmond	32 355 000	134 049	23 456 000	106 823
Rockland	251 190 000	1 080 117	162 400 000	747 040
Saratoga	84 639 000	387 268	81 575 000	392 427
Suffolk	16 360 000	98 560	11 500 000	68 750
Ulster	263 873 000	1 121 460	178 287 000	829 035
Westchester	66 836 000	332 027	52 654 000	263 498
Other counties *a*	21 630 000	128 882	22 795 000	138 531
Total	1 396 606 000	$6 563 212	1 066 982 000	$5 310 511

a Includes in 1910, Chemung, Clinton, Montgomery, Ontario, St Lawrence, Steuben, Tompkins, Warren and Washington counties. In 1911 the same counties are included excepting Steuben which reported no production.

Hudson river region. The greater part of the brick production of the State is made in the Hudson river valley in the stretch from Albany and Rensselaer counties southward to Rockland and Westchester counties. The existence of extensive clay beds suitable for the common grades of brick, the facilities for cheap transportation, and the proximity to the large market of New York City and vicinity combine to make this section the largest brick-manufacturing district in the United States.

The brick clays are found in terraced deposits on either side of the river, extending from the water level to a height of 300 feet or more in places. They are interbedded with and sometimes covered by layers of sand and gravel. Their thickness at any locality may exceed 100 feet, though usually it is much less. Some clay has been obtained by dredging from the bed of the river, as at Haverstraw. The clays are usually of blue color weathering to red or yellow at the surface, and are quite calcareous with an average of from 3 to 6 per cent lime carbonate. In addition to their employment for common brick, they are utilized to some extent for fireproofing and hollow blocks. Slip clay used for glazing pottery is obtained from certain beds of the Hudson river clays.

The common brick are manufactured by the soft mud process and are burned in scove kilns. Machine molding has been tried successfully on some of the clays, but most manufacturers adhere to the old hand process.

There are more than 125 brick yards in the 9 counties along the river, with a combined capacity under full operation of over one and a quarter billion brick a year. So large an output is seldom warranted, however, by the market requirements, and the average product for recent years has ranged around one billion, reaching a maximum of 1,230,000,000 in 1906.

During the last two seasons the demand for brick has been below normal. At the beginning of 1910 the yards still had a stock of about 200,000,000 on hand that remained unsold and with the year's manufacture the total available supply was about 1,300,000,000, of which only 950,000,000 were actually consumed during that season. Consequently the yards carried over about 350,000,000 to 1911. With this formidable accumulation on hand, manufacturers were naturally loath to begin operations, and the opening of the season was delayed beyond the usual time. Many plants reduced their working force; others remained inactive throughout the year. In spite of this curtailment policy which reduced the outturn below that of any previous season for a long time, the market was not able to absorb the supply. It is estimated that about 250,000,000 brick were on hand at the close of 1911. As the number manufactured was approximately 800,000,000 the consumption may be placed at 900,000,000, or about 50,000,000 less than in 1910.

Despite the unfavorable conditions of demand, prices showed some improvement over those reported for the preceding year. The average price received for common brick throughout the district was $4.78 a thousand against $4.54 a thousand in 1910. This represented the average for the sales at the yard and not the New York prices which ranged about $1.25 a thousand higher, an amount equivalent to the cost of river shipment and commissions exacted by the dealers in New York.

The production for 1911 as given in the table herewith was 807,713,000 and was contributed by 96 plants. It has been many years since so few plants were in operation. The number in 1910 was 114. Ulster county as usual held first place in the industry; its contribution was 178,287,000 valued at $829,035, as compared with 263,873,000 valued at $1,121,460 in 1910. Rockland county was second in the list and Dutchess third, the latter displacing Orange county which ranked third in 1910.

The Greater New York Brick Co. was organized during the year to act as selling agents for the manufacturers.

Output of common brick in the Hudson river region in 1910

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	74 496 000	$390 894	$5 24
Columbia	6	92 700 000	454 550	4 90
Dutchess	19	147 696 000	649 862	4 40
Greene	5	30 374 000	137 452	4 52
Orange	8	160 500 000	761 500	4 74
Rensselaer	4	14 600 000	72 800	4 98
Rockland	28	251 190 000	1 080 117	4 30
Ulster	24	263 873 000	1 121 460	4 25
Westchester	8	66 836 000	332 027	4 96
Total	114	1 102 265 000	$5 000 662	$4 54

Output of common brick in the Hudson river region in 1911

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	10	59 517 000	$319 503	$5 37
Columbia	6	57 695 000	284 475	4 93
Dutchess	15	133 229 000	648 151	4 85
Greene	5	28 779 000	139 578	4 85
Orange	6	121 800 000	565 152	4 64
Rensselaer	4	13 352 000	67 760	5 08
Rockland	24	162 400 000	747 040	4 60
Ulster	20	178 287 000	829 035	4 65
Westchester	6	52 654 000	256 449	4 87
Total	96	807 713 000	$3 857 143	$4 78

OTHER CLAY MATERIALS

The manufacture of vitrified paving brick was carried on by four companies in Cattaraugus, Chautauqua, Erie and Steuben counties, the same number as in 1910. The number of paving brick made was 18,996,000 valued at $307,529 against 19,762,000 valued at $333,511 in the preceding year. The price received for paving brick averaged $16.19 a thousand, as compared with $16.88 a thousand for 1910.

The production of fire brick and stove lining was made in Erie, Kings, Rensselaer, Richmond, Schenectady, Washington and Westchester counties, and was valued at $413,500 against $464,693 in the preceding year. Fire brick numbered 7,192,000 valued at $330,659. The stove lining was valued at $82,841. There were 9 companies in operation, or 2 less than in 1910. Most of the refractory clay used by the manufacturers was obtained from without the State, though the company in Richmond county obtained its supply locally.

The output of drain tile was distributed among 9 counties, with Albany as the largest producer. The value of the output, $202,292, showed a considerable decline from the total of $254,679 reported in 1910. There were 16 firms engaged in the industry, 2 less than in the preceding year. The production of sewer pipe, mainly from Monroe county, reached a value of $138,258 against $127,731 in the preceding year. It was contributed by 3 companies.

Fireproofing, including terra cotta lumber, hollow brick, and various other kinds of hollow fireproofing, was made last year by 7 firms, distributed among Erie, Kings, Monroe, New York, Oneida, Onondaga and Rensselaer counties. The value of the output was $229,627 as compared with $256,820 in 1910, when 8 firms were active. Local clays are used for its manufacture. The use of fireproofing has grown quite rapidly and there would seem to be opportunity for an enlarged development of the local industry.

Building tile, inclusive of roofing tile, vitrified floor tile and terra cotta tile, was reported from Allegany, Erie, Kings and Monroe counties by a total of 4 firms, 2 less than in 1910. The output was valued at $82,217 against $65,190 in the preceding year. This is another department of the clay-working industry which deserves greater attention than it has received in the past.

Architectural or ornamental terra cotta declined in value from $1,062,017 in 1910 to $718,700 last year. Its manufacture is carried on by 3 firms in Queens, Richmond and Steuben counties. The Staten Island cretaceous clays are used in part for this product.

The miscellaneous clay materials accounted for a value of $20,179 against $134,752 in 1910.

POTTERY

New York is deficient in clays suitable for the finer grades of pottery such as china and porcelain ware. The clay beds of Long Island, Staten Island and Onondaga county have supplied some stoneware clays, and slip clay of excellent quality is obtainable at Albany. Common earthenware clays also are abundant. There are no kaolin deposits supplying pottery material, and the entire requirements of the local manufacturers are met by purchases from southern mines or by importations from abroad.

Notwithstanding the limitations of resources, the pottery industry has shown a fairly steady growth. The output last year was valued at $2,196,054 and was the largest that has ever been recorded. The corresponding total for 1910 was $2,136,578 and for 1909 it was $1,827,193. The potteries contributing to the total numbered 21, 1 less than in the preceding year, distributed among the following counties: Albany, Erie, Kings, Livingston, Nassau, Onondaga, Ontario, Queens, Schenectady, Suffolk and Washington. Onondaga county alone reported a production valued at $774,477.

Of the various pottery products stoneware is one of the few that has not shared in the general advance of the industry. The production in 1911 was valued at $39,095, or less than one-half of the output five years ago. Red earthenware consisting mainly of flower pots, amounted in value to $32,495, about the usual average. The white products, including china tableware, sanitary ware and electrical supplies, have shown the largest gains; the porcelain and semiporcelain wares were valued at $1,026,517. Most of the china tableware was made in Syracuse and Buffalo, the electrical supplies were made in Victor, Syracuse, Schenectady and Brooklyn; and the sanitary wares in Brooklyn.

Value of production of pottery

WARE	1909	1910	1911
Stoneware	$41 298	$41 925	$39 095
Red earthenware	32 800	25 713	32 495
Porcelain and semiporcelain [1]	999 663	1 027 249	1 048 872
Electric and sanitary supplies	697 573	991 131	1 026 517
Miscellaneous	55 859	50 500	48 075
Total	$1 827 193	$2 136 518	$2 196 054

[1] Includes china tableware and cream-colored ware.

CRUDE CLAY

The clay obtained in a few localities is not utilized by the original producer but is shipped to others for manufacture, some of it going to points outside the State. This production, therefore, is listed separately from that of clay materials. The clay most extensively exploited for shipment is the Albany slip clay which is found in layers within the ordinary brick clay of the Hudson valley. It resembles the latter in appearance but has a finer grain and a larger percentage of the alkaline constituents than the usual run of the deposits. It has consequently a low fusibility and when applied to clay wares as a " slip " gives a rich brown glaze.

The light-colored refractory clays of Long Island and Staten Island and various pottery clays are also shipped to some extent. Returns were received from 6 producers in 1911 and their total shipments of crude clay amounted to 14,193 short tons valued at $11,982. In the preceding year the reported shipments amounted to 6005 short tons valued at $9667. The relatively higher value assigned to the product in 1910 is explained by the large proportion of slip clay included in the total.

EMERY

The mining of emery has been carried on for a number of years near Peekskill, Westchester county, one of the few places in this country where the material is known to occur in quantity. The industry is small, as the native emery does not find so wide a market as the Grecian and Turkish product which can be imported at low cost.

The Peekskill emery is a mixture of corundum, spinel and magnetite chiefly, though the mineral composition is rather variable.

The corundum, which is the most valuable constituent from the abrasive standpoint, may constitute as much as 50 per cent of the entire rock, and in the typical material is often seen in the form of large porphyritic crystals scattered through a fine-grained mass of magnetite and spinel. The rock is dense and hard, of dark gray to nearly black color, sometimes mottled by the lighter crystals of corundum. It occurs as lenticular and banded masses within local intrusions of basic gabbroic rocks which are known as the Cortlandt series. The emery masses are believed to represent segregations of the heavier minerals of the gabbro while the latter were in a molten condition, a process similar to that which led to the formation of the titaniferous magnetites in the anorthosites and gabbros of the Adirondacks. Some of the deposits in Westchester county contain a fairly high percentage of magnetite and were once mined for iron ore, but owing to the high alumina content proved too refractory for furnace use.

The output of emery last year was below the usual average, showing a decline of about 200 tons from the total reported in 1910. The actual amount reported by the producers was 769 short tons with a value of $8810. In 1910 it was 978 short tons valued at $11,736. The maximum product for any recent year has been about 1500 tons.

The emery is all shipped in lump form to abrasive manufacturers, who grind and prepare it for use. The list of producers in 1911 included the Blue Corundum Mining Co., Easton, Pa.; Keystone Emery Mills, Frankford, Pa.; and John Buckbee, Peekskill. In former years the Hampden Corundum Wheel Co. and R. Lancaster have been active in the district.

FELDSPAR

The commercial grades of feldspar are obtained in this State from pegmatite bodies that accompany the crystalline formations of the Adirondacks and the southeastern Highlands. The pegmatite has the composition of granite and represents a coarse phase of that rock originating through specially favorable conditions of crystallization supplied, perhaps, by abundance of water vapor. It is commonly associated with granites and granitic gneisses, but may be found as offshoots or independent bodies surrounded by rocks of quite different character. In the granite areas it occurs frequently in lenticular and irregular masses which show no distinct boundaries but grade by imperceptible stages into the finer-grained rock. Elsewhere the pegmatite shows intrusive relations with the county rocks, forming dikes and bosses with well-defined walls.

The feldspar is predominantly a potash variety, that is either orthoclase or microcline, but soda feldspar or albite and the lime-soda varieties are frequently represented. Microcline is by far the commoner of the potash feldspars in the New York localities. For pottery purposes it is an advantage to have the feldspar in large well-segregated crystals or masses so that it can be readily freed from the accompanying minerals. In the pegmatites which are quarried for pottery spar, the crystals range up to 3 or 4 feet in diameter. The pegmatites of finer texture and those in which the minerals are intimately intergrown have application principally for roofing material.

Quartz is an important ingredient of all pegmatites and if obtainable in pure condition may also have value. It is an important by-product, for example, of the Bedford quarries. It occurs in irregular masses, seldom showing any traces of crystal form, and is of gray, white, or pink color. When intergrown with the feldspar to any extent it detracts from the value of the latter for pottery use, though quartz is a necessary ingredient of the pottery mixture.

The accessory constituents of the pegmatites include a variety of minerals of which the commoner are the micas, hornblende, pyroxene, and tourmalin, while of less frequent occurrence are garnet, magnetite, pyrite, epidote, titanite, and beryl. Black tourmalin is nearly always present in the Adirondack pegmatites. These constituents may be of determinative importance with reference to the commercial value of a pegmatite occurrence, since if disseminated through the mass they preclude the extraction of high-grade material.

The only feldspar quarries that have been worked during the past year are situated in Westchester and Essex counties. Those near Bedford, Westchester county, have yielded most of the higher grade product used for pottery and enamel ware; they are operated by P. H. Kinkel's Sons. They are opened in a large mass of pegmatite that outcrops on the eastern and northern slopes of the hill lying a little south of Bedford village. In addition to the feldspar there is a considerable output of quartz which is sold for wood filler. The feldspar is shipped in three grades, of which no. 1

grade consists of pink microcline practically free of quartz. It is all sold in crude condition for pottery use. No. 2 consists of white albite with more or less quartz and is ground at the local mill before shipment. It goes mainly to enamel ware manufacturers. No. 3 grade carries quartz, as well as more or less of the iron-bearing minerals, and finds application in glass manufacture. It is likewise ground locally.

The quarries in Essex county are situated near Ticonderoga and Crown Point. Those at the former locality are owned by the Barrett Manufacturing Co., which utilizes the product mostly for prepared roofing material. The pegmatite is broken down and sent to the mill without sorting. It is thus a mixture of feldspar, quartz and other minerals.

The quarries of the Crown Point Spar Co., just south of Crown Point, produce crushed feldspar for roofing purposes, poultry grit and concrete, and some that finds use in enamel ware. They are situated on top of Breed's hill, an elevation mainly composed of black hornblende-biotite gneiss in which the pegmatite appears to form a bosslike intrusion measuring several hundred feet in diameter. The feldspar consists of pink microcline and white or greenish albite. It is frequently intergrown with quartz, but may form separate masses up to 5 or 6 inches in diameter. Biotite is the chief dark mineral and appears in seams, or as a coating on the feldspar. The pegmatite has been squeezed or fractured, and there is a noticeable development of secondary chlorite. The quarries are connected with the mill which is situated at the lakeside over a mile away by an aerial tram. The product is there crushed and graded into different sizes for use as roofing material, poultry grit, and in concrete. A part of the product is sold also to the enamel ware trade.

The production of feldspar, including crushed unsorted pegmatite, amounted in 1911 to 15,652 short tons valued at $61,769. This showed a slight gain compared with the totals reported for previous years. In 1910 the output was 12,132 short tons valued at $46,863 and in 1909 it amounted to 13,871 short tons valued at $46,444. Market prices remained unchanged; the crude feldspar for pottery uses brought about $3 a ton, the ground spar for pottery and enamel ware $6, and the crushed material for roofing, poultry grit, etc., about $3 a ton.

NOTES ON THE OCCURRENCE OF FELDSPAR IN NEW YORK

It is the purpose of the present notes to call attention to some little known or undeveloped feldspar deposits which were visited in the summer of 1911 during the course of a field investigation of the granite quarries of the State. A report on the feldspar deposits of the United States was issued in 1910 by the United States Geological Survey. The report, contributed by Edson S. Bastin, contains a very detailed description of the better known local occurrences from which the supplies of feldspar have been obtained in recent years, but omits mention of those here considered.

Crown Point, Essex county. The pegmatite occurrence called Roe's spar bed has been a source of feldspar for pottery purposes, having been worked some 15 years ago and the product shipped to potteries outside the State. It has received only fugitive attention in the geological reports relating to Essex county, though mentioned in one of the papers by J. F. Kemp as an important deposit. It is chiefly known at present as an interesting mineral locality.

The deposit is most conveniently reached from Crown Point, from which it lies about 8 miles distant in a northwesterly direction. It outcrops about 1 mile directly south of Towner pond at an elevation of between 1100 and 1200 feet, as shown on the topographic map. It is now the property of Mr H. W. Willcox.

The old quarry working shows a face about 50 feet high and 75 feet wide in a body of pegmatite which seems rather a lenticular or boss-shaped mass than a dike. The outlines, however, are not clearly revealed by outcrops and there is some uncertainty as to the extent of the deposit. The longer axis appears to run about n. 50° e., as indicated by a series of openings below the main quarry which follows that direction. The width of the exposed part at right angles is from 75 to 100 feet.

The pegmatite is very coarse and the components well segregated. Feldspars with a diameter of 3 feet are not uncommon. They often show crystal boundaries. Quartz is of subordinate importance, but is rather unequally distributed. It is partly of pink color and partly the milky variety. Graphic intergrowth of quartz and feldspar is not abundant. The iron-bearing minerals are chiefly biotite and tourmalin and though fairly plentiful on the whole they are usually concentrated in certain parts of the deposit so that their presence would not necessarily entail any great waste in the production of pottery material. The existence of trap dikes, of which four were noticed in the quarry face, varying from 1 inch to 4 feet thick, is of some consequence though probably not a very serious drawback.

The feldspar includes a pinkish variety which shows the characteristic optical properties of microcline and a light-gray oligoclase. They appear to be in about equal amounts.

In the former operations which were carried on by Mr Roe, the spar was hauled to Crown Point for shipment. The costs of haulage are reported to have been $1.50 a ton in summer and $1.25 in winter. The stretch of road from the quarry to Crown Point Center is over a rough country but chiefly with descending grade.

Chestertown, Warren county. There are openings in a pegmatite body that is situated on the north side of a high ridge about 3 miles south of Chestertown and 1.5 miles east of the Warrensburg road. They are said to date back about 15 years. The purpose of the operations was to produce mica rather than feldspar. Two workings may be seen of which the principal one lies to the south and higher up on the ridge. This consists of an open cut about 50 feet long and 15 feet wide on a dike or elongated body of pegmatite that strikes northeast. The limits of the mass are indeterminate except on the east side of the pit where the county rock is exposed a few feet away. The northern pit reveals very little as to the size of the pegmatite mass or the conditions of its occurrence, being a narrow opening which at the time of the writer's visit was filled with water. It may be on a separate body.

The pegmatite is a coarse intergrowth of white feldspar, quartz and mica. The last named mineral is chiefly biotite with a brownish variety in subordinate amount. The latter may be muscovite but it is not of good quality being in imperfect crystals that show rulings. The largest crystals measure about a foot in diameter. Black tourmalin is quite common in the feldspar and quartz. The feldspar appears in pure masses and also as graphic intergrowths with the quartz. It belongs to the potash variety with the optical properties of microcline.

Fort Ann, Washington county. An exposure of pegmatite near this place has been worked at different times for feldspar and quartz. It is reported as one of the localities from which quartz was obtained for grinding at the mill that was operated at Fort

Ann about 25 or 30 years ago. More recently it has been a source of feldspar for shipment and has been worked intermittently according to the market demand, the last time by Dominick Ashley of Glens Falls.

The outcrop lies about 2½ miles northwest from Fort Ann at the base of the gneiss ridge of which the higher part is known as Putnam mountain. It is on or near the farm of Ira D. Gilmore. It consists of a rather irregular area, though the general shape is lenticular, with its longer direction nearly transverse to the general axis of the ridge, or to the northwest. An open cut about 125 feet long and from 30 to 40 feet deep has been made. The lens is broadest near the southeastern end where it measures fully 75 feet wide. To the northwest it gradually diminishes and wedges out in the gneiss 50 feet beyond the end of the pit. When visited by the writer the workings were partly filled with water and the deeper parts of the excavation consequently could not be inspected. The wall rock as seen in exposures nearby is a well-laminated biotite gneiss.

The pegmatite is made up largely of graphic granite, that is an intimate mixture of feldspar and quartz, but the two minerals also occur separately to a considerable extent. Masses of milky quartz up to 2 or 3 feet in diameter are found and also feldspar crystals of similar dimensions. The feldspar is mainly of grayish color and so far as tested appears to consist largely of microcline. There is present also a little pinkish feldspar which may be orthoclase. Tourmalin and the iron-bearing silicates generally have a very limited representation, though the pegmatite shows much iron stain, the result perhaps of pyrite.

Alteration of the feldspar is much in evidence in parts of the exposure. This results in the formation of kaolin and sericite and sometimes is accompanied by a greenish coloration of the secondary products which is probably the effect of intermingled serpentine. The presence of this mineral can not be traced to any magnesium component of the pegmatite, but seems referable to an interchange of the alkaline constituents of the feldspar for magnesium which has been introduced perhaps by ground waters.

Kushaqua, Franklin county. A large pegmatite body is found about 4 miles north of this place on the slopes of Sable mountain. It has been prospected during the last few years but has not supplied any feldspar in commercial quantity. The outcrop lies high up on the mountain near the summit at an elevation probably of about 2500 feet above sea level. It is reached by a rough trail from Kushaqua.

Two openings have been made in the body which is elsewhere concealed by surface materials. The lower of these exposes the pegmatite over a width of 50 feet and a depth of 25 feet. The upper opening is a little smaller. There are said to be other prospects on the mountain which were not visited but which indicate that the pegmatite has the form of a dike and continues for over half a mile along the strike.

The feldspar is red microcline, showing little tendency to assume regular outlines. The rough and somewhat broken masses measure a little over a foot in diameter as a maximum. It is rarely free from admixture with other minerals and consequently could not be quarried to advantage for pottery use. Hornblende, tourmalin and biotite are the chief iron-bearing silicates.

De Kalb, St Lawrence county. The existence of a ledge of coarse pegmatite in this section was made known to the writer by J. H. McLear of Gouverneur. The locality is between East De Kalb and Bigelow, about 3 miles north of the latter place. The pegmatite is exposed in a natural outcrop that has not as yet been developed.

The principal showing consists of a ledge which exposes the pegmatite for a distance of 75 feet along the strike and 40 feet across it and then disappears below the surface deposits. The outcrop is fresh and free from iron stain. The pegmatite consists of white feldspar and milky quartz in fairly pure aggregates in a matrix formed by a fine intergrowth of the same minerals. The individual feldspar crystals range from 6 inches to 3 feet in maximum diameter. There appears to be very little admixture with other minerals usual to pegmatites. Pyrite, however, may be observed occasionally in the quartz. A second ledge in the same line of outcrop is exposed about 300 feet distant from the first, with similar characters. The quality of the feldspar so far as it may be estimated under the conditions, appears to be fairly good. The samples that were examined show it to be practically all microcline. A quantity of first-grade material could be extracted, but the main part owing to admixture with quartz would have to pass probably as lower grade. There is need for thorough prospecting to confirm the estimate that is formed on the surface showing, as well as to determine the size of the body.

Fowler, St Lawrence county. A dike of pegmatite carrying finely crystallized feldspar is found on the farm of C. W. Denesia about 2 miles south of Fullerville in the town of Fowler. It is only exposed, however, over a very limited area and where seen its width is not over 8 feet. The feldspars are developed in prismatic crystals from 2 to 3 feet long. They are inclosed in a ground mass of intergrown quartz and feldspar with which tourmalin and biotite are associated. They consist of a deep red microcline and a pinkish variety which is an intergrowth of microcline and albite. Unless the dike proves of greater magnitude than is indicated by the exposed part it would hardly be workable.

Fine, St Lawrence county. The occurrence of pegmatite on the farm of Fred Scott, about 4 miles north of Oswegatchie in the town of Fine, is of interest particularly for the associated minerals. These include fluorite, hornblende, pyroxene, pyrite, chalcopyrite and titanite in well-crystallized individuals. The feldspar occurs in pink, white and greenish varieties, evidently representing both the potash and lime-soda series. It is too much intergrown with the other minerals to have commercial value.

GARNET

The Adirondack garnet mines reported an output last year of 4285 short tons with a valuation of $121,759. This was less than in 1910 when the total amounted to 5297 short tons valued at $151,700 but may be considered as about the average outturn. The production has varied from year to year according to the activity of the market but at no time has taxed the full capacity of the mines. In fact the demand for abrasive garnet has shown very little tendency to increase, and there would seem to be little opportunity at present for the development of new sources of supply.

No important changes in the industry have taken place during the past year. The principal producers, as heretofore, were the mines in the vicinity of North River. The largest factor in the industry has been for some time the North River Garnet Co. with mines and milling plant on Thirteenth lake, Warren county. The other active mines in that section included those on Gore mountain owned by H. H. Barton & Son Co. and those of the American Glue Co., a little farther north in Essex county. At Riparius, the Warren County Garnet Mills have operated in a small way. In northern Essex county near Keeseville the American mine shipped some material.

The conditions surrounding the occurrence of garnet in the Adirondacks have been described in several papers and in previous issues of this report. The mineral is fairly widespread as a constituent of the metamorphosed igneous and sedimentary rocks, but only in a few places is it found in sufficient abundance and with the requisite characters to be worked for commercial abrasive purposes.

The value of abrasive garnet depends, of course, primarily upon its hardness. This is a variable character and on the usual mineral scale garnet is classed as having a hardness of from 6.5 to 7.5. The limits as given are only approximate, as it is difficult and even impossible to estimate hardness with precision. Chemical composition is undoubtedly a factor in determining the hardness of the common kinds of garnet found in the metamorphosed rocks, like gneisses, schists and crystalline limestones. The iron-alumina variety (almandite) is generally harder than the lime-alumina (grossularite), or the lime-iron variety (andradite). Well-crystallized garnet is tougher and probably also harder than the granular or massive garnet of similar chemical composition. The property of toughness or tenacity is very important in an abrasive which has to withstand considerable pressure as when used as polishing machines. Another factor which has a bearing upon the value of abrasive garnet is the size of the product which can be secured in the ordinary practice of mining and separation. If the crystals are small or have been badly shattered by compression after crystallization the product may be too fine to yield the necessary assortment of commercial sizes. It is an advantage, however, that the garnet should possess an imperfect cleavage or parting, so that on crushing the grains show one or more smooth surfaces. These surfaces permit firm attachment to the cloth or paper and also provide a sharp cutting edge. Color is no criterion of quality in ordinary garnet, but abrasive users seem to prefer the darker shades of red which approach the distinctive garnet color.

The local industry has very little competition from other mines in this country. Mines have been worked at different times in New Hampshire, Massachusetts, Pennsylvania and North Carolina but have not proved permanent factors in the trade. The importation of Spanish garnet, first noted in 1907, has assumed some importance as a substitute for the finer sizes of the Adirondack mineral. This garnet is said to be obtained by concentration of alluvial sands and can be produced cheaper than the domestic garnet, but comes only in the finer sizes. It pays no import duty. The importations in 1911 were 693 short tons, with an invoice value of $10,526. In 1900 they amounted to 775 short tons valued at $14,830. The principal ports of entry are New York, Boston and Chicago, and the shipments are made from both Spanish and British ports.

GRAPHITE

No noteworthy developments were recorded for the graphite industry during 1911. The production amounted to 2,510,000 pounds, about the usual quantity, and represented a value of $137,750. The total for the preceding year was 2,619,000 pounds, with a value of $160,700. Prices appeared to be somewhat lower; the reported average was about 5.5 cents a pound, as compared with 6.1 cents in 1910.

The American mine at Graphite, owned by the Joseph Dixon Crucible Co., continued as the leading producer. This mine has long been the largest and most successful of the kind, not only in the State but in the country as well, and may be considered the pioneer enterprise in all that relates to the technology of treating the disseminated flake graphite which constitutes the principal source of domestic production. The methods of extracting and refining the graphite as developed by its management have seldom been applied elsewhere with similar results, owing in some measure undoubtedly to the unusually favorable natural conditions found at Graphite. The ore is a quartzite carrying flakes of graphite distributed along the cleavage planes. The flakes are relatively of large size, showing the appearance of having been squeezed out by regional compression, and measure up to one quarter inch in diameter. The average content in graphite may be placed at about 6 or 7 per cent. What is most important to the success of the milling operations is the practical absence of micaceous minerals which are more or less common in the graphitic schists and quartzites of the Adirondacks. When present in any amount a high-grade graphite product can not be expected.

The deposits of the American mine have a northeast-southwest strike and their extension to the southwest is found on the adjoining lands owned by W. H. Faxon of Chestertown, N. Y. This property has been explored recently with considerable thoroughness by test pits and diamond drilling, but still awaits active development. The exploration has demonstrated the continuity of the graphite beds over a distance of fully 4000 feet along their course to the southwest and with some interruptions for several hundred feet on the dip which follows a low angle to the southeast. The same series of gneisses, limestones and graphitic quartzites is found here as in the area under exploration. The graphitic quartzite that constitutes the principal ore body has a thickness ranging from 5 or 6 to 25 feet, showing local pinches and bulges as is usual in the Adirondack deposits. There is considerable variation in the size and abundance of the flake, but as a whole the character of the quartzite is quite like that in the American mine. Near the southwestern end of the property the graphite series outcrops in a little ravine where a short drift has been extended into the north bank; two distinct beds are found here separated by a band of garnetiferous gneiss. In a drill hole (No. 2) 300 feet or so northeast of the drift a similar relation holds, the upper bed measuring about 4 feet and the lower 18 feet thick with 26 feet of gneiss between them. The two beds appear to merge a little further northeast for in No. 3 drill hole just east of the camp a single seam over 20 feet thick was encountered and this apparently continues with local variations as to thickness to the northeastern limits of the property, except in one place where the series is invaded by a gabbro intrusion. The deepest hole, No. 7, was put down in the flat about 600 feet east of No. 3 and twice that distance from the outcrop of the graphite bed on the ridge to the northwest. The data for this boring have been kindly supplied by Mr Faxon and are illustrative of the general conditions under which the graphite occurs.

STRATA	THICKNESS FEET	THICKNESS INCHES
Rock with large flake graphite	2	0
Garnetiferous gneiss	20	0
Garnetiferous gneiss and limestone	24	0
Limestone	9	0
Limestone and quartz	8	10
Limestone	36	8
Black rock (hornblende?)	4	0
Limestone	5	3
Lost core	1	6
Graphite	0	6
Good flake graphite	5	4
Fine flake graphite	5	6
Good large flake graphite	12	2
Garnetiferous gneiss	24	0
Black rock	5	8
Total	164	5

In hole No. 1 on the northeast, next to the American property the graphite bed measured 20 feet thick.

The Empire Graphite Co., owning mines in the town of Greenfield, Saratoga county, 4 miles west of Kings, was active during a part of the year. The work consisted mainly of development incident to a change from surface to underground methods of mining. The deposit along the outcrop has been decomposed with the formation of clayey matter which complicated the separation of the graphite. The matrix is a feldspathic quartzite resembling that at the American mine, but the flake averages a little smaller in size. Two distinct beds are in evidence, separated by 4 feet of limestone and barren quartzite. The upper bed has a thickness of from 10 to 14 feet and the lower of from 4 to 5 feet. The immediate walls consist of mica schist, carrying pyrite, but thick-bedded garnetiferous gneisses occur in the upper part of the series, south of the workings. The outcrop of the beds strike nearly east and west and is marked by a slight depression in the easterly sloping ridge. It is traceable for 1500 feet or more from the present mine openings which are at the eastern end of the outcrop. The dip is about 30° south. The principal development aside from the open cuts consists of an adit driven in the side hill along the course of the upper seam for a distance of about 125 feet. Additional workings will be necessary before the mill can be maintained in steady operation. This is a large concrete structure situated on the side hill at the mines. It is equipped with a gyratory crusher, 10 stamps, and rolls for the reduction of the ore. The separating equipment includes buddles, settling tanks, screens and dryers.

The Saratoga Graphite Co. has lately erected a mill near Kings Station north of Saratoga Springs.

The other properties in the eastern Adirondacks that have been active during the last few years include the Conklingville mine of the Sacandaga Graphite Co., and the mine near Chilson lake, owned by the Crown Point Graphite Co.

A small quantity of graphite has been shipped recently by the Macomb Graphite Co., from its property near Popes Mills, St Lawrence county.

GYPSUM

The remarkably rapid progress that has characterized the gypsum industry during recent years was interrupted in 1911 and the output showed a decline amounting to about 4 per cent. The setback may be attributed doubtless to the lessened activity in the building trades, as most of the output was used for the manufacture of calcined plasters and for admixture with portland cement. There was a similar falling off in many other industries based on the production of building and structural materials. It may also be said that the period of rapid expansion marking the development stage of the gypsum industry is probably over and that progress henceforth will be slower and less constant than in the past.

The output based on the crude rock mined or quarried last year amounted to 446,794 short tons. The corresponding total for the preceding year was 465,591 short tons, showing a decrease of 18,797 short tons, compared with a gain of 87,359 tons in 1910. With the one exception the product last year was the largest on record.

Of the total as given about 70 per cent was consumed by the local calcining plants operated in connection with the mines for the manufacture of plaster of paris and wall plasters. The reports of these plants showed a production of 262,249 tons of calcined plasters with a value of $871,106. The outturn for 1910 was 250,228 tons valued at $838,340. The quantity of gypsum ground for land plaster was reported as 9959 tons valued at $18,508, against 12,597 tons valued at $28,100 in 1910. The sales of crude or lump gypsum, chiefly to portland cement works, accounted for 144,035 tons valued at $202,984, as compared with sales of 178,518 tons valued at $256,512 in the preceding year.

Production of gypsum

MATERIAL	1910		1911	
	SHORT TONS	VALUE	SHORT TONS	VALUE
Total output, crude	465 591	....	446 794	....
Sold crude	178 518	$256 512	144 035	$202 984
Ground for land plaster	12 597	28 100	9 959	18 508
Wall plaster, etc. made	250 228	838 340	262 249	871 106
Total	....	$1 122 952	....	$1 092 598

The output of gypsum and gypsum products as given was reported by 14 firms and was divided among the five counties of Onondaga, Cayuga, Monroe, Genesee and Erie. The greater quantity of rock was obtained in the western section where it found use mainly in the production of calcined plasters.

In Onondaga county there was less activity than usual. The Fayetteville Gypsum Co. produced most of the crude gypsum obtained in the county and shipped the output to New York City for calcination. The property operated by the company was the

Severance quarry near Lyndon, notable for the great thickness of the gypsum beds which are exposed around the summit of a hill and have a vertical extent of from 40 to 60 feet. They are worked by open cut excavation, after first blasting down the overlying shale and limestone which are from 20 to 25 feet thick. The lump gypsum is loaded on 20-ton wagons and hauled 2 miles by a traction engine to the Erie canal for shipment. The quarry formerly worked by the National Wall Plaster Co., in the same vicinity, produced some gypsum which was ground in the local mills to land plaster.

The quarries at Union Springs, Cayuga county, were worked during the year by local interests, the lease under which they had been operated for several years by the United States Gypsum Co. having expired. Most of the output from this place has been used for land plaster and for portland cement. The gypsum ranges from 20 to 30 feet thick and is worked by quarry methods.

In Monroe county around Garbutt the usual activity was manifest, though there was one less producer than in the preceding year. The Garbutt Gypsum Co., one of the pioneers in the district, closed down its mine and mill. The active companies were the Consolidated Wheatland Plaster Co., the Empire Gypsum Co., the Lycoming Calcining Co., and the Oatka Gypsum Co., the last named succeeding the Monarch Plaster Co. The gypsum occurs in two seams, each from 5 to 8 feet thick, separated by from 6 to 12 feet of limestone. Only the upper seam has thus far been attacked. The work is all underground, conducted through adits or shallow vertical shafts. About one-fourth of the output last year was marketed as crude or ground raw gypsum, the rest being converted into calcined plasters. Monroe county held second place in quantity and value of its products.

The active mines in the western section were those of the United States Gypsum Co. and the Niagara Gypsum Co. near Oakfield, Genesee county, and of the American Gypsum Co. and the Akron Gypsum Co. near Akron, on the Erie-Genesee county boundary. Their output was consumed mainly in the manufacture of wall plasters by the plants located at the mines. The American Gypsum Co., however, shipped most of its output to portland cement makers. The gypsum beds in this section are rather thin, averaging not more than 4 or 5 feet, but they are of high-grade character, well adapted for calcination. The mines are worked through vertical shafts in a manner similar to that employed in coal mining. Their equipment and management are based on the most modern approved methods, some of the mines being operated by electric power.

IRON ORE

The record of the iron mining industry last year was uneventful. The reports from the individual companies covering the year's operations indicated the usual number of active enterprises but the average quota was less than for some time and in most sections diminished attention was given to exploration and development work. Unsatisfactory market conditions were responsible for the poor showing. The large production of iron in the preceding year proved to be in excess of the market requirements and brought on a slump which extended well into the season of 1911. There was consequently very little inquiry for ore during the early months. The absorption of the surplus output was facilitated by radical price cutting and by the middle of the year the conditions so far as related to the demand were somewhat improved. This change in the situation proved permanent and enabled the mining companies to dispose of most of their output for the year though at reduced prices. At the close of the season the outlook for the immediate future seemed fairly encouraging.

The production of iron ore in the State during the last two decades is shown in the accompanying table. The figures are based on lump ore and concentrates of commercial grades and not on the mine output which is considerably larger. The volumes of the *Mineral Resources* published by the United States Geological Survey have supplied the data for the years previous to 1904.

Production of iron ore in New York State

YEAR	MAGNETITE	HEMATITE	LIMONITE	CARBONATE	TOTAL	Total value	Value per ton
	Long tons	Long tons	Long tons	Long tons	Long tons		
1891	782 729	153 723	53 152	27 612	1 017 216	....	.....
1892	648 564	124 800	53 694	64 041	891 099	$2 379 267	$2 67
1893	440 693	15 890	35 592	41 947	534 122	1 222 934	2 29
1894	....	....	....	....	242 759	....	.....
1895	260 139	6 769	26 462	13 886	307 256	598 313	1 95
1896	346 015	10 789	12 288	16 385	385 477	780 932	2 03
1897	296 722	7 664	20 059	11 280	335 725	642 838	1 91
1898	155 551	6 400	14 000	4 000	179 951	350 999	1 95
1899	344 159	45 503	31 975	22 153	443 790	1 241 985	2 80
1900	345 714	44 467	44 891	6 413	441 485	1 103 817	2 50
1901	329 467	66 389	23 362	1 000	420 218	1 006 231	2 39
1902	451 570	91 075	12 676	Nil	555 321	1 362 987	2 45
1903	451 481	83 820	5 159	Nil	540 460	1 209 899	2 24
1904	559 575	54 128	5 000	Nil	619 103	1 328 894	2 15
1905	739 736	79 313	8 000	Nil	827 049	2 576 123	3 11
1906	717 365	187 002	1 000	Nil	905 367	3 393 609	3 75
1907	853 579	164 434	Nil	Nil	1 018 013	3 750 493	3 68
1908	663 648	33 825	Nil	Nil	697 473	2 098 247	3 01
1909	934 274	56 734	Nil	Nil	991 008	3 179 358	3 21
1910	1 075 026	79 206	4 835	Nil	1 159 067	3 906 478	3 37
1911	909 359	38 005	5 000	Nil	952 364	3 184 057	3 34

The production in 1911 as reported by all the active mines was 952,364 long tons valued at $3,184,057. Compared with the reported output of 1,159,067 long tons for 1910 there was a decline of 206,703 tons or about 18 per cent. The average value was $3.34 a ton against $3.37 a ton in the preceding year; but the decline in the market prices was greater than indicated by this comparison since the average grade of the ore as shipped was considerably higher in 1911 than in 1910.

Of the output magnetite constituted a total of 909,359 long tons and represented a value of $3,088,869. The quantity of hematite mined was 38,005 long tons, all from the Clinton belt, with a value of $88,188. A few thousand tons of limonite were shipped from the Dutchess county district. No carbonate ore was produced.

The output of magnetite was made up largely of concentrates and consequently did not represent the full quantity of that ore hoisted from the mines. The actual mine output of magnetite was 1,215,868 tons. The total quantity of ore of all kinds hoisted during the year therefore was 1,258,873 tons. In 1910 the corresponding total was 1,517,880 tons.

The list of companies that were active in the industry last year included for the Adirondack region: Witherbee, Sherman & Co. and the Port Henry Iron Ore Co., at Mineville; the Cheever Iron Ore Co., Port Henry; the Chateaugay Ore and Iron Co., Lyon Mountain; and the Salisbury Steel and Iron Co., Salisbury Center. The Benson Mining Co., at Benson Mines, was engaged in erecting a new mill but did not contribute any output last year. The producers of magnetite in southeastern New York were the Hudson Iron Co., Fort Montgomery, and the Sterling Iron and Railway Co., Lakeville. The single producer of limonite in the region east of the Hudson river was the Amenia mine. The output of hematite was made by C. A. Borst, Clinton; Furnaceville Iron Co., Ontario Center; and Ontario Iron Ore Co., Ontario Center.

Mineville. The two companies at Mineville maintained steady operations throughout the year, though on a somewhat reduced scale as compared with their output in 1910. The amount of ore hoisted was reported as 734,353 tons, against 953,553 tons in the preceding year, which was the largest on record.

The mines operated by Witherbee, Sherman & Co. included the Old Bed, Harmony and Barton Hill groups. Both lump ore and concentrates were shipped, the concentrates being supplied from No. 1 and No. 2 mills on the Old Bed and No. 3 mill on the Harmony group. The lump ore came from the Old Bed.

The Old Bed workings, reached through the Joker and Bonanza shafts, have been enlarged recently by the development of a separate bed underlying the main deposit. This lower ore body spreads over a considerable area as a nearly flat sheet, in strong contrast with the complex overlying body, and has a thickness up to 30 feet. The ore resembles that of the Old Bed proper, but contains a little less apatite. Both the Joker and Bonanza shafts have been connected through to the deposit which furnished last year about one-half of the quantity hoisted from the Old Bed group. The ore body extends for a considerable distance to the north and west, and it is intended to connect the workings with the Miller pit, as a provision for safety and ventilation.

The Harmony mines have been usually active, the output going to the new No. 3 mill completed in 1910. The products consist of ordinary concentrates with about 64 per cent iron and extra high grade concentrates with 71.4 per cent iron, the latter being used for making electrodes for arc lamps. The tailings from the mill also find application for road and concrete work. A complete description of this mill which contains many advanced features in the magnetic separation of iron ore has been given by H. Comstock,[1] Assistant General Manager of Witherbee, Sherman & Co.

The work in the Barton Hill mines has been mainly of development character, preparatory to their steady operation. From the new tunnel a raise has been excavated to the old Orchard pit encountering good ore all the way. For the treatment of the future mine output a new mill is in course of construction, the fourth erected by the company. The mill is designed for a capacity of 100 tons crude ore an hour. It is to be an all-steel structure with corrugated iron cover. The crushing department will be equipped with a 24 by 36 inch jaw crusher and two no. 5 Gates gyratory crushers from which the product will go to a storage bin of 1200 tons capacity. From the storage bin the ore passes to revolving screens making four sizes each of which is delivered to independent separators of the drum and belt types. These make three products, concentrates that go to the shipping bin, tailings to the stock pile, and middlings which are reground by rolls, sized and again separated. The power for driving the crushers and separators will consist of four motors of 150 h. p. each.

The Port Henry Iron Ore Co. obtained most of its product from the Clonan shaft in the southern part of the "21" ore body, but

[1] The Iron Trade Review, Nov. 9, 1911, p. 825-29.

also hoisted some ore from the upper workings reached by the incline. The Welch shaft farther north contributed a small output.

Cheever mine. The recently revived operations at this mine near Port Henry continued to afford a good output during the past year. The southern end of the old workings have thus far received most attention. Though no extensive bodies of rich ore have been found, a large quantity of material of concentrating grade has been developed, sufficient to assure a steady production for some time to come. The shipments are all in the form of concentrates, made in a local mill.

Some prospecting has been under way during the year on the northern continuation of the Cheever ore belt. The results of the work which was carried on by a Buffalo company have not been given to the public.

Lyon Mountain. The mines at Lyon Mountain were operated as usual for the supply of the Standish furnace.

Benson Mines. No production of ore was made by these mines last year. The results obtained with the old mill proved so unsatisfactory, that work was suspended and preparations started toward its replacement by a new structure. This is now in course of erection. The mill which is planned for two units will be first equipped for a single unit with a capacity of 1000 tons crude ore a day. The scheme of separation involves the use of dry magnetic belt and drum machines following the general plan adopted in the other Adirondack mills. A storage capacity of 10,000 tons of dried ore will be provided so as to insure continuous work during the winter season which is rather severe in that region. Power for the mines and mill is to be supplied from an independent hydro-electric station.

MINERAL PAINT

Under this title are included the natural mineral colors which require nothing more than grinding or washing in their preparation for the market. The raw materials found in the State that have been used for the purposes are iron ore, ocher, shale and slate. New York is also one of the leading producers of artificial pigments, specially those made from lead, but as the materials are derived from outside sources no account of them is taken in this place.

The Clinton hematite affords an excellent base for the manufacture of metallic paint and mortar color. The beds with a relatively high iron content are employed, as they possess the softness and uniformity of texture, as well as depth of color, which are generally sought for. The mines owned by C. A. Borst at Clinton, Oneida county, and those of the Furnaceville Iron Co., at Ontario, Wayne county, supply most of the ore for paint. The hematite from the former locality belongs to the oolitic variety and that sold to paint manufacturers carries about 45 per cent iron. The ore in Wayne county is of fossil character carrying about 40 per cent iron. The red hematite from St Lawrence county is also used for metallic paint.

The manufacturers of metallic paint and mortar colors in New York State include the Clinton Metallic Paint Co., of Clinton, the William Connors Paint Manufacturing Co., of Troy, and the Rossie Iron Ore Paint Co., of Ogdensburg. A large quantity of the Clinton hematite is shipped to points outside of the State for manufacture.

Both shale and slate are ground for paint, their color depending largely upon the amount and nature of the iron oxids present. When there is a large proportion of ferric oxid the shale and slate may be sold as metallic paint. At Randolph, Cattaraugus county, beds of green, brown and bluish shale occurring in the Chemung formation have been worked for paint purposes. The red shale from the base of the Salina formation has been similarly utilized in years past, having been obtained from a locality in Herkimer county. At Roxbury, Delaware county, a shale in the Catskill series was once employed. The red slate of Washington county, which belongs to the Cambric, is the principal source of pigments of this character at present. The Algonquin Red Slate Co. of Worcester, Mass., and A. J. Hurd's Sons of Eagle Bridge are producers of red slate pigment.

The ferruginous clay called ocher is of common occurrence, but is not now worked in the State. Sienna, a deep brown variety of ocher, is found near Whitehall.

The production of mineral paints in 1911 included 7237 short tons of metallic paint and mortar color valued at $68,870 and 1646 short tons of slate pigment valued at $12,864. The totals for 1910 were 8063 short tons of metallic paint and mortar color valued at $70,841 and 1400 short tons of slate pigment valued at $10,900. These quantities represent only the pigments manufactured within the State from local materials.

MINERAL WATERS

New York has held for a long time a leading position among the states in the utilization of mineral waters. The different springs, of which over two hundred have been listed as productive at one time or another, yield a great variety of waters in respect to the character and amount of their dissolved solids. There are some that contain relatively large amounts of mineral ingredients and are specially valuable for medicinal purposes; Saratoga Springs, Ballston Springs, Richfield Springs, Sharon Springs and Lebanon Springs are among the more noted localities for such waters. Numerous other springs are more particularly adapted for table use containing only sufficient mineral matter perhaps to give them a pleasantly saline taste. Both kinds of waters are generally carbonated and sold in small bottles.

Of late there has developed an important business in the sale of spring waters which can hardly be classed as mineral in the common acceptance of the word, but which are extensively consumed for office and family use in the larger towns and cities. Their employment depends upon their freedom from harmful impurities, in which feature they are generally superior to the local supplies. In so far as such waters are an article of commerce they may well be included in a canvass of the mineral water industry. They are usually distributed in large bottles or carboys in noncarbonated condition.

Character of mineral waters. Among the spring waters that contain mineral ingredients in appreciable quantity those characterized by the presence of alkalis and alkaline earth are the most abundant in the State. The dissolved bases may exist in association with the chlorin and carbon dioxid, as in the springs of Saratoga county, or they may be associated chiefly with sulfuric acid, as illustrated by the Sharon and Clifton springs.

The mineral waters of Saratoga Springs and Ballston are found along fractured zones in Lower Siluric strata, the reservoirs occurring usually in the Trenton limestone. They are accompanied by free carbon dioxid which, together with chlorin, sodium, potassium, calcium and magnesium, also exists in dissolved condition. The amount of solid constituents in the different waters varies from less than 100 to over 500 grains per gallon. Large quantities of table and medicinal waters are bottled at the springs for shipment to all parts of the country. The carbon dioxid which issues from the wells at Saratoga is likewise an important article of commerce.

The waters at Richfield Springs contain the elements of the alkali and alkaline earth groups together with sulfuric acid and smaller amounts of chlorin, carbon dioxid and sulfureted hydrogen. They are employed for medicinal baths as well as for drinking purposes. The springs issue along the contact of Siluric limestone and Devonic shales. Sharon Springs is situated to the east of Richfield Springs and near the contact of the Lower and Upper Siluric. Clifton Springs, Ontario county, and Massena Springs, St Lawrence county, are among the localities where sulfureted waters occur and are utilized.

The Oak Orchard springs in the town of Byron, Genesee county, are noteworthy for their acid waters which contain a considerable proportion of aluminum, iron, calcium and magnesium, besides free sulfuric acid.

The Lebanon spring, Columbia county, is the single representative in the State of the class of thermal springs. It has a temperature of 75° F. and is slightly charged with carbon dioxid and nitrogen.

Ordinary spring waters. The greater quantity of spring waters consumed in the State belongs to the nonmedicinal, noncarbonated class, represented by such springs as the Great Bear, Deep Rock, Mount View, Sun Ray, Chemung etc. The waters are obtained either by flowing springs or from artesian wells and are shipped in carboys or in tank cars to the principal cities where they are bottled and distributed by wagons among the consumers. The essential feature of such waters is their freedom from noxious impurities. This is generally safeguarded by the care exercised in the handling of the waters which are also regularly examined in the chemical and bacteriological laboratories.

Carbon dioxid. This gas is given off in quantity by some of the wells at Saratoga Springs, and its collection and storage for shipment constituted for many years an important industry at that place. Over 30 wells have been bored there for gas alone. The industry has now been discontinued by force of a legislative enactment; it was considered that the pumping of the wells for the production of the gas was detrimental to the other springs that were utilized solely for their waters. For some time the value of the natural gas secured for the wells exceeded that of the mineral water sales.

List of springs. The following list includes the names and localities of most of the springs in the State that are employed commercially, as shown by a canvass of the industry:

NAME	LOCALITY
Baldwin Mineral Spring	Cayuga, Cayuga co.
Coyle & Caywood	Weedsport, Cayuga co.
Diamond Rock Spring	Cherry Creek, Chautauqua co.
M. J. Spicer	West Portland, Chautauqua co.
Breesport Oxygenated Mineral Spring	Breesport, Chemung co.
Chemung Valley Spring	Elmira, Chemung co.
Chemung Spring Water Co	Chemung, Chemung co.
Lebanon Mineral Spring	Lebanon, Columbia co.
Monarch Spring Water Co	Matteawan, Dutchess co.
Mt Beacon Spring	Matteawan, Dutchess co.
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Elk Spring Water Co	Lancaster, Erie co.
Beauty Spring Water Co	Lyons Falls, Lewis co.
Cold Spring	New York Mills, Oneida co.
Lithia Polaris Spring	Booneville, Oneida co.
J. Wells Smith	Franklin Springs, Oneida co.
F. H. Suppe	Franklin Springs, Oneida co.
W. W. Warner	Franklin Springs, Oneida co.
Geneva Lithia Spring	Geneva, Ontario co.
Red Cross Lithia Spring	Geneva, Ontario co.
Crystal Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
J. Hagerty	Oswego, Oswego co.
Os-we-go Spring	Oswego. Oswego co.
Mammoth Spring	North Greenbush, Rensselaer co.
Shell Rock Spring	East Greenbush, Rensselaer co.
Massena Mineral Spring	Massena Springs, St Lawrence co.
Arondack Spring	Saratoga Springs, Saratoga co.
Artesian Lithia Spring	Ballston Springs, Saratoga co.
Chief Spring	Saratoga Springs, Saratoga co.
Coesa Spring	Saratoga Springs, Saratoga co.
Comstock Mineral Spring	Ballston Springs, Saratoga co.
Congress Spring	Saratoga Springs, Saratoga co.
Excelsior Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Hathorn Spring	Saratoga Springs, Saratoga co.
High Rock Spring	Saratoga Springs, Saratoga co.
Patterson Mineral Spring	Saratoga Springs, Saratoga co.
Quevic Spring	Saratoga Springs, Saratoga co.
Royal Spring	Saratoga Springs, Saratoga co.
Saratoga Seltzer Spring	Saratoga Springs, Saratoga co.
Saratoga Vichy Spring	Saratoga Springs, Saratoga co.
Star Spring	Saratoga Springs, Saratoga co.
Chalybeate Spring	Sharon Springs, Schoharie co.
Eye Water Spring	Sharon Springs, Schoharie co.
Gardner White Sulphur Spring	Sharon Springs, Schoharie co.
Sulphur-Magnesia Spring	Sharon Springs, Schoharie co.
Red Jacket Spring	Seneca Falls, Seneca co.
Pleasant Valley Mineral Spring	Rheims, Steuben co.
Setauket Spring	Setauket, Suffolk co.
Elixir Spring	Clintondale, Ulster co.
Sun Ray Spring	Ellenville, Ulster co.
Vita Spring	Fort Edward, Washington co.
Briarcliff Lodge Association	Briarcliff Manor, Westchester co.
Gramatan Spring Water Co	Bronxville, Westchester co.

Production. The reports received from the mineral water trade in 1911 showed sales of 8,923,628 gallons valued at $756,147. The number of springs contributing to the production was about 40. In the preceding year the sales amounted to 8,432,672 gallons valued at $675,034, reported by 46 springs. The value of the water is estimated at the spring water localities and does not include the cost of bottling. No account is made of the waters used in hotels, sanatoriums etc., run in connection with the springs, though this is an important item in the business in some places.

A comparison of the sales reported for a number of years back shows that the demand for the higher priced carbonated waters apparently has fallen off, but this decrease has been more than counterbalanced by the increased consumption of the ordinary spring waters supplied for office and family use.

Saratoga Springs. The plans for the creation of a State reservation which is to include practically all the springs hitherto employed for the commercial production of mineral waters and carbon dioxid have begun to take definite form. The commission empowered to effect the transfer of the property from private to State ownership had taken over at the close of the year the following springs: Hathorn (nos. 1, 2, 3), Coesa or Carlsbad, Champion, Red, Patterson, Putnam, Star, Governor, High Rock, Seltzer, Magnetic and Peerless, Victoria, Geyser, Adams and Congress. Those not included in the transfer at that time were the Arondack, Vichy, Chief, Excelsior and Quevic. Of the springs on the State reservation a few were utilized for commercial production by Hathorn & Co., under lease.

NATURAL GAS

The natural gas resources of the State are undergoing steady development, the production being little influenced by the varying trade conditions that affect other branches of mining. The supply, though it has increased markedly of late years, falls far short of meeting the requirements in the territory around the gas fields, and is helped out by importations from other states, chiefly Pennsylvania. Natural gas has been in use locally for nearly a century; there is a record of its employment for fuel and light as far back as 1825 at which time wells were in operation in Chautauqua county for the supply of natural gas to households.

The industry of supplying gas for general consumption first assumed importance, however, with the development of the oil districts in Allegany and Cattaraugus counties, the gas being recovered as a by-product and sold to distributing companies who piped it to the towns and villages in the surrounding section. In the nineties of the last century exploration for gas was carried on actively all through the western part of the State and some new fields were discovered, notably in the section along the shore of Lake Ontario. A little later an important field was opened in Erie county, east of Buffalo. The gas pools were encountered in the Medina sandstone and led to the exploration of this formation along the dip in southern Erie and northern Chautauqua counties where some very productive wells have been opened at depths of 2000 feet or more.

Altogether there are 16 counties in the State that produce natural gas. The principal fields are found in Erie, Genesee, Chautauqua, Allegany and Cattaraugus counties. Outside of these the pools are of subordinate extent and importance, so far as they have been tested, and are scattered rather sparsely over the western section of the State, from Lake Erie and the Niagara river to the east end of Lake Ontario. Exploration of the rocks in eastern New York has been unsuccessful in locating valuable pools.

The supply of natural gas is derived from several geologic horizons, from the Potsdam sandstone in the Cambric to the Chemung strata at the top of the Devonic. The more productive formations include the Trenton limestone of the Lower Siluric, the Medina sandstone of the Upper Siluric, and the Portage and Chemung shales with interbedded sandstones belonging to the Devonic. With few exceptions the gas pools now producing occur in one or another of these formations.

The oil fields of Allegany and Cattaraugus counties have contributed, and still do contribute, considerable quantities of gas. The pools are found in sandstones at different horizons in the Devonic, such as the Bradford, Kane, and Elk "sands" of the Chemung. Some of the supply is consumed in the gas engines for pumping the oil, and the remainder is used for lighting and heating in the local towns or is piped to Buffalo. The distribution of the gas is mainly in the control of a few companies, like the Empire Gas and Fuel Co. of Wellsville, the Producers Gas Co. of Olean, and the United Natural Gas Co. of Oil City, Pa. Some of the local towns supplied from the fields are Olean, Andover, Wellsville, Friendship, Hornell and Geneseo. In the northwestern part of Cattaraugus county there is a small field of which Gowanda is the center and which extends across the border into Erie county. The gas is said to occur in the

Marcellus and Onondaga formations of the Middle Devonic. The output is distributed by the Gowanda Gas Co. for use in Gowanda. Explorations have been under way recently in northern Cattaraugus county between Gowanda and Cattaraugus where pools are reported at depths from 2500 to 3300 feet in what is supposed to be the Medina sandstone.

In Chautauqua county the productive area comprises a belt bordering Lake Erie from Silver Creek southwest to the Pennsylvania state line. Until quite recently the supply has been obtained from wells a few hundred feet deep in the Portage and Chemung beds and the individual output was small, sufficing only for a few families at most. Deep drilling during the last few years has resulted in the discovery of more productive pools, lying at depths from 1900 to 2300 feet in what is considered Medina sandstone. Some very large flows have been encountered in the vicinity of Silver Creek, Dunkirk, Forestville, Sheridan and Westfield. These wells are mainly owned by local companies who sell the output in the neighboring towns and villages. The principal operators include the Frost Gas Co., Silver Creek Gas and Improvement Co., South Shore Gas Co., and Welch Gas Co. During the past year the United Natural Gas Co. has been engaged in exploration in the town of Arkwright east of Fredonia and is reported to have encountered gas in quantity at depths around 2100 feet.

Erie county contains several fields. A few wells have been put down within the limits of Buffalo. East Aurora, Collins, North Collins, Angola and Springville in the southern part are centers of a more or less active industry. Within the last 15 years a field has been opened east of Buffalo in the towns of Cheektowaga, Amherst, Lancaster, Clarence, Alden and Newstead, which for some time has been the most productive in the State. The gas is found in the Medina sandstone at depths of from 1200 to 1600 feet, and the wells have proved quite persistent producers. It is transported in pipe lines to Buffalo, Tonawanda, Batavia, Lancaster, Depew, Honeoye Falls and other towns in the vicinity. There are over 200 productive wells in the field.

In Genesee county a prolific field has been developed at Pavilion during the last five years. The gas is found in the same horizon as in eastern Erie county, at depths of about 1700 feet. The Pavilion Natural Gas Co. and the Alden-Batavia Natural Gas Co. are the chief operators in the field and supply the gas to Pavilion, Leroy and Batavia.

In Wyoming county a few wells are in operation at Attica; in Livingston county at Caledonia, Avon and Lima; and in Ontario county in the towns of East Bloomfield and West Bloomfield. Farther east in Onondaga county there are wells at Baldwinsville and Phoenix which supply gas for local use. The pools are found in the Trenton shales and limestone. Oswego county marks the eastern limit of the productive territory, with wells at Pulaski and Sandy Creek.

Production. The value of the natural gas production during the last 4 years is shown in the accompanying table which is arranged to show also, so far as practicable, the contributions from the principal fields. The returns for the year 1911 indicated a total of $1,547,077, against $1,045,693 for 1909, an increase of approximately 50 per cent in the two years. The quantity of gas produced was approximately 5,127,571,000 cubic feet as compared with 4,815,643,000 cubic feet in 1910 and 3,825,215,000 cubic feet in 1909. These amounts include estimates for some of the smaller producers who have no meters attached to their mains, but they are believed to be close approximations of the actual production. The average value of the gas was 30 cents a thousand, against 29 cents and 27 cents a thousand respectively in the preceding years.

Production of natural gas

COUNTY	1908	1909	1910	1911
Allegany, Cattaraugus..	$264 736	$282 964	$337 427	$402 931
Chautauqua..........	153 019	174 597	202 754	222 023
Erie [1]................	451 869	461 531	717 038	813 279
Livingston [2]...........	54 083	59 888	60 997	73 357
Onondaga............	13 837	12 310	12 733	12 972
Oswego...............	12 800	14 402	14 783	14 913
Wyoming [3]............	37 431	40 001	65 967	7 602
Total............	$987 775	$1 045 693	$1 411 699	$1 547 077

[1] Includes all the output in Genesee county for 1911 and a part of it for the preceding years.
[2] Includes also Seneca, Schuyler, Steuben, Ontario and Yates.
[3] Includes Niagara and also some of Genesee except for 1911.

The reports for 1911 covered a total of 1403 productive wells.

A comparison of the figures shows that Erie county leads all others in quantity and value of output. Its contribution including also that of Genesee county, amounted last year to 2,444,721,000 cubic feet valued at $813,279. There were 342 productive wells in the two counties.

The production given under Allegany and Cattaraugus counties included mainly the gas collected from oil wells, but there was a small output also from fields in the northern parts of the two counties where no oil is produced. The combined output taken from the reports of the pipe-line companies and the individual producers amounted last year to 1,600,317,000 cubic feet valued at $402,931, from a total of 766 wells.

The wells in Chautauqua county made an output of 804,713,000 cubic feet valued at $222,023. The principal part of the supply came from the deep wells which have been put down in the last few years in the belt along Lake Erie.

Genesee county has shown the largest relative increase in production during the past years, but the figures are included with those of Erie county.

PETROLEUM

The anticipated effects of the recent decline in crude oil prices were very manifest during 1911, at least in the New York field. There was less activity in exploration than for many years and with the comparatively poor record of new drilling in 1910, the productive conditions were most unfavorable. The maintenance of the local industry for a long time has been the small increments of yield obtained by redrilling old territory, for which the main incentive existed in the high market value of the local product. The recent decline, amounting to over 50 cents a barrel, practically put an end to such developments.

The total production in 1911, as reported by the pipe-line companies operating in the New York oil region, amounted to 915,314 barrels. The total for the preceding year was 1,073,650 barrels, showing a falling off of 158,336 barrels, or 15 per cent. The output in 1909, which was a year of good prices on the whole, amounted to 1,160,402 barrels. The value of the product last year was $1,198,868, or an average of $1.31 a barrel, against $1,458,194, an average of $1.36 in 1910, and $1,914,663, an average of $1.65 in 1909.

The production of oil during the last two decades is shown in the accompanying table. The figures for the years 1892–1903 have been compiled from the annual volumes of the *Mineral Resources*, while those for subsequent years are based on the reports received from pipe-line companies who transport the oil to the refiners. The following companies operate pipe lines in the New York field: The Allegany Pipe Line Co., Columbia Pipe Line Co., Union Pipe Line Co., and Fords Brook Pipe Line Co., of Wellsville; Vacuum Oil Co., of Rochester; New York Transit Co., of Olean; Emery Pipe Line Co., Kendall Refining Co., and Tide Water Pipe Co., Limited, of Bradford, Pa.

Production of petroleum in New York

YEAR	BARRELS	VALUE
1892	1 273 343	$708 297
1893	1 031 391	660 000
1894	942 431	790 464
1895	912 948	1 240 468
1896	1 205 220	1 420 653
1897	1 279 155	1 005 736
1898	1 205 250	1 098 284
1899	1 320 909	1 708 926
1900	1 300 925	1 759 501
1901	1 206 618	1 460 008
1902	1 119 730	1 530 852
1903	1 162 978	1 849 135
1904	1 036 179	1 709 770
1905	949 511	1 566 931
1906	1 043 088	1 721 095
1907	1 052 324	1 736 335
1908	1 160 128	2 071 533
1909	1 160 402	1 914 663
1910	1 073 650	1 458 194
1911	915 314	1 198 868

The average quotations for crude oil from the Appalachian districts were lower in 1911 than at any time since 1901. The prices of Pennsylvania crude, which are taken as the basis for rating the New York output, were $1.30 a barrel at the opening of the year and remained unchanged until the last week in December when they advanced to $1.35. The outlook for the current season would appear more favorable, as the tendency in the early months was toward a higher level.

The records for the year showed that 195 new wells were completed, as compared with 283 wells in the preceding year, and 457 wells in 1909. The increment of production from the new wells amounted to 201 barrels a day, while in 1910 it was 368 barrels and in 1909 it amounted to 715 barrels. Of the number of wells given 59 were dry, as compared with 61 and 32 respectively for the two preceding years.

The oil pools found in the State constitute the northern extension of the Appalachian field which reaches its main development in Pennsylvania, Ohio and West Virginia. They underlie small areas in Cattaraugus, Allegany and Steuben counties near the Pennsylvania border. The first well was drilled in Cattaraugus county in 1865, and Allegany county began producing about 1880. The oil is found in fine-grained sandstones of dark color belonging to the Chemung formation of the upper Devonic. In Cattaraugus county the productive area embraces about 40 square miles, mostly in Olean, Allegany and Carrolton townships. The pools of which the principal ones are the Ricebrook, Chipmunk, Allegany and Flatstone, occur at several horizons from 600 to 1800 feet below the surface. The oil district of Allegany county extends across the southern townships of Clarksville, Seneca, Wirt, Bolivar, Alma, Scio and Andover and is divided into several pools that are considered to be more or less independent. The Bolivar, Richburg and Wirt pools have been most productive. The oil is found at depths of from 1400 to 1800 feet. The Andover pool lies partly in the town of West Union, Steuben county, and is accountable for the production in that section. The reports of the *Mineral Resources* covering the year 1910 showed a total of 10,995 productive wells in the State, of which number Allegany county had 7859, Cattaraugus county 2917 and Steuben county 219. Practically all the wells are pumped and the average yield is less than one-third of a barrel a day.

There has been a great deal of exploration outside the districts mentioned, but up to the present time has not led to any positive additions to the productive area. Some of the more interesting and promising developments have been in northern Allegany county. A discovery of oil was reported a few years since in the town of Granger on the Livingston county border, considerably north of the other pools, and about 30 wells were drilled as a test. Some of these flowed under natural pressure, but they soon gave out, yielding less than 3000 barrels altogether. In the last year or two another section near Swain, town of Grove, has been under exploration. The original discovery was reported on the Fred Bennett farm where oil and gas were encountered in a well put down to 740 feet depth. Some other holes in the same vicinity were dry. Recently drilling has been under way on the Harman place, and two productive wells are reported to have been brought in of which the first produced from 5 to 6 barrels a day. The second was dry when drilled, but began to flow after having been "shot." The oil is said to be of a dark, heavy quality.

PYRITE

Pyrite is obtained commercially in St Lawrence county. The mines of that section have been worked intermittently for many years but have come into prominence only of late, largely as the result of the systematic operations carried on by the St Lawrence Pyrite Co. The property of this company is situated at Stellaville near Hermon, and comprises a number of mines that have been more or less extensively developed, a large concentrating plant, and other equipment including the branch railroad from Hermon to De Kalb Junction which it built to secure an outlet for its product. The shipments are in the form of concentrates which are sold to sulfuric acid makers.

In addition to the Stellaville mines, the Cole property near Gouverneur has been a producer during the last two years, having been reopened in 1910. It is worked under lease by the Hinckley Fibre Co., which uses the output in crude form for the manufacture of sulfite pulp at its plant at Hinckley, Oneida county.

The employment of the crude low-grade ore for direct conversion of the sulfur into sulfurous acid to be used in the sulfite pulp process is a new development which if permanently successful, as it appears likely to prove from present indications, may have important consequences for the Adirondack mining industry. The output of sulfite fiber by the mills in that section is reported as about 900 tons daily for which 135 tons of commercial sulfur are imported at an average cost of $3300. To supply the equivalent amount of sulfur from pyrite would require from 400 to 600 tons of the usual grade of St Lawrence county ore, or say 150,000 tons a year. According to information privately communicated to the writer, there is an important economy in the use of the pyrite whenever it can be laid down at the mill at a fair price. In the case of such low-grade ores, its uses, however, necessitate special apparatus and methods which have been the subject of extended investigation; that success, to a certain degree at least, has attended the experiments seems to be evidenced by the continued shipments from the Cole mine.

Pyrite is rather abundantly distributed in the Adirondack region, and is represented in larger quantity in association with the Grenville series of gneisses, schists and crystalline limestones. The principal deposits thus far found occur in the belts of these rocks, which are regarded as metamorphosed sediments, on the western border in St Lawrence and Jefferson counties. One large belt extends from near Antwerp, Jefferson county, across Gouverneur, De Kalb and Hermon townships of St Lawrence county, a distance of over 40 miles. It is the same belt which carries the red hematite ores of that region. The pyrite is disseminated through the schists and gneisses, but here and there it occurs segregated in bands or lenses so as to constitute mineable deposits, though of rather low-grade character. The bodies are arranged in conformity with the major structural features of the county rocks, so far as can be determined, having usually a northeast-southwest strike and a northerly dip as are prevalent throughout the region. They show local modifications in the way of folding, swells and pinches and were no doubt accumulated before the final period of regional compression which has affected the wall rocks.

The ore as mined consists normally of a granular aggregate made up of crystals and irregular particles of pyrite distributed through a gangue of which quartz is the chief component. The texture and grade of the ore is quite variable. Considerable masses of practically pure pyrite are found as an intergrowth of large-sized crystals, but the chief part of the output is represented by a mixture of medium to fine-grained pyrite showing no crystal development, with fairly large amounts of gangue materials. Besides quartz the accompanying minerals include hornblende, biotite, feldspar and alteration products of chloritic nature. Zinc blende and chalcopyrite are found occasionally in small amounts in the ore.

In some parts of the belt pyrrhotite occurs as an associate of the pyrite or in separate bodies of closely related features. It is found for instance at High Falls or Pyrites in distinct shoots though in the same mineralized zone with the pyrite. It has not been considered, hitherto, of any economical value, yet recent progress in the use of low-grade sulfides may be regarded as affording some prospect for its future industrial employment. The sulfur content is naturally lower than that of the pyrite, the theoretic amount being a little under 40 per cent and the average of the usual grade of material probably not over 25 per cent. The pyrrhotite gives a slight reaction for nickel.

The mines at Stellaville operated by the St Lawrence Pyrite Co. are opened on a parallel series of deposits, of which the largest is known as the Stella. A second important deposit, the Anna, is found in the footwall, 1600 feet to the southeast, and others occur in the interval. The ore carries from 15 to 40 per cent of sulfur, with an average probably between 25 and 30 per cent. A small quantity is marketed as hand-cobbed ore or "spalls" with about 33 per cent sulfur, but the main product consists of mill concentrates with a content of 40 per cent or more. The concentrates are shipped to acid burners in the East. Though of lower sulfur content than the imported ores, they are a desirable material for acid-making on account of their freedom from arsenic and other injurious impurities. A comprehensive account of the Stellaville mines and their equipment has been contributed by Felix A. Vogel to volume 16 of the *Mineral Industry*.

The Cole mine at Gouverneur is based on a large outcropping deposit that was first worked as an open cut. The early development was carried out by the Adirondack Pyrite Co., later succeeded by the American Pyrite Co. The latter company ceased work in 1907 and dismantled the mining and milling plant. The property remained idle until the Hinckley Fibre Co. took it over in 1910. As shown in the present workings the ore lies in two parallel bodies separated by 15 or 20 feet of quartz rock. The lower deposit is about 15 feet thick and dips 40° to the northwest. It was first worked by open-cut methods and afterwards through an inclined shaft. The present supply of ore is taken mainly from the overlying body, which at the point of attack shows a thickness of about 50 feet and which is being developed through a raise from the lower workings. The present development of the mine is insufficient to afford much information in regard to the actual relations of the ore bodies and their extent. The crude ore as shipped carries from 25 to 40 per cent sulfur, with an average probably of 30 per cent or slightly less.

The deposits at Pyrites which were taken over by the Oliver Mining Co. about five years ago have remained inactive. They consist of a series of lenses that strike northeast and dip northwest at an angle of 15°. Their line of outcrop extends across the Grasse river under which there are workings reached from an island in the river. They have been explored in depth by the diamond drill but nothing can be stated as to the results beyond the fact that the ore appears to be persistent.

Besides the deposits mentioned that have been developed as mines, there are many prospects and exposures of pyrite in the metamorphic region of St Lawrence and Jefferson counties. Some of the better known localities are on the Alexander Farr farm, two and a half miles northeast of Bigelow; on the George Styles farm, one and a half miles west of Bigelow; the farm of S. Hendricks, one mile south of Bigelow; and that of S. Hockens, seven miles west of Rensselaer Falls. Near Antwerp pyrite is found in the vicinity of the Dixon and Old Sterling iron mines. As has been noted by C. H. Smyth, jr, the hematite deposits of that section are often accompanied by bodies of pyrite in the adjoining wall rocks. Their distribution may afford a useful clew to exploration for the latter. There is an extensive belt of pyrite and pyrrhotite in the vicinity of Ox Bow.

The zinc ores near Edwards which are under development carry more or less pyrite intermixed with the blende. The pyritous ores are being reserved for mill treatment by which it is intended to make a pyrite concentrate as a by-product.

SALT

The salt industry throughout the State was practically unchanged last year. There were no additions to the list of producing plants. The output continued at about the rate established in the preceding year or two, and the market conditions, so far as prices were concerned, were almost stationary, at least showing no definite tendency toward recovery from the previous low levels. The selling prices of the various grades of evaporated salt have undergone a marked decline of late years, and it is doubtful if any further extensive reduction could take place without reacting injuriously upon that branch of the industry. The only real gains in the production recently have come from the rock salt mines and from the wells whose output of brine is consumed without evaporation for manufacture of soda products.

The total quantity of salt taken from the mines and wells during the year was 10,082,656 barrels of 280 pounds. This was a slight decrease from the total of 10,270,273 barrels reported for 1910, the largest ever recorded in the State, but exceeded the output of any other year. The actual decline was thus 187,617 barrels, or a little less than 2 per cent of the gross amount. Converted to a tonnage basis the product in 1911 was equivalent to 1,411,572 short tons against 1,437,838 short tons for the year 1910.

The value of the salt production, as fixed by the reports from the companies, amounted to $2,191,485, as compared with $2,258,-292, the value reported for the year 1910. These figures are based on the values at the mines or works, exclusive of costs of package. The average was 21.7 cents a barrel, against 22 cents a barrel in 1910, 23.3 cents in 1909, 23.7 cents in 1908 and 25 cents in 1907. Prices have thus fallen steadily for a number of years. It is to be noted, however, that the average values as given are reduced considerably by the inclusion of salt used in the form of brine for alkali manufacture. Since this salt is not marketed as such, and is not even evaporated, it is given only a nominal valuation, representing practically the mere cost of pumping. The production of this brine is confined to a single company, the Solvay Process Co., which has a number of wells in the town of Tully, Onondaga county, whence the brine is carried through a pipe line to the alkali works near Syracuse.

The accompanying tables give the statistics of salt production for recent years. For the years 1910 and 1911 the output is given according to grades, so far as the classification could be made without revealing the individual figures. The grades depend upon methods of manufacture and purposes for which the salt is used. Rock salt and salt in brine consumed by the alkali industry appear in the last item of the detailed tables which also includes small quantities of evaporated salt not specially classified in the returns. The evaporated salt is chiefly marketed under the grades of common fine, table and dairy, common coarse, common solar, and packers salt. Table and dairy salt includes the finest grades of artificially evaporated specially prepared for the table and for butter and cheese making; it brings the highest market price. Under common fine are listed the other grades of fine, artifically evaporated salt that are not specially prepared. Common coarse represents the coarser product from artificial evaporation. Coarse solar salt is made by evaporation of brine in shallow pans exposed to the sun's heat. This process is employed only by the manufacturers in Syracuse and vicinity, and can be carried on, of course, only in the summer months. Packers salt includes the product sold to meat packers and fish salters.

Production of salt by grades in 1910

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine [1]	1 322 015	$378 547	$ .28
Common coarse	243 928	81 233	.33
Table and dairy	1 258 089	611 271	.49
Coarse solar	439 780	129 295	.29
Packers	37 935	13 277	.35
Other grades [2]	6 968 526	1 044 669	.15
Total	10 270 273	$2 258 292	$ .22

[1] Common fine includes a small amount of common coarse.
[2] Include rock salt, salt in brine used for soda manufacture, and small amounts of brine salt for which the uses were not specified in the returns.

Production of salt by grades in 1911

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine [1]	1 143 886	$328 127	$ .29
Common coarse	285 407	96 968	.34
Table and dairy	1 312 000	629 581	.48
Coarse solar	434 414	131 247	.30
Packers	40 721	11 402	.28
Other grades [2]	6 866 228	994 160	.14
Total	10 082 656	$2 191 485	$ .217

[1] Common fine includes a small quantity of common coarse.
[2] Include rock salt, salt in brine used for soda manufacture, and small amounts of brine salt for which the uses were not specified in the returns.

The output in 1911 was contributed by 30 mines and works distributed among six counties of the State. Onondaga county was represented by the largest number of producers, having 20 in all. Livingston county was represented by 3, of which 2 were rock salt mines, the only ones now active. Schuyler, Tompkins and Wyoming counties each had 2 producers, and Genesee county which completes the list had 1.

Production of salt in New York since 1887

YEAR	BARRELS	VALUE
1887	2 353 560	$936 894
1888	2 318 483	1 130 409
1889	2 273 007	1 136 503
1890	2 532 036	1 266 018
1891	2 839 544	1 340 036
1892	3 472 073	1 662 816
1893	5 662 074	1 870 084
1894	6 270 588	1 999 146
1895	6 832 331	1 943 398
1896	6 069 040	1 896 681
1897	6 805 854	1 948 759
1898	6 791 798	2 369 323
1899	7 489 105	2 540 426
1900	7 897 071	2 171 418
1901	7 286 320	2 089 834
1902	8 523 389	1 938 539
1903	8 170 648	2 007 807
1904	8 724 768	2 102 748
1905	8 575 649	2 303 067
1906	9 013 993	2 131 650
1907	9 657 543	2 449 178
1908	9 005 311	2 136 736
1909	9 880 618	2 298 652
1910	10 270 273	2 258 292
1911	10 082 656	2 191 485

The large number of producers in Onondaga county is incident to the solar salt industry which is carried on extensively around Syracuse. The brine used by the solar evaporating works or salt yards is stored in glacial gravels and is pumped and distributed by central plants. The principal supply comes from the old Onondaga Salt Springs Reservation that was sold by the Indians to the State in 1788. The manufacture of salt was placed under State control in 1797 from which time complete records of the industry are available. At one time artificial evaporation was extensively practised but this has been given up almost entirely in recent years with the increased competition from other districts. The solar salt is sold through the agency of the Onondaga Coarse Salt Association.

With the exception of the salt made at Syracuse the entire production is obtained from the deposits of rock salt which are found in the Salina formation, a succession of shales and limestones with intercalated beds of gypsum and rock salt. The Salina strata outcrop in an east-west belt across the State from Albany county to the Niagara river and are represented by a smaller separate area in southeastern New York. Well tests indicate that the salt deposits are restricted to the western section of the main belt beginning in Madison county; east of there the strata diminish in thickness to such an extent as to preclude their existence. They are encountered only at a depth of 1000 feet or more where there has been sufficient cover to protect them against solution by ground waters. As the whole stratified series has a dip uniformly toward the south the mines and wells are all located on the southern side of the outcrop which lies about on the line of the forty-third parallel. The dip averages 40 or 50 feet to the mile. The most easterly point where rock salt has been found is at Morrisville, Madison county. Between that place and Lake Erie it has been shown to exist in almost all of the middle tier of counties.

The exploration of the rock salt beds dates from 1878 when a well bored for oil near Wyoming, Wyoming county, encountered 70 feet of salt at 1270 feet from the surface. Discoveries were subsequently made at Warsaw, Leroy, Rock Glen, Batavia and numerous places in Livingston, Wyoming and Genesee counties. Practically the whole valley of Oatka creek, from Leroy to Bliss and the Genesee valley south of Monroe county has been found to be salt-bearing. The region is now the most productive in the State. Livingston county has the largest annual output which is contributed by the two rock salt mines at Retsof and Cuylerville owned respectively by the Retsof Mining Co. and the Sterling Salt Co., and by the evaporating plant of the Genesee Salt Co. at Piffard. The other companies now active in this section include the Leroy Salt Co., of Leroy; the Rock Glen Salt Co., of Rock Glen; and the Worcester Salt Co., of Silver Springs.

In Schuyler county salt is obtained around Watkins. The Glen Salt Co. sank the first well there in 1893 and encountered a deposit at 1846 feet depth. The plant is now operated by the International Salt Co. The Watkins Salt Co. also has works at this place.

A well drilled at Ithaca, Tompkins county, in 1885 passed through seven beds of salt aggregating 248 feet in thickness at depths below 2244 feet from the surface. The discovery was followed by active developments at Ludlowville in 1891 by the Cayuga Lake Salt Co., and at Ithaca in 1895 by the Ithaca Salt Co. The plants were taken over in 1899 by the National Salt Co., which was merged in 1905 into the International Salt Co. The Remington

Salt Co. later erected a plant at Ithaca which is now in operation, obtaining its salt from three wells at a depth of about 2100 feet.

The Solvay Process Co. derives its supply of brine from a number of wells located in the town of Tully, 20 miles south of Syracuse. The brine is carried in pipe line to the works at Solvay.

In Erie county rock salt has been found at Eden Valley, Springville, Perry and Gowanda, but there is no output at present in that county. Among the localities where discoveries have been made may be mentioned Vincent and Naples, Ontario county; Dundee, Yates county; Seneca Falls, Seneca county; and Aurora, Cayuga county. None of these deposits are worked. A well put down in 1909 in the town of Burns, Allegany county, is reported to have passed through 75 feet of clean unbroken salt at 3050 feet depth.

SAND AND GRAVEL

The production of sand and gravel for use in engineering and building operations, metallurgy, glass manufacture, etc., is an important industry involving a very large number of individual operations. The building sand business is specially extensive as there are deposits suitable for that purpose in every section of the State, and nearly every town or community has its local source of supply. Such sand, of course, possesses little intrinsic value. The deposits of glass sand and molding sands are more restricted in their distribution and their exploitation is the basis of a fairly stable industry; certain molding sands are even shipped to distant points, as in the case of those obtained in the Hudson river region.

The sand and gravel beds of the State are mainly of glacial origin, as the whole territory within the limits of New York, in common with the northern section of the United States east of the Rocky mountains, was invaded by the Pleistocene ice sheet which removed all the loose material accumulated by previous weathering and erosion, and left in its retreat a mantle of transported boulders, gravels, sands and clays. In places these accumulations have the character of unmodified drift or morainal accumulations in which the materials are more or less intermixed, and are then of little industrial value. But more generally the deposits show a sorted stratiform arrangement due to their having been worked over by the glacial streams and lakes. Such is the condition in many of the larger valleys like those of the Hudson, Champlain and Genesee where the sands, gravels and clays occur separately in terraced beds extending far above the present water level. Later water action may have effected a beneficial re-sorting of the materials as instanced by the beach sands of Long Island and some of the lakes in the interior of the State.

A measure of the importance of the sand and gravel industry may be had from the accompanying table which, however, lacks something in the way of completeness and accuracy. The figures relating to the molding sand production are believed to be a close approximation to the actual totals, but those for building sand and gravel may vary considerably from the true quantities, perhaps understating them by as much as 25 per cent. The building sand operations are so widely scattered and in many sections carried on in such haphazard or fugitive manner that it is extremely difficult to cover them all in a statistical canvass.

Production of sand and gravel

MATERIAL	1909	1910	1911
Molding sand	$437 402	$424 015	$420 780
Core and fire sand	30 230	33 709	27 484
Building sand	*b*	1 016 598	*c* 750 000
Other sand *a*	*b*	65 835	*c* 50 000
Gravel	*b*	589 551	479 103
Total	....	$2 129 708	$1 727 367

a Includes glass sand, filter sand, engine and polishing sand.
b Statistics not collected.
c Partly estimated.

Molding sand. The use of sand for the casting of metals calls for a large supply of special grades which have a rather restricted distribution, compared with building sands, and consequently greater value.

In New York there are two main areas in which good molding sands occur: (1) on the lands bordering the Hudson river from Orange county to Saratoga county; (2) in Erie county. The sand is found in shallow beds immediately beneath the sod and often covers extensive tracts. In the Hudson river region, which is by far the most important, beds 8 inches thick may be worked if convenient to transportation. From this they range up to 7 or 8 feet thick, though usually the finer grades occur in relatively thin deposits. The sand is graded roughly according to size, which varies from extremely fine sand that will pass through a 100 mesh screen to rather coarse gravel. The business of digging and shipping the sand is mainly conducted by a few large companies who operate in several places and are able to furnish all the grades in demand by foundries.

The production of molding sand in 1911 amounted to 476,014 short tons valued at $420,780, or a little more than in 1910 when the total was 471,351 tons valued at $424,015. The greater part of the output came from the Hudson river region, which contributed altogether 435,868 short tons with a value of $388,561. The counties represented in that section included Albany, Dutchess, Greene, Orange, Rensselaer, Saratoga and Schenectady. The counties in other sections that reported a production were Cayuga, Chautauqua, Erie, Essex, Livingston and Queens.

Core sand used in connection with molding sand for the cores of castings is chiefly produced in Erie and Oneida counties. The product is listed with fire sand, the combined production of the two kinds amounting last year to 49,900 short tons valued at $27,484.

Glass sand. Sand for glass manufacture is obtained from the beach sands of Oneida lake and Long Island. The crude sand undergoes purification by washing to remove the clay, mica, organic matter, etc. The manufacture of window glass was once an important industry in the district around Oneida lake where there are extensive deposits of very fine sand, but it has succumbed to competition with the factories situated in the natural gas region of Pennsylvania and the West. At present the product is shipped elsewhere for manufacture. A total of 20,821 short tons of glass sand valued at $16,000 was reported from the Oneida and Queens counties last year.

Building sand. The use of sand and gravel in building and engineering work calls for enormous quantities of these materials and is the basis of a productive industry that is carried on more or less actively in nearly every county of the State. The business is purely local, as the towns and villages are well supplied with deposits close at hand. The value of the materials is mainly represented in the cost of excavation.

A complete census of this branch of the sand industry would entail labor and expense incommensurate with the value of the results, and therefore nothing more has been done than to arrive at a basis for an approximate estimate. The combined value of the sand and gravel produced in 1911 is placed at $1,229,103, against a value of $1,606,149 in 1910. The quantity of sand was approximately 2,900,000 cubic yards and of gravel 1,013,470 cubic yards, as compared with 3,838,976 cubic yards of sand and 1,037,026 cubic yards of gravel produced in 1910. Nassau county from which much of the sand used in building operations in New York is obtained, contributed alone a total of 1,874,837 cubic yards of sand and 659,106 cubic yards of gravel last year.

SAND-LIME BRICK

The manufacture of sand-lime brick last year was somewhat larger than usual. Five companies reported as active and contributed a total of 15,178,000 bricks with a value of $92,064. This was but little short of the record production which was reported in 1907 and which amounted to 16,610,000 valued at $109,677. The outturn in 1910 was 14,053,000 with a value of $82,619. The selling price of the brick, fixed at the yard, averaged $6.05 a thousand last year, against $5.88 a thousand in 1910.

The following were the active plants: Composite Brick Co., Rochester; Dyett Sand-Lime Brick Co., Port Jefferson; Buffalo Sandstone Brick Co., Buffalo; Paragon Plaster Co., Syracuse; Granite Brick Co., Glens Falls.

The Grant Brick Co. of Brooklyn and the Sandstone Brick Co. of Schenectady reported as active in 1910 but did not manufacture last year.

STONE

The quarrying of stone and its preparation for the varied requirements of building, engineering construction, etc., hold a prominent place in the industrial activities of the State, and the value of the annual contribution ranks second only to that of clay among mineral materials. No other mineral industry includes so many individual enterprises or is so widely represented in the different sections. The resources are abundant and varied, comprehending all the principal varieties known to the trade. The greater number of quarries, however, are opened in the limestones and sandstones and supply material chiefly for engineering work, highway improvement and such purposes which do not entail any considerable amount of elaboration previous to shipment. In the development of the building, monumental and ornamental branches the local industry has not attained the relative importance that it deserves by reason of the natural wealth of materials adapted to those uses and the advantages for marketing; herein lies, it would appear, the principal field for future enterprise.

The statistics of production which have been collected from year to year show that the industry in general remains practically stationary; in fact lately it has taken a downward trend, falling below the average level of earlier years. This has been due in part to the recent business reaction that has affected practically all industries and in part undoubtedly to the gaining favor of cement and concrete for certain construction purposes. The latter has manifested itself particularly in the loss of trade among the bluestone quarries which supply flagstone to New York and other eastern cities. This branch of the industry has shown a decline of over 50 per cent in the last four years.

The total value of the stone quarried in 1911 was $5,455,312, as compared with a reported value of $6,193,252 in 1910. The decrease thus indicated was $737,940 or 12 per cent. The output for 1909 had a value of $7,061,580, showing that a falling off of about 30 per cent has taken place in the interval. It should be noted that the above figures do not include slate, millstones, or limestone used for cement manufacture, which are reported separately.

The output of granite participated in the decline to a marked extent, falling from a value of $244,763 in 1910 to $148,633 last year. The quarries in the Adirondacks and on the St Lawrence river reported a reduced business, and those in southeastern New York were less active than heretofore. New developments in the syenite and anorthosite areas of Clinton and Essex counties have been under way but have not yet reached the stage that enables large shipments to be made.

No great change occurred in the limestone production; the quarries of that material reported a value of $3,174,161 against $3,245,807 in the preceding year. The wide use of limestone for concrete and road work has steadied the market, though conditions in some branches were rather unfavorable.

The value of the marble that was quarried last year amounted to $278,041 against $341,880 in 1910. The main decrease was in building marble from the Dutchess county quarries. The output of monumental marble from Gouverneur was fairly well maintained. The sandstone quarries registered a large falling off in production, returning a total value of only $955,063, less than reported in any recent year. The output in 1910 had a value of $1,451,796. Most of the decrease came from the bluestone quarries.

The trap quarries in the Palisades section produced about as usual, though the reduction or extinction of the present industry is in prospect for the near future owing to the inclusion of the quarry properties in the new Palisades park. One of the quarries terminated its activity during the past season. The production of trap in the State amounted in value to $899,414, against $909,006 in the preceding year, practically all of it in the form of crushed stone.

Production of stone in 1909

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$35 010	$33 818	$1 352	$182 029	$227 737	$479 955
Limestone	217 109	....	15 363	1 744 314	1 323 597	3 300 383
Marble	262 934	104 495	25	6 403	6 159	380 016
Sandstone	358 589	....	783 880	220 200	477 129	1 839 798
Trap	....	....	....	1 061 428	....	1 061 428
Total	$873 651	$138 313	$800 620	$3 214 374	$2 034 622	$7 061 580

Production of stone in 1910

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$40 911	$12 989	*a*	$91 988	$98 875	$244 763
Limestone	99 049	....	$3 888	1 815 809	1 327 061	3 245 807
Marble	252 965	88 684	....	....	231	341 880
Sandstone	387 498	....	408 132	225 408	358 848	1 451 706
Trap	....	....	....	908 931	75	909 006
Total	$780 333	$101 673	$484 020	$3 042 136	$1 785 090	$5 193 252

a Included under "All other."

Production of stone in 1911

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$30 684	$11 353	*a*	$72 401	$34 195	$148 633
Limestone	112 082	....	$11 989	1 936 292	1 113 798	3 174 161
Marble	171 748	79 115	....	....	27 178	278 041
Sandstone	317 571	....	431 047	23 883	182 562	955 063
Trap	....	....	....	896 164	3 250	899 414
Total	$632 085	$90 468	$443 036	$2 928 740	$1 360 983	$5 455 312

a Included under "All other."

GRANITE

In the strict sense granite is an entirely crystalline rock made up of feldspar and quartz, usually with subordinate amounts of one or more minerals of the mica, hornblende and pyroxene groups. Among quarrymen and builders, however, the name granite is given to various other massive rocks that consist chiefly of silicate minerals, such as the heavier and darker colored types included under diorites, norites and gabbros, also syenite which resembles granite but lacks quartz, as well as metamorphic varieties included under gneisses and schists. This usage will be followed for the purposes of the present report, except that the basic dike rocks which are chiefly exploited for crushed stone are treated under the head of trap.

The granite trade for the past few years has not been in a flourishing condition. The production in 1911 showed a considerable decline compared with the reported total for the preceding year which was well below the output in 1909. The decrease has been largely in the less valuable grades of crushed stone and paving blocks, but on the other hand the trade in building and monumental granite has failed to reveal any decided upward trend.

The total production of granite in 1911 had a value of $148,633 against $244,763 in 1910, and $479,955 in 1909. Building stone, rough and dressed, accounted for $30,684 in the total, as compared with $40,911 in the preceding year and $35,019 in 1909. The output of monumental stone was valued at $11,353 against $12,989 in 1910; crushed stone at $72,401 against $91,988; rubble and riprap at $28,162 against $20,272; and all other kinds at $6033 against $78,603 in 1910.

Production of granite

	1909	1910	1911
Building stone	$35 019	$40 911	$30 684
Monumental	33 818	12 989	11 353
Crushed stone	182 029	91 988	72 401
Rubble, riprap	12 737	20 272	28 162
Other kinds *a*	216 352	78 603	6 033
Total	$479 955	$244 763	$148 633

a Includes curbing, paving blocks and minor uses.

NOTES ON THE GRANITE QUARRIES OF NEW YORK

The following notes relating to the granite industry are based on the results of a field investigation carried out during the summer of 1911, as an initial step toward the preparation of a comprehensive account of the quarry resources in the State. Assistance in the field work has been given by R. W. Jones of the State Museum staff.

No complete report on the quarry materials of the State has been issued since the publication of Smock's *Building Stone in New York,* which appeared in 1890 as Bulletin 10 of the State Museum. This work presents a brief but serviceable description of the quarries in existence at the time, as well as chapters on the use of stone in cities, physical tests, and the durability and causes of decay of building materials; it is still a valuable reference work though, of course, scarcely representative of present conditions in the industry. A short paper on the granite quarries in southeastern New York is included in the report of the State Geologist for 1900. This paper, prepared by Edwin C. Eckel, was intended to be only preliminary to a more detailed treatment of the granite and marble industries of the whole State. It affords information in regard to many quarry localities not mentioned in Smock's report, and gives a short description of the geological structure of the region as a basis for the classification of the building stones.

Adirondack region. The great expanse of crystalline rocks included in the Adirondacks and the bordering area affords a variety of quarry materials. The commoner types which are useful for building or monumental stone comprise granites proper, syenites and anorthosite. These are found in both massive and gneissoid development. Gabbros and various dike rocks of which diabase is the most abundant representative occur locally and have limited application for purposes of road improvement and engineering construction.

The quarry industry of this region has made slow progress. Until recent years its development was greatly retarded by lack of adequate transportation facilities and the high costs of shipment to the important markets. Though of less consequence than formerly, the factor of transportation is still of critical importance in some sections, particularly as competition has became very keen with the advantage naturally inclining toward the long-established enterprises of other districts which have attained a certain prestige in the trade. At present the only promising fields for industry are to be found in the marketing of special grades of stone which command attention through their exceptional attractiveness or their adaptability to certain uses.

Among the better known quarry materials for building and monumental purposes are the red granites on the northwestern side of the Adirondacks, the green syenite which is found in various sections as larger or smaller intrusive masses, and the light gray anorthosite which constitutes the great central core of the mountains and is exposed in outliers to the north and east of the main area. Some of the more accessible and important localities for these materials will be described.

St Lawrence river granites. The red granite of Grindstone, Picton and Wellesley islands in the St Lawrence river is one of the characteristic products of the region, widely known as an excellent building and monumental stone. It ranks with the best native granites of its kind. The several exposures on the group of islands between Clayton and Alexandria Bay belong to a single large but irregular mass which in the recently issued geological report covering that section is described and mapped as the Picton granite. In general it is a bright red coarsely textured granite in which the predominant ingredient is feldspar in large red individuals, with quartz and biotite. Most of the product in earlier years came from Grindstone island which furnished large quantities of structural and monumental material to the cities on the St Lawrence and the Great Lakes. Paving blocks were also made in quantity. These quarries are now idle or worked only in a small way. They are situated mainly along the western shore of the island. The quarry of the old Chicago Granite Co., now owned by H. B. Kelly of Clayton, has been more active than the others of late and has furnished stone for many of the structures along the river. The Forsyth quarry in the same vicinity supplied the large columns erected in the Senate chamber of the Albany Capitol. Though of coarse texture the stone has excellent polishing qualities.

The principal quarry operations in the area are now carried on by the Picton Island Red Granite Co., whose property is situated on the northern end of Picton island, between the larger Grindstone and Wellesley islands. The company has three quarries opened in the natural ledges which rise directly from the shore line to a height of 50 or 75 feet and which afford great advantages for economic work. The output as it comes from the quarries or from the cutting yards can be loaded directly on boats for river and lake shipment. Rail shipments are made from Clayton where the company has its own docks and yards. The granite is of finer texture than that from Grindstone island; two varieties are obtained, one with a medium grain and red body flecked with black and the other of finer grain with a uniform pink tint. The latter finds special favor for monumental work on account of its capacity for taking fine tool work and the strong contrast of the hammered and rubbed surfaces. The medium grained granite is very suitable for structural material, its rock and hammered surfaces having a pleasing warm tone, of lighter shade than the polished material. Some of the structures for which this stone has been used include the new part of the American Museum of Natural History in New York, the National Bank in Clayton and the Maryland Museum Building (polished columns) in Baltimore.

An exposure of granite in the vicinity of Alexandria Bay has been of some importance for the production of paving blocks and rough stone. It is a finely textured stone which shows the effects of regional compression, and belongs really to the gneissic types that are so widespread in the western Adirondacks. The principal quarry is a little south of Alexandria Bay and is opened in a knob that rises 100 feet or more above the river. It is owned by J. Leopold & Company of New York. The granite is rather variable in color which is a drawback to its general use for cut stone though well adapted for other purposes. It belongs to the biotite-muscovite class and is mainly composed of alkali-feldspar and quartz.

Granite in southern St Lawrence county. One of the largest areas of massive granite in the Adirondacks is found in the towns of Fine and Pitcairn, St Lawrence county, probably extending also into the adjacent section of Lewis county. The area has not been delimited or mapped as yet, and has never attracted attention apparently for quarry development though traversed by the Carthage & Adirondack Railroad which makes it accessible to the markets of northern and central New York. The granite appears in practically continuous outcrop for a distance of 8 miles along the railroad, in the stretch between Harrisville and Benson Mines. The more available section lies between milestones 56 and 64 of the railroad line, or 25 miles east of Carthage and a little over 40 miles from Watertown. The granite for the most part shows a coarse massive texture, but medium grained types appear near the borders where also it becomes more or less gneissoid. Compared with the Thousand Islands granite it has a lighter color, being light red to pink, with often a mottled pink and white appearance from the varicolored feldspar. There are abundant quarry sites along the railroad, as many of the ridges within the central part of the area afford natural exposures several hundred feet high. The results of field and laboratory examination show the stone to be sound and free of injurious ingredients and practically fresh at the surface. The following analysis of a sample of the granite is by R. W. Jones:

$Si O_2$	72.69
$Al_2 O_3$	14.11
$Fe_2 O_3$	.26
$Fe O$	2.89
$Mg O$	.28
$Ca O$	.64
$Na_2 O$	2.37
$K_2 O$	5.16
$H_2 O+$	.24
$H_2 O-$	.02
	98.66

Sulfur was tested for but not found. The minor constituents including manganese, phosphorus and zirconium, the presence of which was indicated by microscopic analysis, were not estimated.

The granite is bordered on the west by a great intrusion of syenite that is estimated by C. H. Smyth, jr, to cover not less than 75 square miles. The syenite is a grayish green to dark green or nearly black rock composed largely of feldspar but containing considerable amounts of pyroxene, amphibole and magnetite. In its original or unaltered phase it has a coarse massive texture, but the general appearance is that of a granulated and more or less recrystallized rock, showing much more evidence of pressure metamorphism than the granite. The syenite is not adapted for building stone on account of its somber color. For engineering purposes it should prove very serviceable.

Quarries in Clinton and Essex counties. In the eastern Adirondacks the available quarry materials suitable for architectural and monumental work consist of granite, syenite and anorthosite. These formations are of widespread occurrence but in comparatively few places do they possess the qualities requisite for cut stone as they have been largely metamorphosed into gneisses and schists. The unreduced or slightly modified residuals of the igneous intrusions which are found here and there along the borders afford the basis for quarry operations.

The vicinity of Ausable Forks presents many advantages for quarrying in connection with both anorthosite and syenite. For several years past a considerable quantity of monumental stone has been shipped from this section, and recently additional developments with a view to the extraction of all classes of rough and cut stone have been planned.

The Adirondack Granite Co., formed in 1910 as a consolidation of the properties formerly owned by Moore Brothers and the Ausable Granite Co., controls a large acreage of the syenite and anorthosite in that vicinity which as yet is only partly developed. The syenite quarries lie on both sides of the Ausable river, the more important property covering the ridge which lies north of the river and just east of the village. This is an excellent situation, both for economic extraction and shipment. The syenite is of medium grain and has a bright green color on polished surfaces. It is composed mainly of alkali-feldspar and magnetite. It is particularly adapted for monumental work, taking a lustrous polish and showing the finest tracery in strong relief. It is sold under the name of "Adirondack green granite." The company has a second quarry on the west side of Ragged mountain, south of the river, where the rock is of finer grain and darker color. This is marketed as "Killarney green granite." The anorthosite properties are situated south of the village on the ridge along the east branch of the Ausable. This has been opened only in one place, the Wienholz quarry, from which some building stone has been shipped. The anorthosite belongs to the border phase, having a fine ground mass of crushed feldspar which lends a medium gray tone to the rock as seen in large samples, whereas the characteristic Adirondack type has a very coarse texture and dark gray or green color. The light body is set off by inclusions of black pyroxene and hornblende, with an occasional fragment of dark uncrushed feldspar showing the iridescent play of colors peculiar to labradorite. The color effect of the rough and dressed surfaces is about that of a medium gray granite, for which it is an all-round substitute. Owing to its simple mineral character the anorthosite has superior fire-resisting qualities, an important consideration for some purposes. It is no doubt a strong and durable stone.

The syenite quarries owned by F. G. Carnes of West Chazy are situated just south of Ausable Forks. The Keystone lies near the base of Ragged mountain and yields a green syenite of lighter shade than that from the quarries at a higher elevation. The Emerald quarry is situated on the westward continuation of the exposure across the river. The stone from this locality is a medium dark green and rather fine in texture. Both afford excellent monumental material.

Another syenite quarry, known as the Clements quarry, is situated on the side of Ragged mountain overlooking Ausable Forks. It has shipped some monumental stock.

There are a number of anorthosite exposures in the vicinity of Keeseville, from which building material has been taken for local structures and also for shipment in years past. The stone passed in the trade as Ausable granite. The Prospect Hill quarries, just south of Keeseville, are described in Smock's reports as having been operated between the years 1888 and 1890.

Southeastern New York. Massive igneous rocks play a subordinate part in the structure of the Highlands region. Local intrusions of granite, diorite and syenite in the form of dikes, sills and bosses occur, however, in various sections, and afford a fairly varied assortment of quarry materials. Among the more extensive bodies which have gained some prominence as sources of constructional stone may be mentioned the Peekskill or Lake Mohegan granite, the granites near New Rochelle and Garrisons, and the Pine Island bosses in Orange county. An area of somewhat gneissoid diorite, called the Harrison diorite, is found in eastern Westchester county, as an offshoot from the large intrusions of the same rock in Connecticut.

The very basic intrusives are represented by the Cortlandt series of gabbros, having a large boss just south of Peekskill, but showing such variability of composition and appearance as to be of little value for quarry purposes. In this class also belong the serpentines of Westchester and Richmond counties. The great sill of diabase which forms the lines of vertical cliffs known as the Palisades extending along the west side of the Hudson river south from the Highlands has been a prolific source of material for crushed stone of the best quality.

The gneisses which are the most important element in the geology of this section have a composite character, including both igneous and sedimentary derivatives. Some types in the northern and central Highlands appear to be only slightly modified granites, as exemplified by the exposures on Storm King, Crow's Nest and Breakneck mountains at the portal of the Hudson gorge. They have been employed for dimension stone, but mainly for rough work, concrete and road material. Much of the gneiss in the central Highlands is of so variable a nature through injection of igneous material and inclusions of different character as to admit of no extensive application.

In Westchester county the Yonkers gneiss is of considerable importance for local construction purposes. It is a fairly uniform, though distinctly foliated, biotite gneiss of blue or reddish color.

Another member of the gneiss series, the Fordham, occupies extensive belts in the county; it is a banded biotite gneiss and finds limited use for local building and rough work.

Peekskill granite. This is one of the best known constructional granites of the region. It is exposed in two areas about a mile south of Lake Mohegan and five miles east of Peekskill, the two outcrops probably belonging to the same intrusion. The more northerly outcrop is included in the quarry lands of the Mohegan Lake Granite Co.; the other to the south and nearer Peekskill has been worked as the Millstone Hill quarries.

The former quarries were opened in 1892 to supply stone for local engineering works and have since furnished large quantities of building stone, chiefly to New York City and for such notable structures as the new Episcopal Cathedral. The granite is a biotite-muscovite variety, of medium grain, massive and free of knots and streaks. It occurs in two contrasting colors — yellow and light gray. The rare and very attractive yellow granite forms the surficial outcropping part of the mass, changing to the normal gray at about 50 feet depth. The peculiar coloration is the effect of limonite stain introduced by seepage of ground water, and is not brought about by weathering of the stone itself. The quarries are large and well equipped. There is also a crushing plant for employment of the waste material.

The Millstone Hill quarries opened in a north-facing ridge, across the valley from the above mentioned property, are owned by Rudiger Brothers, but have been worked until recently by the contractors of the Croton dam. Besides all the stone used in that structure they have supplied some building material for use in Peekskill and other places. The excavations cover an area of about 500 feet long by 200 feet wide and extend to a depth of 40 feet. The granite is of medium grain, very light gray, with more muscovite than that from the Mohegan Lake quarries. There has been little infiltration of limonite, and the gray color persists practically to the surface. The granite is well adapted for building and all general purposes.

Quarries near Garrison. About five miles north of Peekskill and half that distance south of Garrison is an isolated intrusion of granite which has supplied a considerable quantity of building stone. The quarries were worked by the King Granite Co. and later by Doern & Sons, but have not been active since 1906. They will not be reopened, though there is some prospect of starting work at a new place, on lands owned by Raymond Moore, just south of the King quarries. The granite is of light gray color, medium to fine in grain, and belongs to the biotite variety. A characteristic component is red garnet in small but plainly visible grains or crystals disseminated through the body of the rock. Like the Peekskill granite it belongs rather to the basic class allied to the diorites and may be an offshoot of the Cortlandt intrusion. The granite has been employed mainly in buildings in the towns along the river. The guard house at West Point is a specimen structure.

Yonkers gneiss. There are only a few quarries now active in the Yonkers gneiss, though a considerable number are listed by Eckel[1] as having been worked at the time of his report and the few preceding years. The principal area of the gneiss is a belt that extends from near Van Cortlandt Park to Scarsdale in southern Westchester county and that forms the ridge west of the Bronx river. It also occurs in a considerable area between White Plains and Kensico to the east of the Harlem railroad. There are different color varieties of the gneiss and Eckel states that the red varieties are more open to decay than the blue, though for what reason he does not explain.

One of the large quarries in the Yonkers gneiss is that of Hackett Brothers situated at the junction of Midland and Central avenues, Dunwoodie. It is opened for a distance of 800 feet and has a working face 40 feet high. The stone in the quarry has a bluish appearance, but the hand specimens have a decided pink tinge from the prevailing color of the feldspar. The grain is fine and the arrangement somewhat foliated owing to the regular distribution of the biotite in parallel bands. The jointing is not so close as to preclude the extraction of large-sized blocks. Most of the output is dimension stock. Good examples of the stone from the quarries are found in many of the buildings in Yonkers, including St John's and St Joseph's hospitals and several of the public schools.

In the same vicinity is the quarry worked by John Russo. It produces building stone in small quantity for local sale. In character and appearance the gneiss is similar to that obtained at the Hackett quarry, but the jointing is more closely spaced, permitting the extraction of few large blocks.

The quarry of Louis Perri lies a little east of the Hackett quarry.

[1] The Quarry Industry in Southeastern New York. Ann. Report State Geologist 20, 1902. Also published separately.

The opening is about 100 feet square with a face of 30 feet. Most of the output, which is small, is cut and dressed on the property.

The Flannery quarry, also at Dunwoodie, is an occasional producer of building material. The quarries formerly worked at White Plains, Hartsdale, Tuckahoe, Hastings and Tarrytown have been closed down and the lands converted to other uses.

Fordham gneiss. The Fordham is a light gray banded gneiss, made up of feldspar, quartz and biotite. It is regarded as a metamorphosed sediment, though in places it has been so injected with granite that the igneous material predominates. The gneiss varies much from place to place and even in the limits of a single quarry. Its use, consequently, is mainly for rough stone in foundation work.

The quarry owned by Patrick Reilly in the village of Dublin, Westchester county, has been one of the few producing building material. It has been worked more or less actively for the past 35 years, and recently has been under lease to Thomas Murphy of Irvington. It is opened for a width of 200 feet, with a face from 30 to 50 feet high. The rock is hard, much contorted gneiss, seamed with granite and pegmatite. It has been used in several residences and for some local public buildings.

The Lefurgis quarry, near Unionville, consists of an opening about 100 feet wide with a face of 30 feet. It affords building and rough stone and is to be equipped with a crushing plant. It is operated under lease by William Nichols, jr.

A quarry at Glenville is worked by Duell & Holloway for crushed stone. The old quarries at Uniontown, Bryn Mawr, Lowerre and Fordham are no longer active.

Storm King granite gneiss. The granite exposed on Storm King, Breakneck, Crow's Nest and other prominences in the northern Highlands represents the most considerable body of that rock in massive or slightly modified condition existing anywhere in the southeastern section. It belongs doubtless to the early Precambric series, older than the small granite intrusions around Peekskill. Its appearance in places is that of a medium to coarse massive granite, but more often it shows a distinctly gneissoid arrangement of the minerals and more or less crushing effects. It is a strong and very durable stone that has been used mainly for rough construction and crushing purposes. Its color ranges from medium to dark according to the relative proportion of hornblende that is admixed with feldspar and quartz, the general tone being reddish or greenish. There are quarries and crushing plants at the base of

Storm King mountain below Cornwall and also directly opposite on the east bank of the river, on the side of Breakneck ridge. The latter, known as the Bailey quarries, have supplied considerable building stone.

Granite near Warwick. Several granite intrusions occur in the southeastern part of Orange county, near the New Jersey state line. Two of them constitute bosses that rise into the conspicuous twin peaks Adam and Eve on the edge of the Wallkill "Drowned Lands." Both are made up of coarse hornblende granite, somewhat gneissoid in places and showing pegmatitic and aplitic variations. Mt Eve, the larger, occupies an area about two miles long and a mile wide. Mt Adam is a nearly round mass one-half mile in diameter. There are small knobs of the same granite near Big Island, northeast of Mt Eve, and also in the section southwest along the general axis of the intrusion. Another large intrusion is found on Pochuck mountain, a broad ridge which mainly lies in New Jersey. The northern end that comes within New York State consists of coarse quite massive hornblende granite bordered on the west by biotite gneiss. Quarries have been opened on the northern slope of Mt Adam and the western slope of Mt Eve. The Mt Adam Granite Co. worked at the former locality for several years, beginning about 1889. The quarry opening has a length of 250 feet and a face from 20 to 30 feet high. The granite is mainly a coarse, medium gray, hornblende variety, but with this is associated a finer grained aplitic granite that forms bands and inclusions in such amount as to prevent the extraction of uniform material.

The Mt Eve quarries were opened about 1890 by the Empire Granite Co. which was also engaged in operating the Pochuck mountain quarries. They are situated a little way up the western slope of Mt Eve in the notch. The granite is less broken and more uniform in quality than on Mt Adam. It was employed quite extensively for dimension stone which was sold in Orange, N. J., and other places. The quarries lie one and a half miles from the railroad.

The Pochuck mountain quarries were worked up to about five years ago and have produced mainly building stone and paving blocks. They are opened for a width of 200 feet along the mountain showing a face from 30 to 40 feet high. The granite is slightly foliated in places, but has an attractive appearance, with a pink body mottled by gray and black. Its use as a building stone is exemplified in the post office at Paterson, N. J.

LIMESTONE

The stone classified under this heading consists for the most part of the common grades of limestone and dolomite such as are characterized by a compact granular or finely crystalline texture and are lacking in ornamental qualities.

A smaller part is represented by crystalline limestone and by the waste products of marble quarrying which is sometimes employed for crushed stone, lime-making or flux. Limestone used for the manufacture of portland and natural cement is, however, excluded from the tabulations so as to avoid any duplications of the statistics.

Limestones have a wide distribution in the State, the only region which is not well supplied with this stone being the southern part where the prevailing formations are sandstones of Devonic age. The noncrystalline varieties occur in regular stratified order in the Cambric, Lower Siluric, Upper Siluric and Devonic systems. In most sections they occupy considerable belts and have been little disturbed from their original horizontal position. On the borders of the Adirondacks and in the metamorphosed Hudson river region, however, they have been more or less broken up by faulting and erosion and in places have a very patchy distribution.

The Cambric limestones are found in isolated areas on the east, south and west sides of the Adirondacks. They are usually impure, representing a transition phase between the Potsdam sandstones below and the high calcium limestones above. The lower beds of the Beekmantown formation as originally defined are now known to belong to the Cambric system. The Little Falls dolomite is perhaps the most prominent member of the Cambric limestones and is extensively developed in the Mohawk valley with quarries at Little Falls, Mayfield, Amsterdam and other places. It is a rather heavily bedded stone of grayish color, suitable more especially for building purposes. In Saratoga county the Hoyt limestone is in part the equivalent of the Little Falls dolomite; it has been quarried for building stone just west of Saratoga Springs. On the west side of the Adirondacks the Theresa limestone is described by Cushing as a sandy dolomite which may in part belong to the Cambric system. It is comparatively thin and has no importance for quarry purposes.

The Beekmantown limestone which is now taken as including the middle and upper beds of that series as earlier defined is mostly restricted to the Champlain valley. It occurs on the New York shore in rather small areas, usually down-faulted blocks, that are the remnants of a once continuous belt. It is also represented doubtless in the basal portion of the limestone area that extends across Washington and Warren counties. The only place where it has been extensively quarried is at Port Henry where the purer layers have been worked for flux. In the Lake Champlain region it is a bluish or grayish magnesian limestone occurring in layers from a few inches to several feet thick.

The Chazy limestone is found in the same region as the Beekmantown in discontinuous areas along the eastern Adirondacks from Saratoga county north to the Canadian boundary. It attains its maximum thickness in eastern and northeastern Clinton county, and has been quarried around Plattsburg, Chazy and on Valcour island. The Chazy is the earliest representative of the Paleozoic formations characterized by a fairly uniform high calcium content; analyses commonly show 95 per cent or more of calcium carbonate. It has a grayish color and finely crystalline texture. The fossiliferous beds afford attractive polished material which is sold as "Lepanto" marble. It is used also for lime and furnace flux. There are old quarries on Willsboro point, Essex county. On the west side of the Adirondacks the Pamelia limestone described in the areal reports of that section belongs to the Chazy series. It covers a considerable area in Jefferson county between Leraysville and Clayton, and has been quite extensively quarried for building stone and lime, though of subordinate importance to the Trenton limestones of that section.

In the Mohawkian or Trenton group are included the Lowville (Birdseye), Black River and Trenton limestones which have a wide distribution and collectively rank among the very important quarry materials of the State. They are represented in the Champlain valley, but are specially prominent on the Vermont side; from the latter area a belt extends southwest across northern Washington county to Glens Falls in Warren county and is continued into Saratoga county. Another belt begins in the Mohawk valley near Little Falls and extends northwesterly with gradually increasing width across Oneida, Lewis and Jefferson counties to the St Lawrence river. There are isolated areas of Trenton limestones in the Hudson valley south of Albany. The limestones vary in composition and physical character according to locality and geologic position. They are often highly fossiliferous. In the northern section they are mostly gray to nearly black in color, contain little magnesia and run as high as 97 or 98 per cent calcium carbonate.

The lower part of the group is heavy bedded and well adapted for building stone; the upper beds commonly contain more or less shale. They are used for various purposes including building and ornamental stone, crushed stone, lime, portland cement and flux. In the Champlain valley quarries are found near Plattsburg, Larabees Point and Crown Point; in Washington county at Glens Falls where there are extensive quarries that supply material for building purposes, portland cement and lime. The well-known black marble from Glens Falls is taken from the Trenton. Numerous quarries have been opened in Herkimer, Oneida, Lewis and Jefferson counties. The output of the last named county is specially important, including limestone for building and road construction, and lime for manufacture of calcium carbide. The principal quarries in Jefferson county are at Chaumont.

The next assemblage of limestones in the order of stratigraphic occurrence includes the Clinton, Lockport and Guelph members of the Niagaran group. The Clinton limestone has a variable importance in the belt of Clinton strata that extends from Otsego county a little south of the Mohawk river across the central and western parts of the State on the line of Oneida lake and Rochester to the Niagara river. East of Rochester the limestone is relatively thin, usually shaly and split up into several layers, but on the west end in Niagara county it becomes the predominant member and has a more uniform character. Large quarries have been opened recently at Pekin, Niagara county, for the supply of flux to the blast furnaces of the Lackawanna Steel Co. at Buffalo. The upper beds of bluish gray fossiliferous limestone from 10 to 12 feet thick are the purest and analyze from 90 to 95 per cent calcium carbonate. The Lockport is a magnesian limestone, in places a typical dolomite, and is rather silicious in the lower part. It outcrops in a continuous belt, several miles wide, from Niagara Falls east to Onondaga county and then with diminishing width across Madison county. The upper layers are quite heavy and yield material suitable for building purposes, road metal and lime. There are quarries around Niagara Falls, Lockport and Rochester. It is worked to some extent in Wayne, Onondaga and Madison counties. The Guelph, also a dolomite, occupies a limited area in Monroe and Orleans counties and is worked near Rochester.

The Cayugan group includes among its members the Cobleskill, Rondout and Manlius limestones, which are economically important. They have furnished large quantities of material for the manufacture of natural cement, being the source of the cement rock in the

Rosendale district and in Schoharie and Onondaga counties. The cement rock of Erie county is found in the Salina formation. The purer layers are employed in Onondaga county for lime-making. The Manlius limestone is used for portland cement in the eastern part of the State.

At the base of the Devonic system appears the Helderbergian group which is very prominent for its calcareous strata. Limestones of this age are strongly developed along the Hudson river in Albany, Columbia, Greene and Ulster counties. The Coeymans or lower Pentamerus and the Becraft or upper Pentamerus limestones afford material for building, road metal, lime and portland cement. The limestone for the portland cement works at Hudson and Greenport is obtained from Becraft mountain, an isolated area of limestones belonging to the Manlius, Helderbergian and Onondaga formations. The works at Howes Cave use both the Manilus and Coeymans limestones. Extensive quarries are located also at Catskill, Rondout and South Bethlehem.

The Onondaga limestone, separated from the preceding by the Oriskany sandstone, has a very wide distribution, outcropping quite continuously from Buffalo, Erie county, eastward to Oneida county and then southeasterly into Albany county, where the belt curves to the south and continues through Greene, Ulster and Orange counties to the Delaware river. It is in most places a bluish gray massive limestone with layers and disseminated nodules of chert. The chert is usually more abundant in the upper beds. The limestone finds use as building stone and the less silicious material, also, for lime-making. Quarries have been opened at Kingston, Split Rock (near Syracuse), Auburn, Waterloo, Seneca Falls, Leroy, Buffalo and other places.

The Tully is the uppermost of the important limestone formations and likewise the most southerly one represented in the central part of the State. Its line of outcrop extends from Ontario to Madison county, intersecting most of the Finger Lakes. Its thickness is not over 10 feet, and on that account can not be worked to advantage except under most favorable conditions of exposure. For building stone it is quarried only locally and to a very limited extent. It finds its principal use in portland cement manufacture, being employed for that purpose by the Cayuga Lake Cement Co. in its works at Portland Point, Tompkins county.

Marl is a useful substitute for the hard limestones for some purposes and is quite extensively developed in the central and western parts of the State. It is found particularly in swampy tracts and old lake basins associated with clay and peat. In the Cowaselon swamp near Canastota the marl underlies several thousand acres and is said to be 30 feet thick. The Montezuma marshes in Cayuga and Seneca counties contain a large deposit which at Montezuma is 14 feet thick. In Steuben county the marls at Arkport and Dansville have been employed for lime-making. Until recently marls have been used quite extensively for portland cement and plants were operated at one time in the marl beds near Warners and Jordan, Onondaga county; at Montezuma, Cayuga county; Wayland, Steuben county; and Caledonia, Livingston county. Their principal use at present is for agricultural and chemical purposes.

Production of limestone. The limestone quarries rank first in importance among the stone industries. The product for 1911 was valued at $3,174,161 and was distributed among 31 counties. The returns showed a slight decrease as compared with the output in 1910, which was valued at $3,245,807, and was also below that reported for 1909.

Production of limestone

MATERIAL	1909	1910	1911
Crushed stone	$1 744 314	$1 815 809	$1 936 292
Lime made	452 874	365 839	400 396
Building stone	217 109	99 049	112 082
Furnace flux	434 311	538 491	454 800
Rubble, riprap	82 748	30 819	20 328
Flagging, curbing	15 363	3 888	11 989
Miscellaneous	353 664	391 912	238 274
Total	$3 300 383	$3 245 807	$3 174 161

Erie county had the largest output of any county; its products are chiefly building stone, crushed stone and furnace flux. The total value of the limestone quarried in the county last year was $843,615.

Onondaga county ranks second in the list, but its importance is chiefly due to the operations of the Solvay Process Co. which uses the limestone in alkali manufacture. The company has recently opened new quarries at Jamesville, with equipment for the production of sufficient limestone to meet its requirements. The old quarries at Split Rock have been abandoned.

The other counties reporting a value of over $100,000 in 1911 were Dutchess, Rockland, Genesee, Warren, Ulster, Niagara, and Albany, ranking in the order given.

The distribution of the limestone production by counties and also according to uses is shown in the accompanying tables.

Crushed stone. Limestone finds its principal application as crushed stone in which form it is extensively employed for road metal, concrete and railroad ballast. There are large quarries in Erie, Genesee, Dutchess and Rockland counties besides a great number of smaller ones elsewhere, that are equipped with crushing plants. The canal and highway improvements which have been in progress recently have created a large market for the material, and the production has shown a steady increase. The waste or fine dust that results from crushing is finding use as a fertilizer for soils deficient in lime.

The value of the crushed limestone for 1911 was reported at $1,936,292, as compared with $1,815,809 for the preceding year. The total quantity represented was 3,116,958 cubic yards against 2,800,000 cubic yards in 1910. Erie county alone contributed an output valued at $489,881. The other counties reporting a value of over $100,000 last year were Dutchess, Rockland, Onondaga, Genesee and Albany.

Lime. The total value of the lime made in 1911 was $400,396. This represented a considerable advance from the total of $365,839 reported in 1910, but fell short of the record for 1909. The lime made by the Solvay Process Co. and the Union Carbide Co. has not been included in the totals given, but classed under "Other uses." The leading counties in the manufacture of lime for the trade were Warren, Clinton and Jefferson.

Building stone. The limestones found in the State have only a limited sale for building purposes and few quarries supply more than a local demand so that their output fluctuates greatly from year to year. The restricted market seems to be largely due to the fact that the limestones are prevailingly of grayish color in medium to dark tints, whereas the present demand is for white or very light gray stone such as the Bedford limestone. The extending use of concrete has also been a factor in the recent decline of the cut stone trade, though it has increased the sale of crushed stone.

The returns for 1911 showed a total product of building stone valued at $112,082, as compared with a value of $99,049 in the preceding year. The small gain indicated by these totals did not suffice to counterbalance the decline in the previous years; in 1908 the product of building stone reached a value of $245,655. Erie county contributed a value of $77,689 to the total last year. The industry in Schoharie and Herkimer counties, once quite important, has shrunk to small proportions.

Furnace flux. The value of the limestone used in furnaces for flux is second only to that of crushed stone. The principal quarries of this material are in the Onondaga limestone of Erie and Genesee counties and the Clinton limestone of Niagara county. They supply the iron furnaces at Buffalo and vicinity. Some flux is obtained in the Gouverneur marble region for use in the furnaces at Charlotte. The furnaces in the Lake Champlain section derive their flux from quarries in Clinton and Essex counties.

The production of flux in 1911 was valued at $454,800 representing a total of 792,248 tons. The shipments were smaller than in the preceding year, owing to the dull conditions in the iron market. Erie county contributed the largest value, $268,082, and Niagara county ranked second with $141,824.

Production of limestone by counties in 1910

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$125 450	$4 500	....	....	....	$129 950
Cayuga	39 019	....	....	$7 690	....	46 709
Clinton	13 549	48 823	$12 364	4 160	....	78 896
Erie	476 490	152	322 067	53 881	$13 745	866 335
Genesee	118 797	5 000	90 132	480	200	214 609
Greene	8 225	....	....	....	....	8 225
Herkimer	8 520	3 114	....	....	....	10 434
Jefferson	1 693	*a* 55 837	....	200	168 265	225 995
Lewis	1 195	3 200	....	520	726	5 641
Madison	52 028	....	2 625	800	....	55 453
Monroe	17 423	29 520	....	2 589	1 719	51 251
Montgomery	29 810	....	....	8 622	2 125	40 557
Niagara	5 000	4 000	76 695	3 197	406	89 298
Onondaga	150 640	*a* 1 620	....	12 092	233 228	397 580
Rensselaer	15 000	....	....	100	70	15 170
St Lawrence	870	7 240	27 008	362	1 116	36 596
Saratoga	15 114	....	....	7	....	15 121
Schoharie	12 441	128	....	1 567	624	14 760
Seneca	1 625	192	192	1 192	75	3 276
Ulster	20 654	11 897	....	....	....	32 551
Warren	31 378	140 576	....	1 583	....	173 537
Washington	50 000	44 200	....	....	....	94 200
Westchester	59 387	....	....	....	3 802	63 189
Other counties *b*	561 501	5 840	7 408	7	518	575 274
Total	$1 815 809	$365 839	$538 491	$99 049	$426 619	$3 245 807

a Lime made by Solvay Process Co. and Union Carbide Co. included in "Other uses."
b Includes Columbia, Dutchess, Essex, Fulton, Oneida, Ontario, Orange and Rockland counties.

Production of limestone by counties in 1911

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$132 925	....	....	....	....	$132 925
Cayuga	28 494	....	....	$12 100	....	40 594
Clinton	12 192	$62 002	$9 511	625	$579	84 909
Erie	489 881	300	268 082	77 689	7 663	843 615
Genesee	204 896	....	....	....	....	204 896
Greene	2 625	....	2 000	....	....	4 625
Herkimer	9 283	2 603	....	....	....	11 886
Jefferson	16 749	*a* 18 625	....	....	40 220	75 594
Lewis	2 850	35 000	....	95	91	38 036
Madison	34 361	22 625	5 000	100	....	62 086
Monroe	16 133	18 780	....	3 291	994	39 198
Montgomery	39 000	....	....	5 338	11 184	55 522
Niagara	....	525	141 824	800	....	143 149
Onondaga	170 402	*a* 53	....	10 178	190 704	371 337
Rensselaer	16 556	....	100	....	1 268	17 924
St Lawrence	287	6 824	24 186	652	13	31 962
Saratoga	3 792	....	....	....	....	3 792
Schoharie	19 640	300	....	457	4 600	24 997
Seneca	5 650	22	61	487	74	6 294
Ulster	167 472	19 300	....	....	....	186 772
Warren	18 161	165 064	....	270	5 621	189 116
Washington	1 000	10 000	....	....	....	11 000
Westchester	....	21 072	253	....	4 027	25 352
Other counties *b*	543 943	17 301	3 783	....	3 553	568 580
Total	$1 936 292	$400 396	$454 800	$112 082	$270 591	$3 174 161

a Lime made by Solvay Process Co. and Union Carbide Co. included in "Other uses."
b Includes Columbia, Dutchess, Essex, Fulton, Oneida, Ontario, Orange and Rockland counties.

MARBLE

The granular crystalline limestones and dolomites classed as marble are found in the metamorphosed areas of the Adirondacks and southeastern New York. A few varieties of compact, noncrystalline limestone, such as the black limestone of the Trenton formation occurring at Glens Falls and the fossiliferous Chazy limestone along Lake Champlain, possess ornamental qualities that fit them for special uses and pass as marble in the trade.

The principal quarries of monumental marble are situated in the vicinity of Gouverneur, St Lawrence county. The typical product is a rather coarse-grained, mottled white and gray marble which takes a lustrous polish. It is graded according to color effect into "light," "medium," "dark," and "extra dark." The best quality is employed for monumental and ornamental work; building stone is of secondary importance. The quarries are operated by the

Gouverneur Marble Co., St Lawrence Marble Quarries, J. C. Callahan & Sons, and the Northern New York Marble Co.

The belt of metamorphosed limestones which extends from Columbia county through Dutchess and Westchester to Manhattan island contains in places a good grade of white and gray marble. Quarries have been worked in the past at Ossining, Dobbs Ferry, White Plains, Pleasantville, Tuckahoe, Greenport, and other places. Tuckahoe has been a notable locality for white marble used in the buildings of New York City. At present the only active quarries worked for building stone are at South Dover. The South Dover Marble Co. has been the chief producer of late years and has supplied material for many of the large structures in New York, Washington and other cities. The Dover White Marble Co. has recently worked quarries in the same vicinity. The stone from this locality possesses uniformity of grain and color and is undoubtedly one of the best white marbles in this county.

A mottled pink and gray marble suitable for interior decorations is obtained from the Chazy formation at Plattsburg. The quarries recently operated by the Rutland-Florence Marble Co. have been acquired by the Vermont Marble Co.

Black marble — a fine-grained, compact, black variety of the Trenton limestone — is quarried for ornamental purposes at Glens Falls by Finch, Pruyn & Co. who ship the stone mainly in the rough state.

The production of marble in the State last year was valued at $278,041, an amount considerably below that reported in any other recent year. The value of the output in 1910 was $341,880. In 1908 it was $692,851 or more than double the output last year. The falling off, as shown in the accompanying table, has been mainly in the marble used for building purposes.

Production of marble

VARIETY	1909	1910	1911
Building marble	$262 934	$252 965	$171 748
Monumental	104 495	88 684	79 115
Other kinds	12 587	231	27 178
Total	$380 016	$341 880	$278 041

SANDSTONE

Under sandstone are included the sedimentary rocks which consist essentially of quartz grains held together by some cementing substance. Among the varieties distinguished by textural features are sandstones proper, conglomerates, grits and quartzites.

Of the sedimentary rocks which occur in the State, sandstone has the largest areal distribution, while in economic importance it ranks second only to limestone. Nearly all the recognized stratigraphic divisions above the Archean contain sandstones at one or more horizons. The kinds chiefly quarried are the Potsdam, Hudson River, Medina and the Devonic sandstones. A few quarries have been opened also in the Shawangunk conglomerate and the Clinton and Triassic sandstones.

The Potsdam of the upper Cambric is the lowest and earliest in age of the sandstones that have a fairly wide distribution and are utilized for building purposes. The most extensive outcrops are along the northern and northwestern borders of the Adirondacks in Clinton, Franklin, St Lawrence and Jefferson counties. Other exposures of smaller extent are found in the Lake Champlain valley and on the southeastern edge of the Adirondack region. These latter areas represent the remnants of a once continuous belt that has been broken up by folding, faulting and erosion. The Potsdam sandstone has in many places the character of a quartzite, consisting of quartz grains cemented by a secondary deposition of quartz, and then is a very hard, tough and durable stone. The quartzite from St Lawrence county has sustained a crushing test of more than 42,000 pounds to the square inch. The color varies from deep red to pink and white. The principal quarries are near Potsdam and Redwood, St Lawrence county, and Malone and Burke, Franklin county. Besides building stone which is the chief product, there is some flagstone sold, mainly by the quarries at Burke for shipment to Montreal.

The so-called Hudson River group is essentially a series of sandstones, shales, slates and conglomerates, ranging in age from the Trenton to the Lorraine, but which have not been sufficiently studied to permit the accurate delimitation of the various members on the map. The group is exposed in a wide belt along the Hudson from Glens Falls southward into Orange county and also in the Mohawk valley as far west as Rome. The sandstone beds are usually fine grained, of grayish color and rather thinly bedded. Over wide stretches they provide practically the only resource in constructional stone and consequently they have been quarried at a great number of places to supply the local needs for building and foundation work. Some of the stone is crushed for road metal and concrete.

The Medina sandstone is found along the southern shore of Lake Ontario from the Niagara river east to Oswego county; in central New York it is represented by a coarse conglomeratic phase called the Oneida conglomerate. As developed in the western part of the State where it is principally quarried, it is a hard fine-grained sandstone of white, pink or variegated color. The pink variety is specially quarried for building stone and has an excellent reputation. Many of the large cities of the county and most of the important towns and cities of the State contain examples of its architectural use. The large quarries are situated in Orleans county, near Albion, Holley and Medina, along the line of the Erie canal, but there are others at Lockport and Lewiston, in Niagara county and at Brockport and Rochester in Monroe county. The Medina sandstone also finds extensive application for curbing and flagging and for paving blocks. It is employed more extensively for the latter purpose than any other stone quarried in the State.

The Shawangunk conglomerate is more widely known for its use in millstones than for constructional purposes. It outcrops along Shawangunk mountain in Ulster county and southwesterly into New Jersey, with an outlier near Cornwall, Orange county. The quarries near Otisville have supplied considerable quantities of stone for abutments and rough masonry.

The Clinton sandstone is mainly developed in central New York, being absent from the Clinton belt in the western part of the State. It forms ledges of considerable extent on the south side of the Mohawk valley from Ilion to Utica and beyond. It consists of reddish brown and gray sandstones, of medium texture and hardness. The stone has been used for foundations and building in Utica and other places in the vicinity.

Of the Devonic formations which cover about one-third the whole area of the State, the Hamilton, Portage, Chemung and Catskill contain important sandstone members serviceable for quarry operations. These sandstones are popularly known as bluestone, a name first applied in Ulster county where they are distinguished by a bluish gray color. They are for the most part fine-grained, evenly bedded, bluish or gray sandstones, often showing a pronounced tendency to split along planes parallel to the bedding so as to yield smooth thin slabs. For that reason they are extensively used for flag and curbstone, and a large industry is based on the quarrying of these materials for sale in the eastern cities. Most flagstone is produced in the region along the Hudson and Delaware rivers, where there are convenient shipping facilities to New York, Philadelphia and other large cities. The Hudson river district includes Albany, Greene and Ulster counties, but the quarries are mainly situated in the area that includes southern Greene and northern Ulster, with Catskill, Saugerties and Kingston as the chief shipping points. The Delaware river district includes Sullivan, Delaware and Broome counties; the shipping stations are along the Erie and the Ontario & Western railroads. The sandstone of this section ranges from Hamilton to Catskill age. In the area to the west the quarries are confined to the Portage and Chemung groups, with the most important ones in the Portage. There are large, well-equipped quarries near Norwich, Chenango county, and Warsaw, Wyoming county, which produce building stone for the general market. Numerous small quarries are found in Otsego, Chemung, Tompkins, Tioga, Schuyler, Steuben, Yates, Alleghany, Cattaraugus and Chautauqua counties.

Production of sandstone. The accompanying tables give the production of sandstone during the last two years, divided according to bluestone and other kinds.

There was a very large falling off in the value of the output last year, the returns showing the lowest aggregate reported at any time since the statistics of the industry have been collected by this office. The combined value of both bluestone and sandstone amounted to $955,063, as compared with $1,451,796 in 1910, a decrease of $496,733 or nearly 35 per cent. The value reported in 1909 was $1,839,798. The industry has thus declined nearly 50 per cent in the two years.

All districts in which sandstones are quarried have felt the effects of the depression, but the greatest falling off has been in the bluestone quarries which produce chiefly curb and flagstones. The value of the bluestone output in 1911 was $614,334 against $1,037,637 in 1910 and $1,301,950 in 1909. Of the total for last year, curb and flagstone constituted $337,300, as compared with $385,825 in 1910 and $608,116 in 1909. The value of bluestone used for building purposes amounted to $270,284 against $351,603 in 1910 and $298,631 in 1909. The large decrease in crushed stone last year was due to the completion of a large enterprise in the Hudson river district.

Sandstone other than bluestone, constituted a value of $340,729 against $414,159 in the preceding year and $537,839 in 1909. The showing was thus comparatively better than in the bluestone trade. Orleans county reported a product valued at $255,862 as compared with $332,382 in 1910 and $385,281 in 1909.

Production of sandstone in 1910

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river	$26 689	$164 593	....	$200 000	$42 000	$500
Delaware river	33 965	212 463	....	....	55 010	170
Chenango co	74 985	7 879	....	....	1 165	....
Wyoming co	208 444	....	....	....	327	237
Other districts	7 520	890	....	790	....	10
Total bluestone	$351 603	$385 825	....	$200 790	$98 502	$917
Sandstone						
Orleans co	$23 403	$83 539	$202 773	$4 003	$14 869	$3 755
Other districts	12 402	10 768	26 080	20 615	6 125	5 827
Total sandstone	$35 805	$94 307	$228 853	$24 618	$20 994	$9 582
Combined total	$387 408	$480 132	$228 853	$225 408	$119 496	$10 499

Production of sandstone in 1911

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river	$14 377	$123 189	....	....	$560	$200
Delaware river	31 775	204 629	....	....	1 775	1 245
Chenango co	72 933	9 482	....	....	250	1 210
Wyoming co	145 519	....	....	$600	910	....
Other districts	5 680	....	....	....	....	....
Total bluestone	$270 284	$337 300	....	$600	$3 495	$2 655
Sandstone						
Orleans co	$21 395	$83 519	$145 575	$1 081	$4 257	$35
Other districts	25 892	10 228	16 645	22 202	6 913	2 987
Total sandstone	$47 287	$93 747	$162 220	$23 283	$11 170	$3 022
Combined total	$317 571	$431 047	$162 220	$23 883	$14 665	$5 677

TRAP

The quarrying of trap is a somewhat specialized branch of the stone industry which may be treated with advantage under a separate head. Trap is not a distinct rock type, but the name properly belongs to the fine-grained, dark-colored igneous rocks that occur as intrusive sheets or dikes. In mineral composition it differs from the other igneous rocks classed in the trade as granite, by the prevalence of lime-soda feldspars and higher percentages of the lime, magnesia and iron minerals and correspondingly lower amounts of silica, with little or no free quartz. The name is sometimes applied to fine-grained igneous rocks of granitic or syenitic composition and even to rocks of sedimentary derivation, but such usage is misleading and indefensible.

The particular value of trap is due mainly to its hardness and toughness. Its fine, compact homogeneous texture gives it great wearing powers and it is eminently adapted for road metal and for concrete of which heavy service is required. It has been used to some extent in this State as Belgian blocks. As a building stone it finds very little application, probably on account of its somber color. The expense of cutting and dressing trap is also an obstacle to its employment for building or ornamental purposes.

The trap quarried in New York is properly a diabase, made up of plagioclase feldspar in lath-shaped crystals and pyroxene as the main constituents, and amphibole, olivine and magnetite as subordinate minerals. The largest occurrence is represented by the Palisades of the Hudson, which begin near Haverstraw and extend southward into New Jersey. The Palisades represent the exposed edge of a sill or sheet of diabase intruded between shales and sandstones of Triassic age. The sheet is from 300 to 800 feet thick and about 70 miles long. Most of the trap quarried in this State has been obtained from this region, chiefly from the vicinity of Haverstraw and Nyack, but to some extent from near Richmond, Staten Island, where the sheet has its southern termination. Smaller occurrences of diabase are found in the Adirondacks and the bordering area. There are countless numbers of trap dikes in the interior of the Adirondacks, but few have any considerable thickness and in general they are too remote from the market to be profitably quarried. In the outlying region the dikes at Greenfield, Saratoga county, and at Little Falls, Herkimer county, are the most notable. Quarries have been opened at the former locality and the trap is crushed for road metal.

The production of trap in 1911 amounted in value to $899,414, a small decrease from the total of $909,006 reported in the preceding year. Most of the output was employed for road metal and the quantity thus used was 850,322 cubic yards valued at $696,367. Crushed stone for other purposes chiefly concrete and railroad ballast amounted to 267,930 cubic yards valued at $199,797. The building stone had a value of $3250. Altogether there were 7 firms represented in the industry, of which 6 operated quarries in Rockland county, and 1 the quarry at Greenfield, Saratoga county. The Manhattan Traprock Co. of Nyack discontinued operations during the year having disposed of its quarry property to the Palisades Park Commission.

The future of the trap industry in the Palisades region is involved with the plans for the creation of the park which has received legislative approval in both New York and New Jersey. It is possible that all quarrying operations may eventually be brought to an end. Thus far the only company that has withdrawn from business is the one mentioned, which worked quarries on Hook mountain, north of Nyack.

Production of trap

MATERIAL	1910		1911	
	CUBIC YARDS	VALUE	CUBIC YARDS	VALUE
Crushed stone for roads	1 000 187	$766 733	850 322	$696 367
Crushed stone for other purposes	185 493	122 198	267 930	199 797
Other kinds	100	75	185	3 250
Total	1 185 780	$909 006	1 118 437	$899 414

TALC

The talc mines in the Gouverneur district were quite active last year, though their output was somewhat curtailed by the impairment of mill capacity incident to the long period of dry weather in the late summer and fall, a condition that has been repeated during each of the last three seasons. The production amounted to about 65,000 short tons, all shipped in ground form and mainly, as heretofore, for use in paper manufacture. Prices averaged nearly the same as in the previous year, or about $8.50 a ton; the prevailing quotations for paper stock were between $8 and $9, with a slight reduction for the coarser or inferior grades used for other purposes.

Some interesting developments have taken place in the district during the year. The most important, perhaps, was the entrance of the Uniform Fibrous Talc Co. into the field of commercial operations. This company had been engaged for the last two years in the opening of a mine near Talcville and the erection of a mill and hydro-electric power plant; it began active production in January 1911. The body of talc that has been developed was long neglected on account of the unpromising appearance of the outcrop, but the explorations in depth have demonstrated the existence of a good grade of mineral over a width of 30 feet or more as shown by some of the stopes. Both fibrous and foliated varieties are found, with sufficient of the former to give the mill product the desired quality for the usual commercial applications of the Gouverneur talc.

The present mill, a fire-proof concrete and steel structure, is only partly equipped, being about one-half the capacity that can be obtained when the full complement of machinery is in place. The process of grinding differs somewhat from that employed in the other mills of the district and will be described elsewhere in this article. The power plant that generates the electricity by which both mine and mill are operated is situated on the west branch of the Oswegatchie river, about a mile distant. The dam and power house are built of reinforced concrete. A twin turbine direct connected to a 75 -K.W. alternator supplies the present requirement of power, but a second unit of similar capacity can be added if needed.

The Ontario Talc Co. continued to operate the Potter mine which is now in shape to supply a steady output. The mine is opened on two levels for a horizontal distance of 300 feet, and the shaft is being sunk in preparation for another level. The thickness of the body ranges from 15 to 25 feet or more, with very little waste rock exposed in the workings. It yields a white and very uniform product in which there is a large proportion of fiber. A feature of the mine is the occurrence of considerable masses of the long fiber variety that much resembles asbestos. The mill of the Ontario Talc Co. is about a mile south of the mine near Fullerville, on the west branch of the Oswegatchie. It is operated by a local water power which will probably be supplemented by other supply in the near future, as the company intends to enlarge the milling capacity. Improvements to that end are now under way.

The other producer in the district, the International Pulp Co., made its usual large output, though it concentrated its attentions upon fewer properties than in the previous years. Of the mines owned by the company only three were steadily worked, these including No. 2½ and No. 3 at Talcville and a new mine which has been opened in the vicinity of the old Wight mine in the southwestern section of the district. The mine formerly worked by the United States Talc Co. and taken over by the International Pulp Co. in the recent consolidation was closed down during the year. This has been one of the most productive and best known mines in the district. Little talc was taken from the Arnold and Balmat mines of the old Union Talc Co. The company operated the new No. 6 mill which has a capacity of about 125 tons a day, as well as No. 3 and the Columbia mill. It has recently converted No. 4 mill at Hailesboro into a power plant.

Outside of the Gouverneur district the only talc occurrence that received attention during the year was that near Natural Bridge in Lewis county, mentioned in the preceding issue of this bulletin as under development by the St Lawrence Talc and Asbestos Co. The property is situated about one mile northeast of Natural Bridge in a belt of crystalline limestones and schists that parallels the St Lawrence county district, from which it is 10 or 15 miles distant. The talc, so far as opened, belongs to the massive and platy varieties rather than to the fibrous mineral so characteristic of the Northern belt. There appears to be more or less serpentine in close association with it. Tremolite was observed in a boulder outcrop near the mine. A vertical shaft has been put down on the property, and a crushing plant and mill were under construction last year.

THE GOUVERNEUR TALC DISTRICT

This description of the St Lawrence talc mines is intended only as a sketch of the principal features surrounding the occurrence of the deposits and their industrial utilization. The information on which it is based has been taken largely from published sources, though with such revision as to make the treatment representative of present conditions.

General geology. The investigations of the geology of this section have been carried out mainly by C. H. Smyth, jr. The work hitherto has been in the way of a reconnoissance, as there have been no adequate maps with which to conduct detailed studies of the region which is very involved in its structural and stratigraphic features. The rock formations belong, however, to the same general classes that compose the central Adirondack region and have been described at length in the several areal reports issued by the State Museum.

The talc deposits are immediately associated with crystalline limestones and schists of Grenville age. These occupy belts that have a northeast-southwest trend in conformity with the general structural arrangement throughout the Adirondacks. One of the largest belts begins in the town of Antwerp, Jefferson county, and crosses the towns of Gouverneur and De Kalb, St Lawrence county. It is of considerable economic importance in connection with the marble quarries at Gouverneur. A second belt some 12 miles long and from 1 to 3 miles wide is found a few miles to the east in the towns of Fowler and Edwards. It is this area that contains the fibrous talc deposits. A third belt to the south and east of the latter and lying across the St Lawrence-Lewis county line includes the Natural Bridge talc occurrence that has been recently under development.

The limestones are bordered by members of the Adirondack gneisses, some of which are light in color and have the composition and appearance of slightly modified granites and diorites. A very prominent member in the stretch between Gouverneur and the talc district is a dark hornblende variety which is usually well laminated and garnetiferous and is injected by light red granite. In places the granite forms a branching network that incloses the darker rock in its meshes, producing a mosaic pattern. These granite injections are no doubt offshoots of some of the larger bodies of that rock, while the darker gneiss may belong to the sedimentary series. Of the general relations of the gneiss group it can be said that the igneous types are apparently the youngest and are all later than the limestones. It is not clearly demonstrated as yet whether any of the gneisses in the region are older than the Grenville.

Occurrence of the talc. The talc deposits occur along minor belts within the Grenville limestones and schists. They are locally called veins and have been described as such by some writers, though they have nothing in common with mineral veins, being layers or beds included within the limestones. They have the same strike and dip as the latter and show a fair degree of regularity and persistence. In thickness they range from seams of a few inches up to 50 feet or more. The dip is uniformly toward the northwest at angles that vary usually between the limits of 30° and 60°.

The associated schists are mainly composed of tremolite, but in some places carry considerable quartz. They are singularly free from other minerals. The tremolite is white or light gray in color and is usually developed in finely fibrous individuals which when felted form a compact and tough rock. The pink variety known as hexagonite is of limited occurrence. Bands and irregular masses of the tremolite occur within the talc deposits, and the immediate walls generally consist of the schist, the border being marked by alternating layers of talc and schist.

The association is suggestive of the derivation of the talc which has been the subject of study by C. H. Smyth, jr.[1] The tremolite is no doubt the parent mineral. As explained by Professor Smyth, the limestones were originally impure calcareous sediments and by metamorphic influences have taken on a crystalline character and became impregnated with silicates. Certain limestone beds seem to have contained sufficient magnesia and silica to permit their complete transformation to tremolite, forming a tremolite schist, while other layers, with a preponderance of lime have undergone a partial change, showing scattered crystals and aggregates of silicates within the limestone. The subsequent change of tremolite to talc is the result of weathering and takes place through the agency of ground waters holding carbon dioxid. The alteration may be formulated chemically as follows: $CaMg_3Si_4\ O_{12} + H_2O + CO_2 = H_2\ Mg_3Si_4\ O_{12} + CaCO_3$. The change is accompanied by an increase in volume of talc and calcite amounting to 25.61 per cent, though if the talc alone is considered there is a decrease of .83 per cent as compared with the tremolite. There is little or no calcite in the talc, so that it probably has been removed with the progress of the alteration.

The talc is really a pseudomorph after the tremolite and it is due to this that it possesses a fibrous character. Microscopic examination of specimens from almost any of the mines will show a little residual tremolite in the centers of the fiber aggregates, and in some samples there is a very considerable proportion of unaltered mineral. Foliated talc accompanies the fibrous variety, being more abundant apparently the farther the process of alteration has gone. It is of course a separate development deposited by the circulating waters which have taken the materials of the schist into solution.

The view that the tremolite has been formed by metamorphism from the ingredients of the limestones without addition of material

[1] Report on four townships in St Lawrence and Jefferson counties, N. Y. State Mus. Rep't 47, 1894, p. 491–515. Also, Report on the Talc Industry of St Lawrence County, N. Y. State Mus. Rep't 49-2, 1898, p. 661–71.

from other sources is perhaps the least conclusive part of the explanation as given. This entails a rather unusual chemical composition that is hardly in conformaty with the character of the limestones in the district. As a rule they are not particularly silicious or impure. An alternative to that view, which would seem equally probable in the circumstances, may be found in the introduction of silica and magnesia along certain beds by underground circulations after the limestones were formed.

It is of interest to note that a belt of metallic ores is found in the same limestones on the footwall side of the talc beds. The ores include zinc blende, pyrite and hematite and occur at intervals from Sylvia lake on the southwest to beyond Talcville. They have undoubtedly been deposited by solutions subsequent to the formation of the limestones, and from the similar associations it seems reasonable to connect their introduction with the suggested mode of genesis of the tremolite.

General characters. The fibrous talc is the predominant variety and the usual grade consists of the same felted mass of fine fibers that characterizes the tremolite schist. The fibrous nature is very persistent and can be seen by the microscope to exist even in samples that appear to the unaided eye as massive. Foliated talc, that is the crystallized variety, occurs more specially in the mines on the southwestern end of the belt. It is found as intercalated seams between the fibrous talc.

The fibrous variety is commonly known as agalite, whereas the name rensselaerite is often applied to the foliated mineral. The latter designation seems to rest upon a mistaken identification. The type specimens of rensselaerite collected by Ebenezer Emmons show it to be a mineral of the serpentine family, and to be an alteration of pyroxene.

The color of the talc is white or light gray, with a greenish tint in the foliated variety. The freshly mined material bleaches to a lighter shade on exposure to the air through the evaporation of the mechanically held water. Near the surface the deposits show discolorations from iron and organic matter, but at a depth usually of 40 or 50 feet they pass into commercial rock.

There is no uniform practice followed in selecting or grading the talc before it is sent to the mill. In most mines the foliated talc forms such a small percentage of the average that it does not influence appreciably the quality of the ground product. Certain mines in the town of Fowler produced at one time considerable quantities of this variety, which were sorted out and milled separately. The principal attention is directed toward the character of the material with regard to gritty impurities. It is aimed to leave the gritty talc in the walls and pillars and to send only the milling grade to the surface. The best of the mine output is ground for paper stock, as any appreciable amount of grit affects the sale of the talc in the paper trade.

Mining of talc. The mines are situated along the outcrop of the beds which are included in the section from Sylvia lake in the town of Fowler to near the village of Edwards. Most of the mines have been opened in the northeastern part near Talcville, where there are between 10 and 15 different workings, many of them now abandoned. The chief producers in this section of late years have been the mine of the United States Talc Co., now a part of the International Pulp Co., and No. 2½ and No. 3 mines of the latter company. The Uniform Fibrous Talc Co. has a mine just west of Talcville. The Potter mine of the Ontario Talc Co. is in the central part of the district on the west branch of the Oswegatchie river below Fullerville. On the southwest end of the belt near Sylvia lake are the mines formerly worked by the Union Talc Co., including the Balmat, Arnold, and Wight mines, and the new mine recently opened by the International Pulp Co.

Many of the mines are worked on a leasing system, the operators paying a certain royalty to the owner for each ton of talc extracted. The average royalty is about $.75, which is to be considered as very high for such material.

Mining is carried on entirely by undergound methods. The general practice in the district does not differ materially from that employed in working ore deposits that are similarly situated, though of course the soft and slippery nature of the material necessitates that the pillars left for roof support should be of large size. The workings are reached through inclines carried down on the footwall. In case the bed is not over 15 feet or so thick, a single drift is run from either side of the incline at intervals of from 50 to 75 feet. The drift is carried nearly the full width of the bed and connected with the level above at short intervals by raises, after which the talc is removed between the levels, leaving pillars 25 feet or more square to support the roof. With a bed of greater thickness two drifts may be run on the same level, leaving a wall of talc between to assist in supporting the roof.

Drilling is mostly by machines of the percussion type and the rock is blasted by dynamite. It splits readily along the cleavage planes. The large blocks or slabs from blasting are reduced by sledges to a size convenient for handling. From the stopes the talc is loaded into cars and run out to the incline where it is dumped into skips and hoisted to the surface.

Preparation for the market. The processes in use for grinding and preparing the talc have been gradually evolved out of long continued experimentation. It is said that the first prepared talc shipped from the district was ground in a grist mill. With the discovery of the value of the fibrous variety as a paper filler, attention was directed to the methods of treatment which have been perfected until capable of producing the desired quality and uniformity of grade.

The mills, all of which are run in connection with the mines, number 7 or 8 in all. They have a combined capacity of between 75,000 and 100,000 tons of prepared talc a year. They are situated along the Oswegatchie river in the stretch between Gouverneur and Edwards, the sites being selected with reference to water power facilities. The mines of the International Pulp Co. at Talcville ship their product by railroad to the mills at Hailesboro.

The reduction of the talc is accomplished in several stages. The lump talc as mined is first broken in a jaw crusher of the Blake type. The product then goes through a cone grinder or through rolls where it is reduced to .5 inch or less. In the third stage the crushed talc may be ground between buhrstones of special manufacture or in a centrifugal grinder of which the Griffin mill is a common type. The talc is then passed through a bolt of about 60 mesh and goes to the finishing cylinders, or the finest material may be separated by air currents which blow it into settling chambers and then forms one of the grades for the market. The common practice is to make the final reduction in revolving cylinders charged with pebbles. The Alsing cylinder is the one generally used and is from 8 to 10 feet long and 6 feet in diameter. It is lined with porcelain brick. It is turned from 20 to 25 times a minute. The charge consists of 1 ton of talc and 3 tons of flint pebbles. The grinding of a single charge takes from 2 to 5 hours, depending upon the grade of product that is desired. The fibrous character of the talc is maintained throughout the grinding to the end product, so that it is difficult to size the ground talc by screening; consequently the degree of fineness is regulated entirely by the duration of the final grinding process.

In the new plant of the Uniform Fibrous Talc Co. the Hardinge conical mill is employed in preparing the talc for the finishing process. The crude rock is first passed through a jaw breaker which reduces the lump talc to about 1.25 inch size; and then the product is screened and fed into the Hardinge mill where it is ground to pass a 10 mesh screen for the cylinders. The latter are of the usual intermittent type.

Tube mills of large size, such as are used in the fine grinding of cement and ores, have been installed in one or two plants. They take the place of the Alsing cylinder. They have the advantage over the latter of being continuous in regard to feed and discharge, but are more difficult to regulate so as to give the desired finish to the product.

A coarser grade known as buhr stock is produced by omitting the last stage of grinding in the Alsing cylinder. This is used as a substitute for asbestos in the manufacture of asbestos paper and packing. The ground talc, or mineral pulp as it is called, is put up in paper sacks of 50 pounds each, or in cloth bags of 200 pounds. Shipments are made by the Gouverneur and Oswegatchie Railroad, near the line of which most of the mills are located. Prices are usually quoted from Gouverneur.

Cost of production. The conditions vary so much in the different mines and mills that it is impossible to fix any average basis for estimating the costs of production. The mining and milling operations are perhaps the least variable factors of all, and these may be figured approximately at from $1.50 to $2 a ton. Royalty is an important item in the leased mines; it is usually fixed at about $.75, but may be as low as $.25. The haulage from mine to mill and from the mill to the shipping point is a heavy tax in some cases, as the country is rough and the roads are very poor. This may amount to as much as $1.50 or $2 a ton. The cost of package is about $1.

Uses. The fibrous talc is mainly used in the paper trade as filler for book and writing paper and to a considerable extent for newspaper. It is more readily incorporated with the paper stock than clay and at the same time has a beneficial influence upon the strength of the paper. The manufacturers of gypsum wall plasters are consumers of the talc which takes the place of hair, wood fiber or asbestos in these plasters. Among the minor uses are in the manufacture of waterproof paints and steam pipe coverings.

Chemical analyses. The following analyses indicate the composition of the talc from this district. No. 1 and No. 2 are from Dana's System of Mineralogy. No. 3 is quoted from Professor Smyth's article. For No. 4 the writer is indebted to Mr A. McLintock of the Uniform Fibrous Talc Co.:

	1	2	3	4
SiO_2	60.59	59.92	62.10	68.9
Al_2O_3	.13	.50	......	1.3
Fe_2O_3	......			
FeO	.21	.76	1.30	......
MnO	1.16		2.15	......
MgO	34.72	31.37	32.40	26.6
CaO	......	.57	......	.8
Na_2O	......	.48	......	......
H_2O	3.77	6.25	2.05	2.4
	100.58	99.85	100.00	100.00

Production. The first shipments of talc from the district were made during the seventies of the last century. The earliest regular operations are said to have been instituted by a mineralogist named Minthorne who formed a company for mining and milling talc on the Wight farm in the town of Fowler. By the year 1880 shipments were made in considerable quantity. The production from that date as given in the volumes of the *Mineral Industry* or reported by this office have been as follows:

Production of talc in New York

YEAR	SHORT TONS	VALUE	YEAR	SHORT TONS	VALUE
1880	4 210	$54 730	1896	46 089	$399 443
1881	5 000	60 000	1897	57 009	396 936
1882	6 000	75 000	1898	54 356	411 430
1883	6 000	75 000	1899	54 655	438 150
1884	10 000	110 000	1900	63 500	499 500
1885	10 000	110 000	1901	62 200	483 600
1886	12 000	125 000	1902	71 100	615 350
1887	15 000	160 000	1903	60 230	421 600
1888	20 000	210 000	1904	65 000	455 000
1889	23 476	244 170	1905	67 000	519 250
1890	41 354	389 196	1906	64 200	541 600
1891	53 054	493 068	1907	59 000	501 500
1892	41 925	472 485	1908	70 739	697 390
1893	36 500	337 625	1909	50 000	450 000
1894	50 500	454 500	1910	65 000	552 500
1895	40 000	320 000	1911	65 000	552 500

ZINC

Work on the zinc blende occurrence near Edwards, St Lawrence county, was resumed last year. The Northern Ore Co. recently succeeded to the ownership of the property which had lain idle since 1904 owing to legal complications. It began systematic development of one section of the deposit on April 1st and continued active operations throughout the remainder of the season. As a result the company had at the close of the year about 8000 tons of milling ore on the surface, besides a much larger quantity blocked out underground. Shipments of several hundred tons of selected blende were made for experimental purposes, the first commercial product ever sent to a zinc smelter from this State.

The developments on the property give hope that a substantial mining industry may be established. They are considered sufficiently encouraging by the company to warrant the erection of a milling plant, on which work has already been started at Edwards. The mill is planned for a capacity of 50 tons crude ore a day, and present expectations are that it will turn out concentrates averaging about 60 per cent zinc. Though about one-third of the ore developed last year would bear shipment in crude state, the distance from the zinc-smelting districts makes concentration an advantage and probably all of the output will pass through the mill. This will enable the production, also, of a valuable by-product in the form of pyrite. Some of the ore, furthermore, carries an appreciable quantity of galena which will doubtless be saved by the mill treatment.

Only a limited area of the mineralized zone has been explored as yet. The work during the past year was directed to the underground exploration of a single outcropping lens that had been previously uncovered and followed to a depth of 40 or 50 feet. This has been developed through an inclined shaft following the dip of the ore and by a series of drifts and crosscuts. At the time of the writer's visit to the property in June 1911, the shaft had been sunk about 100 feet and showed a continuous band of ore all the way from 4 to 7 feet thick. According to recent information communicated by A. J. Moore, manager of the Northern Ore Co., at Edwards, the conditions have continued favorable with the further progress of the shaft and additional ore bodies have been encountered in some of the crosscuts.

The ore lens that has been under development is remarkably high in grade, the whole mass being almost solid blende and pyrite.

There is considerable variation in the proportions of the two minerals, though blende is much the more common and in some parts of the deposit is practically the only ingredient. Assays of the richer material show from 40 to 50 per cent zinc. The blende is black, nontransparent, and apparently carries relatively large amounts of iron.

The general features of the ore occurrence in the Edwards section were presented in the issue of this report for the year 1905, but in view of the discoveries that have since been made, it may be of interest to enter upon their discussion here.

The existence of the zinc in this part of St Lawrence county has been known since the early part of the last century and is mentioned briefly by Ebenezer Emmons in his Report on the Geology of the First District, published in 1838. Some attempts were made to work the ores in the early days, as shown by the excavations on the Balmat property which are said to have been undertaken for the purpose of extracting the lead and silver values rather than the zinc. The intimate mixture of galena, blende and pyrite proved no doubt a rebellious material to treat by the methods then available; at any rate mining was soon abandoned. The present interest in the deposits dates from about 1902 when the attention of local mining men was attracted to some specimens of rich blende that were uncovered in the Edwards locality about 12 miles northeast of the old Balmat prospect. These appeared so promising that leases were secured on the property and work was begun under the direction of T. M. Williams. After a short period of exploration which showed promising results the company became involved in legal difficulties that have but recently been removed, and nothing was done in the interval from 1904 to 1911.

The ores are found along a well-marked zone which parallels the talc deposits and lies on the footwall of the latter. The wall rock is crystalline limestone of the same nature as that inclosing the talc; it belongs to the Grenville series, widely represented on this side of the Adirondacks. The limestones are interstratified with thinly bedded quartzose schists, tremolite schists and heavier hornblende gneisses, and the whole series has been invaded then and there by granitic intrusions. The limestones and included schists of this particular district are exposed in a belt that extends from near Sylvia lake, town of Fowler, on the southwest to a point a little north of Edwards village, on the northeast. They represent regionally metamorphosed and compressed sedimentaries which are among the very earliest of the Adirondack formations. The granite is found in dikes, stringers and irregular bodies and belongs probably to one or more of the great invasions of that rock which took place in the Adironacks at different times in the Precambric period. Both fine-grained and pegmatitic varieties occur. The other important Adirondack intrusives including syenite, gabbro, diabase etc., are absent so far as known. There are no Paleozoic strata though they begin a few miles to the west with horizontal beds of Potsdam sandstone. They no doubt extended over this area at one time and reached far into the interior of the Adirondacks, but have been planed off by erosion.

The limestones and schists have a northeasterly strike and are upturned at a high angle, the dips being usually 45° or over toward the northwest. The limestone is coarse and carries abundant silicates. The latter in places constitute the greater part of the mass. The tremolite schists from which the talc beds are derived represent the extreme stage in the silication of the limestones. The quartzose schists and hornblende gneisses are probably metamorphosed products of impure sandstone and shales.

The zinc ores at Edwards occur in a mass of impure serpentinous limestone which forms a low ridge just north of the Oswegatchie river on the road to Trout lake. On the north end of the ridge there is a shallow open cut showing a band of mixed blende and limestone about 15 feet thick. The blende occurs in irregular bunches which apparently are the brecciated fragments of what was once a more or less solid lens or band of the ore. There is evidence of intense compression which has forced the limestone into the fractures and recemented the mass. The limestone for some distance away from the lens is impregnated with blende so as to form a lean ore. The occurrence has not been tested for any considerable depth. Several other showings of ore are found on the sides and top of the ridge to the south of this opening. About 1000 feet away and on the opposite or eastern side of the ridge is the one which has been explored during the past season, as above mentioned. In this place the ore shows less evidence of compression or disturbance and admixture with limestone. The lenses also have well-defined walls. The blende is finely granular without any trace of crystal form. The pyrite is sprinkled through the mass in rounded grains which range up to one-fourth inch in diameter and occasionally show a cubical development. Barite is found in some quantity in the walls. On the weathered outcrop it shows prominently as a spongy aggregate that was first mistaken for smithsonite.

In the interval between Edwards and the Balmat prospect there have been several discoveries of ore which, however, have not been sufficiently prospected to reveal anything definite as to their extent. They indicate that the mineralization follows a fairly definite zone parallel and in proximity to the talc deposits.

The Balmat occurrence is described briefly by Emmons in the report already referred to as "a remarkable occurrence of the sulfurets of zinc, lead and iron in about equal proportions . . . . The direction of the vein is north-northeast and south-southwest and the width about 8 inches, but not well defined. The sulfurets traverse a bed of serpentine 40 to 50 feet wide. The occurrence of zinc intermixed with lead is not favorable to the reduction of the latter." There are two shafts on the ore body about 1000 feet apart. The outcrop of the ore where it is revealed shows a vein or band up to 3 feet thick. Near the south shaft a short adit has been driven into the ore from the side hill, the only part of the workings now accessible, and shows the vein at this point to be from 4 to 5 feet thick. There is much more galena in this occurrence than at Edwards and usually more pyrite.

Another ore locality in the southwestern section is on the lands owned by J. H. McLear, south of Little York and near Sylvia lake. The deposit was originally opened with a view to the working of iron ore which occurs in the form of specular hematite. Some of it was used in the Fullerville furnace nearby. The hematite occurs in a lens of uncertain size, some of it being nearly pure and other parts charged with pyrite and blende. The sulfides are specially developed along one of the walls. Specimens from this part have assayed above 20 per cent zinc. There has been no recent work done on the deposit.

From the present stage of development there is insufficient evidence to base any prediction as to the possibilities of the district as a producer of zinc ore. It is evident, however, that a small output is assured by the results obtained at Edwards where thus far only a single outcropping has been attacked. If the developments there continue as favorable during the coming season as they have been in the past they will go far toward proving the persistence of the deposits in depth which is of most importance to the future of the district and about which least is now known. In the case of such issue there will be much encouragement, also, for the extension of exploration to other parts of the mineralized area. Though the deposits are narrow as compared with those found in the important zinc-producing districts of other states, they possess an advantage over most in their average tenor. They are furthermore exceptionally situated for economic exploitation, with convenient shipping facilities, cheap electric power available, and efficient labor to be had in the district.

The derivation of the ores is an interesting problem that need not be given detailed treatment in this place. The apparent close association of the zinc and talc deposits may be pointed out as a feature of practical importance to exploration and it seems very likely to reflect some underlying geological principle. The geological relation, if such exists, is probably between the tremolite and the zinc ores rather than between the latter and the talc itself which is an alteration product of the tremolite. The extensive development of tremolite in belts within the limestone is regarded by the writer as the work of underground circulations which have brought in silica and perhaps also a part of the magnesia necessary for the conversion of the lime carbonate to the magnesia-lime silicate. These circulations, it is reasonable to suppose, may have carried other ingredients including zinc, lead and iron which have gone to form the metallic deposits.

The zinc deposits have the general appearance of replacement bodies rather than the fillings of open fissures or cavities. In most places their boundaries are not clean cut but are in the nature of transition zones shading off gradually into the limestone. The lens of compact ore which has been under recent development shows, however, fairly sharp contacts. The internal structures are not those characteristic of open-fissure fillings as there is no appearance of banding or crusts or drusy cavities lined with crystallized minerals. The compact granular nature of the ore suggests deposition at considerable depth and under pressure. In that event it may be inferred also that the deposits are very old, possibly of Precambric age. Erosion in this part of the Adirondack region seems to have been comparatively slight since Cambric times and has been mainly effective in removing the mantle of Paleozoic sediments which now are only found in the bordering area.

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Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y., under the act of July 16, 1894

No. 510 ALBANY, N. Y. JANUARY 1, 1912

New York State Museum

JOHN M. CLARKE, Director

EPHRAIM PORTER FELT, State Entomologist

Museum Bulletin 155

27th REPORT OF THE STATE ENTOMOLOGIST

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1911

New York State Education Department
Science Division, December 26, 1911

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to communicate herewith the annual report of the State Entomologist for the fiscal year ending September 30, 1911, and to recommend the same for publication.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 26th day of December 1911

Commissioner of Education

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John M. Clarke, Director

Ephraim Porter Felt, State Entomologist

Museum Bulletin 155

27th REPORT OF THE STATE ENTOMOLOGIST, 1911

Dr John M. Clarke, Director of Science Division

I have the honor of presenting herewith my report on the injurious and other insects of the State of New York for the year ending September 30, 1911.

The appearance in late May of a large brood of the periodical Cicada or so-called seventeen-year locust was of great popular interest and an entomological event of some importance. A hitherto unknown colony was located near Amsterdam and through the cooperation of many local observers much was learned respecting the present distribution and relative abundance of this insect in New York State. A fine series of photographs showing the transformations to the adult was obtained. Despite the warnings of earlier years, a number of young orchard trees had been set in the vicinity of populous Cicada colonies and, as a result, were severely injured. A detailed notice of this unique form is given on subsequent pages.

During the period covered by this report, Miastor larvae were discovered, their biology ascertained in large measure, their amenability to laboratory conditions demonstrated, and owing to the value of this information to teachers, a discussion of pedogenesis in this insect and its allies was included in an appendix to the Entomologist's report for 1910. Subsequent studies have confirmed the observations referred to above and have shown a wide distribution for Miastor.

Fruit pests. The experiments with the codling moth or apple worm were continued in the orchard of Mr W. H. Hart of Poughkeepsie and in those of Messrs Edward Van Alstyne and

William Hotaling at Kinderhook. Special pains were taken to secure uniform plots of ample size and to see that the treatment was thorough. Each plot, as last year, except in the case of Mr Hotaling's orchard, consisted of forty-two trees, the fruit from the central six alone being counted. The relative value of one, two and three sprayings, and also of one application made three weeks after the blossoms dropped, was ascertained. The results compare closely with those obtained in 1909 and go far to show that the conditions in 1910 were exceptional. One thorough application last season resulted, in the case of trees bearing a fair crop, in from over 98 to more than 99 per cent of worm-free fruit. This should prove most encouraging to the fruit grower, since the work was done under practical conditions which can be duplicated in almost any section. Assistant State Entomologist Young assisted in the field work, classified the wormy fruit and computed the tabulated data.

The work of 1911 with the codling moth has been correlated with that of the two preceding years and is the most comprehensive data yet secured as to the possibilities with one spraying under varied conditions. These results should be of great practical value in enabling the fruit grower to determine for himself the advisability of spraying for this pest more than once in any season. The details are given on subsequent pages.

Observations show that the San José scale, while a serious fruit tree pest, is being generally controlled, though some fruit growers are not entirely successful, due in large measure to difficulties in treatment. Some of these are excessively large or inaccessible trees, adverse weather conditions at the time the work should be done or defects in equipment. The concentrated homemade or commercial lime-sulfur washes were used largely and mostly with very satisfactory results.

The peculiar linear series of eggs so frequently seen on apple and pear bark have been identified as those of the notch wing, a species noticed below. The usually rare Say's blister beetle was exceptionally numerous. Two small fruit insects, the raspberry Byturus and the garden flea, were studied at Milton, the former proving somewhat injurious.

Gipsy moth. The discovery of a gipsy moth colony at Lenox, Mass., while not entirely unexpected, was something of a shock to our extensive agricultural interests. A personal examination satisfied the Entomologist that the insect was brought there with trees and shrubs purchased a few years ago in eastern Massachusetts. A small colony was discovered later at Great Barrington, Mass. Nothing but the closest inspection and the adoption of most rigid precautions will prevent the early establishment of this pest in New York State. Judged solely from an economic standpoint, there can be no question as to the advisability of keeping this insect out of the State as long as possible. We have assembled during the year a series of preparations designed to facilitate the recognition of this pest in any stage. Several of these have been reproduced as photomicrographs and will be of great service in identifying this species.

The Entomologist visited the territory in eastern Massachusetts infested by this insect and found the residential area, as a whole, in excellent condition though there were extensive tracts of forest land badly infested. The ultimate spread of this pest is inevitable. The Federal authorities have accomplished much in retarding its dissemination by keeping the roadside trees of the principal thoroughfares free of caterpillars. Marked progress is being made in the work of introducing parasites and natural enemies which it is expected will shortly prove of material service in checking this destructive insect. The latter is no justification for not adopting every reasonable measure for preventing the spread of this dangerous enemy. The state of Connecticut has made excellent progress in handling its gipsy moth problem. This insect is more fully considered below.

Brown-tail moth. This species, while not so destructive as the gipsy moth, has become established in North Adams, Mass. and smaller infestations occur at Adams and Williamstown, Mass. Since both sexes of the moth fly readily, it will probably not be long before this pest appears somewhere in New York State. The winter nests are so characteristic that there should be little difficulty in identifying the insect and at the outset preventing excessive multiplication. Careful inspection of nursery stock should prove a most effective barrier to its being introduced with trees and shrubs. The observations above relating to the parasites of the gipsy moth apply equally to the natural enemies of the brown-tail moth.

Shade tree pests. The Entomologist investigated conditions in a number of communities and found exceptionally severe and widespread injury by the elm leaf beetle. The defoliation was so general, in connection with the work of previous years and the severe droughts of earlier seasons, that many trees have succumbed or are likely to perish in the next few years unless radical measures are adopted for their better protection.

There seems to be great difficulty in securing efficient treatment, even if the equipment be adequate. This defect has been pointed out and, with a fuller understanding on the part of those compelled to solve the problem, we look for materially better results another season. The elm leaf beetle is not such a serious pest in Europe, and it would seem, in view of the probable continuance of the severe injury of the last few years, due in part at least to changed conditions, as though a serious effort might well be made to secure natural enemies, since they appear to be very effective checks upon this beetle in European countries.

The cottony maple scale and the false maple scale occasioned repeated complaints, because of serious injury to hard and soft maples, especially in the vicinity of New York City. An unfortunate condition developed in the city of Mount Vernon. Several hundred hard or sugar maples were seriously injured or killed, following the application of one of the commercial miscible oils in early spring. An investigation convinced the Entomologist that the trouble was due to the material applied, the injury being greatly aggravated by subsequent cold weather retarding growth and producing conditions favorable for penetration by the oil. We must therefore classify early applications of oily preparations as dangerous to hard maples. Our findings are given in detail below.

The extended outbreak by the green maple worm was investigated and must be partly charged to the general destruction of birds and a consequent scarcity of the insectivorous species. Investigations by Zoologist W. G. Van Name showed that nine species were feeding upon the caterpillars, while nine others were in the vicinity, probably for the same purpose. A relatively slight increase in the number of birds would doubtless have prevented the defoliation of the trees. A detailed account of this insect is given in subsequent pages. The spiny elm caterpillar and the white-marked tussock moth are two other shade tree pests which were excessively abundant and the subjects of much correspondence. The ornamental birches are being rapidly destroyed by the pernicious bronze birch borer, the depredations of which were detected the past season in the eastern part of the State.

Forest pests. Injuries by insects to forests have greatly increased during recent years. The hickory bark borer has destroyed thousands of magnificent trees in the vicinity of New York. The investigations of the Entomologist showed that this nefarious pest had destroyed many hickories at Tivoli. A warning circular was issued and widely copied by the local press. The two-lined chestnut borer, probably breeding first in fungous-affected chestnut, invaded nearby oaks at Old Westbury. This outbreak was studied and appropriate repressive measures advocated. Damage by this species was also reported from Garden City. The severe though local injury by the locust leaf beetles at Syosset and Jericho received personal attention and is fully discussed on subsequent pages. The exceptional abundance of the maple leaf cutter at Lake George was also investigated, and an account is given below.

Flies and mosquitos. General interest has been maintained in the house fly campaign. The Entomologist prepared several popular notices and experimented in a limited way with a fly trap. The results with the latter, while beneficial, were not entirely convincing. We investigated a local mosquito problem at South Salem and had the satisfaction of learning that the execution of our recommendations resulted in the speedy disappearance of the pests. Many localities in the State are suffering needless annoyance and, in some cases, illness because mosquito breeding pools are ignored. One case came to our notice where malaria developed following the employment of Italians in a locality previously free from this disease.

Gall midges. Our studies in this interesting and important group have been continued as opportunity offered. A number of new species have been reared and described, and a table of food habits of the reared species and a generic synopsis of the entire group published. This family, composed entirely of small to minute flies and including a number of destructive forms, is an immense complex which could be grouped satisfactorily only after prolonged and careful microscopic studies. This has been accomplished and a monographic account of the family is now in manuscript.

Publications. A number of brief popular accounts of the more injurious species of the year were prepared and widely circulated through the agricultural and local press. The extended contributions, aside from the report for last year, are: *Summary* *of the Food Habits of American Gall Midges; A Generic Synopsis of the Itonidae; Hosts and Galls of American Gall Midges;* and *New Species of Itonidae.* A list of the more important publications of the Entomologist, forty-four in number, is given below.

Collections. There has been a continued increase in the State collections. Most of the additions the past year have resulted from collections by the office staff, some of the most desirable having been reared. Extremely large series of Miastor and Oligarces were obtained in this manner and will later be available for exchange. Specimens illustrating the habits and work of insects are being collected at every opportunity, since they are particularly valuable for economic and exhibition purposes. There have been substantial additions to the gall midges or Itonidae and they are now in very satisfactory condition. The pinned specimens were rearranged by Miss Hartman and this, in connections with the numerous microscopic slides, and the large assemblage of galls and other biological material, will prove invaluable to subsequent workers, especially as the collection includes a very large number of types.

The classification of the diversified material in the Museum and that daily coming to hand is necessarily slow and is a work which must extend over years. There is need of more assistance in carrying on the large amount of labor involved in the amassing of a thoroughly representative collection necessary for the maintenance of an adequate exhibit in the enlarged quarters afforded by the new Education Building.

Three additions have been made to the series of plant groups designed for the exhibition of insects in their natural environment. These will add greatly to the attractiveness and pedagogical value of the enlarged exhibit collections now in preparation.

Assistant State Entomologist Young has rearranged and identified the Muscidae, the species belonging to the Coleopterous genera Telephorus and Podabrus, and has done considerable on the snapping beetles or Elateridae, the parasitic flies, the Tachinidae, and a group of parasitic wasps, the Braconidae.

Miss Hartman made nearly five hundred microscopical preparations of various species, mostly gall midges and scale insects, rearranged the pinned collection of scale insects and prepared a special Cicada exhibit. She also gave much time to mounting, spreading and labeling of specimens.

Nursery inspection. The nursery inspection work conducted by the State Department of Agriculture has resulted in the office being requested to make numerous identifications and also recommendations in regard to the policy which should be pursued by the State. Most of the material submitted for name is in poor condition, may represent any stage in insect development, and is often from a foreign country. This work, though time-consuming and laborious, is very important, since the disposition of large shipments of nursery stock must depend in great measure upon our findings. The possibility of introducing the gipsy and brown-tail moths with stock originating in territory infested by these pests, justifies a most careful examination of all such material and the adoption of every reasonable precaution.

Miscellaneous. A series of experiments, conducted to test the value of heat as an insecticide, showed that the relatively moderate temperature of 120° F. is soon fatal to the common black cockroach so frequently seen in warmer parts of dwellings. Buildings equipped with ample heating facilities are adapted to this method of checking household and storeroom pests. A series of observations were made upon the hibernation and development of the rose leaf hopper. An interesting outbreak by an Iris borer was also investigated. These two insects are discussed more fully on subsequent pages. Assistant State Entomologist Young had charge of the heat experiments, being assisted in this by Miss Hartman.

The Entomologist, as in previous years, has been called upon to lecture upon injurious insects at farmers institutes, horticultural and other gatherings. Information respecting shade tree pests, owing to their serious injuries this year, was most frequently desired.

Office matters. The general work of the office has progressed in a satisfactory manner. The Assistant State Entomologist was in charge of the office and responsible for the correspondence and other matters during the absence of the Entomologist. Miss Hartman, in addition to matters noted above, made a large colored chart of the elm leaf beetle, rendered material assistance in various aspects of the experimental work, cared for breeding jars, compiled bibliographies and translated a number of excerpts from scientific articles. Numerous specimens have been received for identification during the year and many inquiries made concerning injurious forms. The correspondence shows a marked increase over that of last year; 2219 letters, 23 postals, 1014 circulars, 1623 packages were sent through the mails and 42 packages were shipped by express.

General. The work of the office has been greatly facilitated, as in past years, by the identification of certain species through the courtesy of Dr L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture, and his associates. Several correspondents have aided materially in securing valuable specimens and many rendered efficient service by transmitting local data respecting various insects. As heretofore, there has been a most helpful cooperation on the part of all interested in the work of this office.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

October 14, 1911

INJURIOUS INSECTS

CODLING MOTH

Carpocapsa pomonella Linn.

Plates 1–7

The work of the last two years with this important pest of the fruit grower has been continued and some extremely interesting data secured. Even one spraying resulted in obtaining 98 to 99 per cent of sound fruit, while the check trees yielded only 67 and 85 per cent of worm-free apples. The second and third poison applications increased the percentage of sound fruit comparatively little. These results confirm those secured in 1909 and go far toward showing the possibility of a thorough, timely spraying. The low efficiency of the one application made three weeks after the falling of the blossoms, determined last year as approximately one-half that of a timely application, was confirmed this season by experiments in two orchards under diverse conditions.

Life history and habits. The discussion of the experimental data may well be preceded by a brief summary of the life history of this species. The codling moth or apple worm, as is well known, winters in a tough, silken cocoon usually found under the rough bark of trees. The appearance of warm weather in the spring, which in New York means late April and early May, is followed by the caterpillars transforming within their silken retreats to the brown, apparently lifeless pupae, and a week or ten days after the blossoms drop, the moths commence to emerge and continue to appear throughout the greater part of June. The minute, whitish eggs are deposited largely upon the leaves though a number may be found on the young fruit. These hatch in about a week and as a consequence the young apple worms of the first brood may be entering the small fruit from early in June, approximately three weeks after the blossoms fall, to nearly the end of the month or even later. The caterpillars require about four weeks to complete their growth, at which time they desert the fruit, wander to a sheltered place, spin a cocoon, transform once more to pupae and in about two weeks, namely, the last of July or in August, another brood of moths may appear. These in turn deposit eggs which hatch in due time and the young larvae usually enter the side of the fruit. Two broods appear to be the rule in the northern fruit-growing sections of the United States though some investigators claim a third in the southwest.

Experimental work. The work of the last two years with the codling moth was continued the present season with extremely gratifying results. Comparative tests were made to ascertain the value of but one spraying just after the blossoms fall, with a similar treatment supplemented by a second application about three weeks later, namely, about the time when the young codling moth larvae enter the fruit. The third plot received, in addition to the two sprayings described above, a thorough application the latter part of July, designed especially to control the second brood. One plot, in continuance of the work of last year, was given only one application about three weeks after the blossoms dropped simply to test the relative value of this treatment. Check or unsprayed trees were left for comparison in each of the series.

Location and treatment of plots. Series 1 The experiments in this series were conducted in the young orchard belonging to Mr W. H. Hart of Arlington, N. Y., near Poughkeepsie and located close to Briggs Station on the Hopewell branch of the Central New England Railroad. The orchard is on a moderately high hill, the trees being thrifty, about 17 years old, 18 to 20 feet high and 30 feet apart. The experimental trees were in all cases Baldwins. Each plot consisted of approximately 42 trees, 6 trees in a row one way and 7 in a row the other way, the central 6 being the actual experimental trees. These latter were carefully selected for uniformity in size, fruitage and infestation. The one exception to the arrangement outlined above occurred in plot 4 and the check trees. These latter were the central 2 of the usual 6 experimental trees, while the other 4 in the center of a plot containing 42 trees received only the one late application. All of the barrier trees were sprayed at the usual time. This modification was made because the owner did not wish to have too many trees unprotected or only partially protected from codling moth work. The systematic and thorough commercial spraying of the two preceding years had served to keep this orchard in excellent condition and, as a consequence, there was not an excessive infestation by the codling moth. The conditions we consider typical of a well-kept commercial orchard. Plots 1, 2 and 3 were located in the northern end of the orchard on a gently sloping side hill, the actual experimental trees being separated from adjacent woodland by at least three barrier trees. The conditions were fairly uniform, the plots producing respectively 16,638, 19,994 and 20,926 apples. It will thus be seen that the largest yield was on plots 2 and 3 and, as a consequence, the test for the single spraying was fully as severe as in the case of the trees receiving two and three applications. Plot 4 and the check trees were located near the southern end of the orchard and bore relatively less fruit.

The trees were sprayed for the first time May 18th. The day opened with rain about 7 o'clock, continuing to nearly 9, and then breaking with showers till about 11 o'clock, sprinkling again at 1.45 and with a few showers till about 4.20 p. m., at which time it poured. Spraying began at about 1.25 p. m. on plot 2 at which time there was a slight breeze. The treatment of the actual experimental trees was completed by 1.35 and then working southward those of plot 1 were finished by 1.46. A sprinkling of rain began at 1.45 and was rather lively at 1.46, stopping at 2 p. m. The leaves at this time were partly flooded with rain but there was no marked dripping. An examination of the experimental trees in plots 2 and 1 showed that in the former, sprayed some ten minutes before the rain began to fall, there was very little or no washing, while in plot 1 those trees which had been completed just a few minutes before the rain came, showed some washing though this was limited largely to the carrying of the poison to the lower edge of the leaf where it settled in large drops. There was very little dripping and probably nothing was washed from the blossom ends of the young fruit. Spraying on the barrier trees was started at 2.10 p.m., at which time the trees were wet but not dripping. The experimental trees on plot 3 were sprayed at 3.15 p.m., the foliage being dry. The work in this entire plot was completed about 3.45, though some of the barrier trees on plot 2 were not finished till nearly 4 p.m., at which time there was a sprinkling of rain, it pouring by 4.20. Only 150 gallons were necessary to cover most of four rows in plots 1 and 2, or 59 trees.

The spray applied consisted of 7½ pounds of Grasselli's arsenate of lead (15 per cent arsenic oxid) and 4½ gallons of

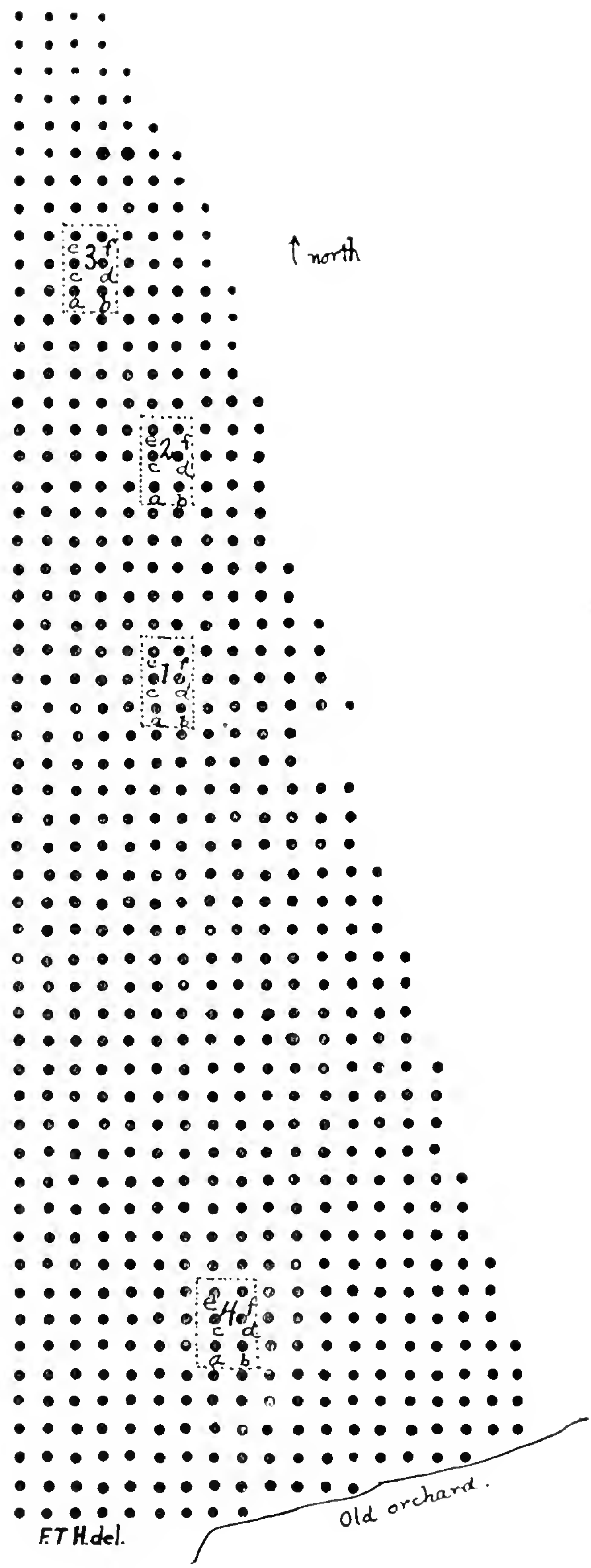

Fig. 1 Plan of Part of the Orchard Belonging to W. H. Hart, Poughkeepsie, Showing the Location of the Plots in Series 1

a concentrated lime-sulfur wash (31° Baumé) to each 150 gallons. The pressure was maintained at from 150 to 160 pounds. The spraying was from the ground, the hose being tied to long bamboo rods and the nozzles were of the later Friend type with apertures which had been worn somewhat by earlier work with a lime-sulfur wash and the spray was therefore rather coarse. Plots 1, 2 and 3 and the barrier trees on plot 4, in which latter were located the check trees, were thoroughly sprayed at this time.

Plots 2 and 3 were sprayed a second time June 8th and the four trees comprising plot 4 for the first and only time on the same day. The weather conditions were perfect, there being a light northwest wind. The material was the same as employed in the earlier application. The entire orchard was then in fine condition. There had been a little burning by the spray on some of the northern spy trees but nothing of the kind was observed on the Baldwins in the experimental plots. Many of the branches showed six or more inches of new growth. Aphids were more or less abundant but not present in sufficiently large numbers to cause serious damage, though a few injured apples were noted in plot 2. Some of the fruit was more or less injured by a green fruit worm or Cacoecia larva. Seven injured apples were picked from tree 2 B and as many from one of the barrier trees in the plot.

The third application to plot 3 was made July 26th, three gallons of spray being used for each tree and an average of a minute being required for the treatment of each tree. An examination at this time showed almost no wormy apples on plot 1, even in the case of trees sprayed just before the rain. Practically the same conditions obtained in plots 2 and 3.

September 28th the spray material was very perceptible and in some instances rather abundant upon the foliage. There was much more russeting or burning of the fruit on plot 3 and the injured areas (plate 6) were checking considerably.

A tabulation of the data is given below.

Series 1, plot 1 (Sprayed once)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 22	130	121		9				9	3	
	Sept. 15	21	18		3				3	2	
	Sept. 26–28	57	53		4		3		1		
		3633	3626		7		2	1	4		
		3841	3818	99.40	23	.60	5	1	17	5	
B	Aug. 22	31	29		2				2	2	
	Sept. 15	14	11		3				3	1	
	Sept. 26–28	17	14		3				3		
		1732	1724		8		1		7		
		1794	1778	99.11	16	.89	1		15	3	
C	Aug. 22	119	113		6				6	6	
	Sept. 15	48	43		5		2	1	2	4	
	Sept. 26–28	45	37		8		2	1	5	1	
		3859	3842		17		4		13	6	
		4071	4035	99.12	36	.88	8	2	26	17	
D	Aug. 22	58	57		1				1	1	
	Sept. 15	19	15		4				4	2	
	Sept. 26–28	14	13		1			1			
		1788	1783		5		1	1	3	1	
		1879	1868	99.41	11	.59	1	2	8	4	
E	Aug. 22	104	101		3				3	2	
	Sept. 15	26	24		2				2	1	
	Sept. 26–28	24	24		0				0	0	
		2899	2884		15		1	1	13	4	
		3053	3033	99.34	20	.66	1	1	18	7	
F	Aug. 22	68	68		0						
	Sept. 15	11	8		3				3	2	
	Sept. 26–28	15	6		9		1	6	2	2	
		1906	1901		5		2		3		
		2000	1983	99.15	17	.85	3	6	8	4	
	Grand total	16638	16515	99.26	123	.74	19	12	92	40	

Series 1, plot 2 (Sprayed twice)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT Total	CLEAN FRUIT Per cent	WORMY FRUIT Total	WORMY FRUIT Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 22	270	263	......	7	......	......	......	7	4	.....
	Sept. 15	33	30	......	3	......	......	1	2	3	.....
	Sept. 26–28	64	58	......	6	......	1	......	5	1	.....
		3940	3923	......	17	......	2	1	14	.....	.....
		4307	4274	99.23	33	.77	3	2	28	8	.....
B	Aug. 22	202	198	......	4	......	......	......	4	4	.....
	Sept. 15	25	25	......	0	......	......	0	0	.....	.....
	Sept. 26–28	48	47	......	1	......	......	......	1	.....	.....
		3355	3351	......	4	......	......	1	3	1	.....
		3630	3621	99.75	9	.25	......	1	8	5	.....
C	Aug. 22	119	118	......	1	......	......	......	1	1	.....
	Sept. 15	39	36	......	3	......	......	......	3	1	.....
	Sept. 26–28	60	58	......	2	......	......	......	2	1	.....
		3136	3136	......	0	......	......	......	0	0	.....
		3354	3348	99.82	6	.18	......	......	6	3	.....
D	Aug. 22	237	235	......	2	......	1	......	1	2	.....
	Sept. 15	48	46	......	2	......	1	......	1	1	.....
	Sept. 26–28	83	73	......	10	......	......	......	10	1	1
		3901	3897	......	4	......	......	......	4	1	.....
		4269	4251	99.58	18	.42	2	......	16	5	1
E	Aug. 22	128	126	......	2	......	......	......	2	2	.....
	Sept. 15	18	13	......	5	......	......	......	5	2	.....
	Sept. 26–28	43	39	......	4	......	......	......	4	2	.....
		1194	1191	......	3	......	......	......	3	.....	.....
		1383	1369	98.98	14	1.02	......	......	14	6	.....
F	Aug. 22	131	127	......	4	......	......	......	4	4	.....
	Sept. 15	28	27	......	1	......	......	......	1	0	.....
	Sept. 26–28	45	44	......	1	......	......	......	1	1	.....
		2847	2842	......	5	......	......	......	5	1	.....
		3051	3040	99.64	11	.36	......	......	11	6	.....
	Grand total	19994	19903	99.54	91	.46	5	3	83	33	1

Series 1, plot 3 (Sprayed thrice)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 22	207	206	......	1	......	......	......	1	......	......
	Sept. 15	26	26	......	0	......	......	......	0	......	......
	Sept. 26–28	108	107	......	1	......	......	......	1	......	......
		3881	3879	......	2	......	......	......	2	1	......
		4222	4218	99.90	4	.10	......	......	4	1	......
B	Aug. 22	185	182	......	3	......	......	......	3	1	......
	Sept. 15	22	22	......	0	......	0	......	0	......	......
	Sept. 26–28	73	69	......	4	......	2	......	2	1	......
		2193	2187	......	6	......	......	......	6	4	......
		2473	2460	99.47	13	.53	2	......	11	6	......
C	Aug. 22	195	192	......	3	......	......	......	3	2	......
	Sept. 15	14	13	......	1	......	......	......	1	1	......
	Sept. 26–28	34	33	......	1	......	......	......	1	1	......
		2471	2471	......	0	......	......	......	0	......	......
		2714	2709	99.81	5	.19	......	......	5	4	......
D	Aug. 22	391	374	......	17	......	2	......	15	12	......
	Sept. 15	52	47	......	5	......	1	......	4	3	......
	Sept. 26–28	75	71	......	4	......	2	......	2	2	......
		3829	3821	......	8	......	1	2	5	3	......
		4347	4313	99.22	34	.78	6	2	26	20	......
E	Aug. 22	89	88	......	1	......	0	......	1	1	......
	Sept. 15	113	113	......	0	......	0	......	......	......	......
	Sept. 26–28	82	72	......	10	......	3	......	7	3	......
		2901	2901	......	0	......	......	......	......	......	......
		3185	3174	99.65	11	.35	3	......	8	4	......
F	Aug. 22	121	112	......	9	......	0	......	9	8	......
	Sept. 15	29	26	......	3	......	3	......	0	0	......
	Sept. 26–28	153	138	......	15	......	3	......	12	3	......
		3682	3680	......	2	......	......	......	2	......	......
		3985	3956	99.27	29	.23	6	......	23	11	......
	Grand total	20926	208 0	99.54	96	.46	17	2	77	46	......

Series 1, plot 4 (Sprayed once, late)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 22.......	181	178	....	3	....	1	.....	2	1	.....
	Sept. 15.......	42	22	....	20	....	7	3	10	4	.....
	Sept. 26–28....	102	63	....	39	....	10	2	27	7	.....
		2705	2658	....	47	....	8	6	33	6	.....
		3030	2921	96.40	109	3.60	26	11	72	18	.....
B	Aug. 22.......	73	60	....	13	....	4	3	6	7	.....
	Sept. 15.......	53	10	....	43	....	25	5	13	22	.....
	Sept. 26–28....	35	9	....	26	....	6	7	13	9	.....
		848	767	....	81	....	24	21	36	26	.....
		1009	846	83.84	163	16.16	59	36	68	64	.....
C	Aug. 22.......	185	175	....	10	....	2	1	7	6	.....
	Sept. 15.......	30	15	....	15	....	5	3	7	4	.....
	Sept. 26–28....	51	36	....	15	....	3	3	9	5	.....
		2454	2415	....	39	....	15	4	20	7	.....
		2720	2641	97.09	79	2.91	25	11	43	22	.....
D	Aug. 22.......	171	139	....	32	....	15	.....	17	18	.....
	Sept. 15.......	78	16	....	62	....	29	15	18	29	.....
	Sept. 26–28....	76	21	....	55	....	13	7	35	12	.....
		1885	1809	....	76	....	19	15	42	20	.....
		2210	1985	89.82	225	10.18	76	37	112	79	.....
	Grand total..	8969	8393	93.57	576	6.43	186	95	295	183	.....

Series 1, check trees (Unsprayed)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Aug. 22.......	199	108	....	91	....	51	10	30	34	.....
	Sept. 15.......	152	27	....	125	....	88	17	20	47	.....
	Sept. 26–28....	92	34	....	58	....	16	12	30	24	2
		2524	2411	....	113	....	49	24	40	27	.....
		2967	2580	86.95	387	13.05	204	63	120	132	2
Y	Aug. 22.......	145	72	....	73	....	32	18	23	30	.....
	Sept. 15.......	131	19	....	112	....	67	20	25	46	.....
	Sept. 26–28....	113	37	....	76	....	18	20	38	31	.....
		1981	1832	....	149	....	58	45	46	46	1
		2370	1960	82.70	410	17.30	175	103	132	153	1
	Grand total..	5337	4540	85.06	797	14.94	379	166	252	285	3

A study of the above data reveals several very interesting facts. The 16,638 apples of plot 1 are fairly evenly distributed between the 6 trees, the numbers ranging from 1794 to 4071. The average percentage of worm-free fruit is 99.26, the individual trees varying from 99.11 to 99.41. The total wormy fruit is only 123, one tree having but 11, while the maximum is 36. The number of end wormy per tree varies from 1 to 10, while the side wormy range from 10 to 28, a total of 31 end wormy and 104 side wormy. Assuming that the percentage of infested fruit on the check trees in this series is typical for the plot, we find that one application has reduced the infestation by 14 per cent, or resulted in removing from the wormy column some 2329 apples, about 4½ barrels. The cost of spraying the 6 trees was 48 cents, or less than 12 cents for each barrel of fruit kept from being thrown into second-class or cider apples as an outcome of injury by codling moth. The financial returns from this transaction are apparent.

The 19,994 apples of plot 2 range in number per individual tree from 1383 to 4307. The percentage of sound fruit is 99.54, a variation for individual trees of from 98.98 to 99.82. The total wormy is only 91, there being only 8 of these end wormy and 86 side wormy. The end wormy per tree vary from nothing to 5, while the side wormy range from 6 to 30. The second treatment resulted in an additional gain of slightly over ¼ of 1 per cent (.28 per cent) over the single treatment for plot 1. Obviously, the returns from this second spraying are relatively less than in the case of the first.

The total fruit in plot 3 amounts to 20,926, individual trees producing from 2473 to 4347. The percentage of worm-free fruit was exactly the same as in plot 2, 99.54, the variations ranging from 99.22 to 99.90. There were a few more wormy apples than in plot 2, namely, 96, 19 of these being end wormy and 79 side wormy. There appears to have been no material benefit in the case of this plot, resulting from the third spraying. This is more probably chargeable to the extreme thoroughness of the first two applications rather than being attributable to any defect in method. The margin of less than ½ per cent (.46 per cent) is so small that at best only a very slight difference could be expected.

Plot 4 comprises only 4 trees producing 8969 apples, individual trees yielding from 1009 to 3030. The percentage of worm-free fruit was 93.57, individual trees varying from 83.84 to 97.09. There were 576 wormy apples, 281 being end wormy and 390 side wormy. The great relative increase in end wormy apples is apparent at once and is easily explained by the one application being so late that it was impossible thoroughly to poison the floral organs and the calyx cavity. Even this treatment was worth while if compared with the results on unsprayed trees, since in this plot we have an average of over 93½ per cent of sound fruit as compared with a trifle over 85 per cent on the check trees, a gain of 8½ per cent or of over 760 sound apples, approximately a barrel and a half at a cost for spraying of about 32 cents. The treatment paid for itself, though the profit was not nearly so great as in the case of the first application.

The two check trees produced 5337 apples, one yielding 2370, the other 2967. The average percentage of sound fruit was 85.06, while the number of wormy apples was 797, 545 of these being end wormy and 418 side wormy. A comparison of these figures with those of plots 1, 2 and 3 show at once that the major portion of the benefit from the early applications at least is in the destruction of the codling moth caterpillars as they attempt to enter the calyx end of the young fruit. These data simply confirm the importance of making the first spraying at the proper time and doing it most thoroughly, since it is the early application which gives the most benefit.

Series 2. The experiments in this series were conducted in the orchard of Mr Edward VanAlstyne at Kinderhook, N. Y. Plot 1, comprising greenings, was located on the southwestern side of the road next the shed. Plot 2 was some rows farther north and west on the same side of the road, plot 3 several rows still farther north on the east side of the road, and plot 4, comprising only two trees, on the west side of the road and near two check trees. The relative location of the trees in plot 4 and the checks was nearly the same as in Mr Hart's orchard, though owing to the uneven setting of fruit a symmetrical distribution was impossible. All of the trees except in plot 1 were Baldwins. The conditions in plots 1 to 3 were fairly uniform, these plots producing respectively, 20,802, 34,019, and 31,119 apples. The largest yields were therefore limited to the plots receiving the most sprayings and, as a consequence, the test for the single application was rather more severe.

The treatment was substantially the same as in series 1, except that lead arsenate (15½ per cent arsenic oxid), manufactured by the Interstate Chemical Co., was used at the rate of 15 pounds to 250 gallons of water, and a concentrated home-made lime-sulfur wash, 40-80 formula (27° Baumé) was used at the rate of 1 gallon to 25 of the spray. The spraying began May 23d. The trees were 18 to 25 feet high and the work slower and if anything more careful than in series 1. The tower was used, one man being located on this and the other with an extension nozzle operating from the ground. There was probably considerably more liquid applied per tree than in the preceding series. The blossom ends were well sprinkled but there was practically no penetration of the poison to the inner calyx cavity. The leaves were well covered with the poison and rarely flooded. There were still a few blossoms on the ends of the limbs. The eastern barrier rows of plot 1 were completely sprayed on the first day, and the three rows next the driveway and west were sprayed from the east side beginning with the experimental trees in plot 1. The next day, the 24th, a few of the remaining trees were sprayed with the wind in the opposite direction, though nearly constant showers seriously hindered operations. The remainder of the plots, including the barrier trees, were finished May 25th. Trees A and B on plot 2 were sprayed on the morning of the 24th, the application being followed shortly by heavy showers. The spray, however, could be seen upon the foliage the following day. The weather during both the 24th and 25th was rather showery and spraying was frequently interrupted.

Plots 2, 3 and 4 were sprayed June 19th. The weather was bright and clear with a light southeast wind. The work began at 9.30 a.m. and was completed at 3.15 p.m. The B tree in plot 2 contained a nest of fall webworms; this was also true of one of the barrier trees. There was throughout the orchard considerable crinkling and yellowing of leaves, which might be attributed to former applications were it not that the unsprayed trees on plot 4 as well as the check trees exhibited the same conditions. There had been an excellent growth and the foliage had a good color. The fruit presented a fine appearance and there was an excellent setting with but few exceptions.

Plot 3 was sprayed for the third and last time July 29th, using only arsenate of lead in the proportions previously employed.

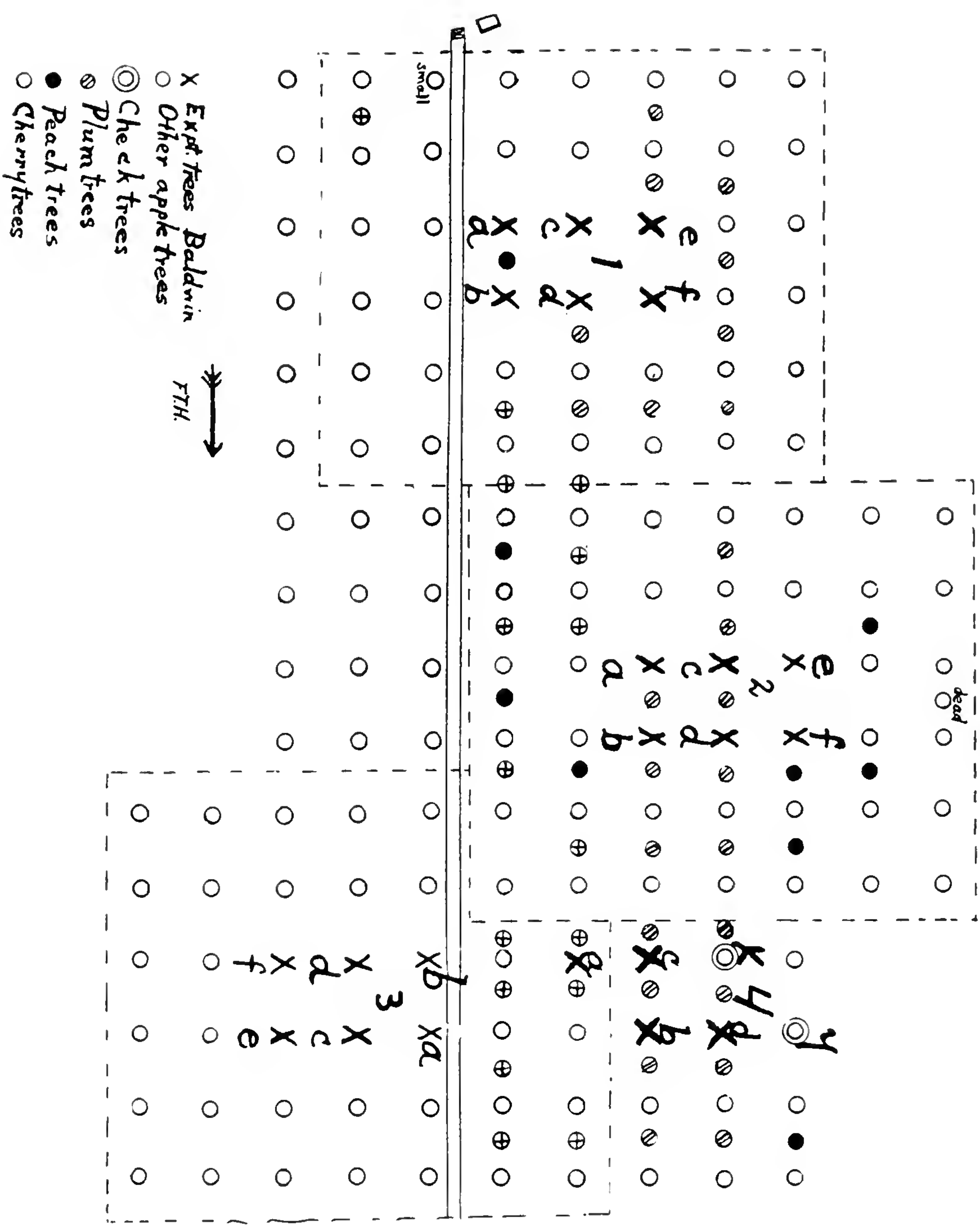

Fig. 2 Plan of Orchard Belonging to Edward Van Alstyne, Kinderhook, Showing the Location of the Plats in Series 2

The application was thorough and was confined to the six experimental trees. There was a slight breeze though not sufficient to interfere with operations. The trees on plot 1 were well laden, healthy, and the fruit was developing very nicely. Very few or no wormy apples were seen and there were very few on the ground. A rather large number of small apples were on the ground in plot 2, the drop probably being the result of drought. There were a number with brown, scabby areas on the side exposed to the sun, probably due to sun scald. There were very few or no wormy apples. There was abundant fruit on plot 3 except on small portions of one or two trees. There was rather more injury to the fruit possibly than on plot 2 and certainly more than on plot 4. The spray was evident on the foliage and very few or no wormy apples were to be seen. Some wormy fruit was seen on plot 4 but not so much as on the checks. Some of the apples were injured by sun scald though not so much as on plot 2. Some were badly checked later (plate 7). There were only two trees on plot 4 with a good setting of fruit. The checks bore markedly more wormy apples than the other trees and had practically no fruit injured by sun scald.

A tabulation of the data follows:

Series 2, plot 1 (Sprayed once)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24.......	244	238	....	6	....	.....	.....	6	2	.....
	Sept. 19.......	629	622	....	7	....	1	.....	6	.....	.....
	Oct. 2.........	184	166	....	18	....	1	1	16	2	.....
		2895	2868	....	27	....	1	.....	26	.....	.....
		3952	3894	98.53	58	1.47	3	1	54	4	.....
B	Aug. 24.......	213	196	....	17	....	2	.....	15	14	.....
	Sept. 19.......	359	347	....	12	....	1	.....	11	.....	.....
	Oct. 2.........	234	189	....	45	....	3	1	41	3	.....
		2129	2090	....	39	....	2	2	35	5	.....
		2935	2822	96.15	113	3.83	8	3	102	22	.....
C	Aug. 24.......	281	278	....	3	....	.....	.....	3	2	.....
	Sept. 19.......	380	374	....	6	....	1	.....	5	3	.....
	Oct. 2.........	256	244	....	12	....	.....	.....	12	1	.....
		3345	3333	....	12	....	1	.....	11	.....	.....
		4262	4229	99.22	33	.78	2	.....	31	6	.....
D	Aug. 24.......	249	247	....	2	....	1	.....	1	1	.....
	Sept. 19.......	660	648	....	12	....	2	.....	10	6	.....
	Oct. 2.........	134	124	....	10	....	.....	1	9	2	.....
		2215	2198	....	17	....	.....	1	16	6	.....
		3258	3217	98.74	41	1.26	3	2	36	15	.....
E	Aug. 24.......	233	226	....	7	....	1	.....	6	5	.....
	Sept. 19.......	483	466	....	17	....	1	1	15	9	.....
	Oct. 2.........	193	186	....	7	....	1	.....	6	.....	.....
		2269	2253	....	16	....	2	1	13	2	.....
		3178	3131	98.52	47	1.48	5	2	40	16	.....
F	Aug. 24.......	163	153	....	10	....	1	.....	9	5	.....
	Sept. 19.......	375	347	....	28	....	2	5	21	9	2
	Oct. 2.........	222	194	....	28	....	3	1	24	6	.....
		2457	2414	....	43	....	1	.....	42	.....	.....
		3217	3108	96.61	109	3.39	7	6	96	20	2
	Grand total..	20802	20401	98.07	401	1.93	28	14	359	83	2

Series 2, plot 2 (Sprayed twice)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT Total	CLEAN FRUIT Per cent	WORMY FRUIT Total	WORMY FRUIT Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24	403	395	......	8	......	......	......	8	8	.....
	Sept. 19	270	257	......	13	......	2	......	11	6	.....
	Oct. 5	567	562	......	5	......	......	......	5	1	.....
		4024	4020	......	4	......	......	......	4	.....	.....
		5264	5234	99.43	30	.57	2	......	28	15	.....
B	Aug. 24	429	420	......	9	......	......	......	9	5	.....
	Sept. 19	449	416	......	33	......	6	4	23	18	3
	Oct. 5	653	607	......	46	......	4	10	32	18	1
		5755	5724	......	31	......	1	3	27	11	.....
		7286	7167	98.37	119	1.63	11	17	91	52	4
C	Aug. 24	513	506	......	7	......	1	......	6	4	.....
	Sept. 19	800	775	......	25	......	1	3	21	7	2
	Oct. 5	950	928	......	22	......	3	1	18	.....	.....
		3522	3507	......	15	......	3	2	10	5	.....
		5785	5716	98.81	69	1.19	8	6	55	16	2
D	Aug. 24	309	300	......	9	......	2	......	7	6	.....
	Sept. 19	319	291	......	28	......	3	7	18	14	3
	Oct. 5	425	381	......	44	......	5	9	30	11	.....
		3102	3081	......	21	......	2	2	17	10	.....
		4155	4053	97.54	102	2.46	12	18	72	41	3
E	Aug. 24	253	242	......	11	......	1	......	10	6	.....
	Sept. 19	151	130	......	21	......	2	2	17	14	.....
	Oct. 5	486	452	......	34	......	1	4	29	17	.....
		4480	4466	......	14	......	2	......	12	.....	.....
		5370	5290	98.51	80	1.49	6	6	68	37	.....
F	Aug. 24	451	443	......	8	......	1	......	7	5	.....
	Sept. 19	412	372	......	40	......	5	......	35	21	1
	Oct. 5	635	596	......	39	......	8	7	24	15	.....
		4661	4639	......	22	......	......	......	22	1	.....
		6159	6050	98.23	109	1.77	14	7	88	42	1
	Grand total	34019	33510	98.50	509	1.5	53	54	402	203	10

Series 2, plot 3 (Sprayed thrice)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT Total	CLEAN FRUIT Per cent	WORMY FRUIT Total	WORMY FRUIT Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Sept. 1	308	264	....	44	....	8	1	35	19	.....
	Sept. 21	380	358	....	22	....	7	......	15	7	.....
	Oct. 9	628	614	....	14	....	3	2	9	3	.....
		2074	2059	....	15	....	2	3	10	5	.....
		3390	3295	97.20	95	2.80	20	6	69	34	.....
B	Sept. 1	925	898	....	27	....	2	3	22	16	.....
	Sept. 21	1154	1145	....	9	....	3	3	3	3	.....
	Oct. 2 and 9	1332	1327	....	5	....	2	......	3	.....	.....
		3571	3568	....	3	....	1	1	1	1	.....
		6982	6938	99.37	44	.63	8	7	29	20	.....
C	Sept. 1	434	421	....	13	....	2	......	11	7	.....
	Sept. 21	452	440	....	12	....	5	......	7	7	.....
	Oct. 9	1001	992	....	9	....	......	3	6	4	.....
		3560	3558	....	2	....	1	......	1	.....	.....
		5447	5411	99.34	36	.66	8	3	25	18	.....
D	Sept 1	375	358	....	17	....	3	3	11	16	.....
	Sept. 21	594	587	....	7	....	4	......	3	2	.....
	Oct. 9	1139	1129	....	10	....	......	2	8	1	.....
		2939	2937	....	2	....	......	......	2	1	.....
		5047	5011	99.28	36	.72	7	5	24	20	.....
E	Sept. 1	246	236	....	10	....	1	......	9	9	.....
	Sept. 21	270	254	....	16	....	8	2	6	9	.....
	Oct. 9	977	969	....	8	....	1	......	7	1	.....
		3251	3244	....	7	....	2	......	5	2	.....
		4744	4703	99.14	41	.83	12	2	27	21	.....
F	Sept. 1	694	682	....	12	....	4	......	8	9	.....
	Sept. 21	1333	1331	....	2	....	1	......	1	.....	.....
	Oct 9	1423	1423	....	......	....	......	......	......	.....	.....
		2059	2058	....	1	....	......	......	1	.....	.....
		5509	5494	99.73	15	.27	5	......	10	9	.....
	Grand total	31119	30852	99.14	267	.86	60	23	184	122	.....

Series 2, plot 4 (Sprayed once, late)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 25	757	433	....	324	....	171	32	121	219	.....
	Sept. 20	1440	951	....	489	....	245	96	148	339	14
	Oct. 6	1016	647	....	369	....	86	92	191	107	6
		3975	3673	....	302	....	64	68	170	70	.....
		7188	5704	79.35	1484	20.65	566	288	630	735	20
B	Aug. 25	727	415	....	312	....	116	10	186	256	.....
	Sept. 20	1445	833	....	612	....	279	94	239	311	9
	Oct. 6	737	477	....	260	....	67	28	165	74	1
		3887	3667	....	220	....	67	24	129	39	1
		6700	5392	79.34	1404	20.66	529	156	719	680	11
C	Aug. 25	68	44	....	24	....	9	4	11	16	.....
	Sept. 20	156	131	....	25	....	11	2	12	12	.....
	Oct. 6	52	37	....	15	....	4	3	8	6	.....
		341	299	....	42	....	15	7	20	16	.....
		617	511	82.80	106	17.20	39	16	51	50	.....
D	Aug. 25	286	78	....	208	....	115	12	81	103	.....
	Sept. 20	388	132	....	256	....	120	46	90	130	2
	Oct. 6	322	107	....	125	....	18	29	78	47	2
		1218	1099	....	119	....	35	31	53	37	.....
		2214	1506	68.02	708	31.98	288	118	302	317	4
	Grand total	16815	13113	77.98	3702	22.02	1422	578	1702	1782	35

Series 2, check trees (Unsprayed)

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Sept. 1	1411	669	....	742	....	447	41	254	427	11
	Sept. 22	2885	1563	....	1322	....	585	249	488	770	21
	Oct. 2-6	943	507	....	436	....	131	113	192	126	5
		4279	3679	....	600	....	168	137	295	153	5
		9518	6418	67.43	3100	32.57	1331	540	1229	1476	42
Y	Aug. 24	356	103	....	253	....	116	25	112	160	4
	Sept. 20	1249	453	....	796	....	431	149	216	364	5
	Oct. 6	701	435	....	266	....	65	90	111	76	1
		2846	2451	....	395	....	105	145	145	103	2
		5152	3442	66.81	1710	33.19	717	409	584	703	12
	Grand total	14670	9860	67.21	4810	32.79	2048	949	1813	2179	54

Series 2 largely confirms the results obtained in series 1 though the crop was somewhat larger, the trees older and consequently more difficult to spray thoroughly. On the other hand the nearly level ground facilitated the use of a tower, while the greater abundance of the codling moth afforded a more severe test of the efficacy of spraying.

Plot 1 produced 20,802 apples, the individual trees yielding from 2935 to 4262. The average percentage of sound fruit was 98.07, the trees varying from 96.15 to 99.22. There were 401 wormy apples, the number per tree ranging from 33 to 109. There were only 42 end wormy, while the great majority, 373, were side wormy. This one treatment resulted in saving nearly 21 per cent of what otherwise would have been wormy fruit or about 4000 apples, approximately 8 barrels. This was effected at a cost of about 60 cents or less than 10 cents per barrel.

Plot 2 produced a total of 34,019 apples, the individual trees yielding from 4155 to 7286. The average percentage of worm-free fruit was 98.50, the trees varying from 98.23 to 99.43. There were 509 wormy apples, 107 being end wormy and 456 side wormy. It will be noted that this second treatment resulted in securing nearly ½ of 1 per cent (.43 per cent) more sound apples than in the case of plot 1.

Plot 3 produced 31,119 apples, the individual trees yielding from 3390 to 6982. The average percentage of sound fruit was 99.14, varying from 97.20 to 99.73. There were only 267 wormy apples, 83 being end wormy and 107 side wormy. Tree A for some reason or other gave distinctly less satisfactory results than the others. It produced over one-third of the wormy apples and had a percentage of only 97.20, otherwise the average percentage would have been perceptibly higher for this plot. As it is, there were about 1 per cent more worm-free apples on plot 3 than on plot 1, and it is possible that there should have been 1½ per cent additional sound fruit.

The four trees of plot 4 produced 16,815 apples, the individual trees varying from 617 to 7188. The percentage of sound fruit was 77.98, it varying from 68.02 to 82.80. There were 3702 wormy apples, 2000 of these being end wormy and 2280 side wormy. Over one-quarter of this latter number included in the totals of end wormy and of side wormy were end and side wormy. Accepting the check trees as standard, this one late application resulted in nearly 10 per cent additional sound fruit or about 1600 apples, over three barrels, the one treatment cost-ing approximately 40 cents. It paid for itself though the work would have been much more profitable had it been done three weeks earlier.

The check trees yielded 14,670 apples, the individual trees 5152 and 9518. The average percentage of sound fruit was 67.21, there being very little variation in this respect. These two trees produced 4810 wormy apples, 2997 being end wormy and 2762 side wormy. Here we have again most conclusive evidence showing that the major portion of the protection accrues from the first spraying as a result of its destroying young codling moth caterpillars entering at the blossom end of the fruit.

Series 3. Certain corroborative experiments were conducted in the young orchard of Mr William Hotaling of Kinderhook, N. Y. The trees are exceptionally fine, being only six or seven years old, dwarf in habit and, as a rule, well laden for such young trees. They are set in four rows, running approximately north, with rows of peach trees between, and in the case of the experimental areas the Wealthy apples alternate with Mackintosh. Three plots were laid out, the trees invariably being on the two middle rows. Plot 1 was limited to transverse rows 35, 36, 37 and 38, and plot 2 to transverse rows 39, 40, 41, 42, 43, 44 and 45, numbering from the house toward the railroad. The check trees were in transverse rows 23, 24 and 25. The trees were small and the spraying was very thorough, being made by Mr Hotaling personally. He took special pains to cover the under as well as the upper surface of the leaves, applying so much that there was considerable dripping. There was relatively more spray material used for each tree than in any other experiments during the season. Arsenate of lead (15 per cent arsenic oxid) was used at the rate of 4 pounds to 44 gallons of mixture, and a home-made lime-sulfur wash (33° Baumé) at a rate of 1 gallon to 30 gallons of spray. The first treatment was given May 23d to plots 1 and 2. Plot 2 was sprayed a second time June 19th, the treatment being limited to the experimental trees and the barrier trees in the longitudinal rows. At that time much of the fruit in this orchard had dropped, though it was not attributed to the spraying. There was some burning from the earlier application to the barrier trees though there seemed to be no injury to the experimental trees. The orchard presented a fine appearance, many twigs showing a growth of 8 or 10 inches. There was remarkable freedom from insect injury though near the house one tree had practically every apple injured by the codling moth.

The results secured in this series are tabulated below.

Series 3, Mackintosh, plot 1 (Sprayed once)

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	39	36	92.30	3	7.70	1	......	2	......	......
B	3	2	66.66	1	33.34	......	......	1	......	......
E	119	109	91.60	10	8.40	2	......	8	2	......
F	......	......	......	......	......	......	......	......	......	......
I	34	29	85.30	5	14.70	1	1	3	......	......
J	77	64	83.11	13	16.89	3	2	8	4	......
Total	272	240	88.23	32	11.77	7	3	22	6	......

Series 3, Mackintosh, plot 2 (Sprayed twice)

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	37	35	94.60	2	5.40	1	......	1	1	......
B	39	37	94.87	2	5.13	......	......	2	2	......
E	10	10	100	......	......	......	......	......	......	......
F	16	16	100	......	......	......	......	......	......	......
I	251	239	95.20	12	4.80	1	......	11	1	......
J	212	205	96.70	7	3.30	2	......	5	2	......
M	57	56	98.25	1	1.75	......	1	......	......	......
N	16	13	81.25	3	18.75	1	......	2	......	......
Total	638	611	95.76	27	4.24	5	1	21	6	......

Series 3, Wealthy, plot 1 (Sprayed once)

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
C	604	592	98	12	2	1	......	11	......	......
D	273	262	96	11	4	1	......	10	1	......
G	69	65	94.20	4	6.80	......	......	4	......	......
H	225	213	94.66	12	5.34	1	......	11	2	......
K	202	192	95.05	10	4.95	......	......	10	2	......
L	57	50	87.72	7	12.28	1	......	6	......	......
Total	1430	1374	96.08	56	3.92	4	......	52	5	......

Series 3, Wealthy, plot 2 (Sprayed twice)

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
C	398	395	99.24	3	.76	......	......	3	......	......
D	179	175	97.76	4	2.24	......	......	4	......	......
G	407	403	99.01	4	.99	1	......	3	......	......
H	14	14	100	0	0	......	......	......	......	......
K	83	82	98.79	1	1.21	......	......	1	......	......
L	87	87	100	0	....	......	......	......	......	......
Total	1168	1156	98.97	12	1.03	1	......	11	......	......

Series 3, Wealthy, checks (Unsprayed)

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
C	38	17	44.73	21	55.27	13	3	5	3	......
D	2	......	......	2	100	......	......	2	......	......

Series 3, Mackintosh, checks (Unsprayed)

TREE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
E.	......	......	....	......	....	......	......	......	......	......
F.	29	17	58.62	12	....	3	6	3	1	......

Series 3, Winesap, checks (Unsprayed)

TREE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A.	20	10	50	10	50	4	4	2	2	......
B.	29	14	48.27	15	51.73	15	......	......	......	......
Total	118	58	49.15	60	50.85	35	13	12	6	......

Series 3 is interesting largely because it shows the results which may be expected on small trees producing comparatively few apples. It also illustrates a marked difference in the liability of different varieties to injury by this pest.

The six Mackintosh trees in plot 1 produced a total of only 272 apples, the average percentage of sound fruit being 88.23, individual fruiting trees ranging from 66.66 to 92.30, though the maximum and minimum number of wormy apples were only 1 and 13.

Plot 2. The six Mackintosh trees produced 638 apples, giving an average percentage of 95.76 of sound fruit. There were only 27 wormy apples in the plot, the number per tree ranging from nothing to 12, yet the percentage variations ran from 81.25 to 100.

The six Wealthy trees in plot 1 produced 1430 apples, giving an average of 96.08 per cent of sound fruit. There were 56 wormy apples, individual trees producing from 4 to 12 and giving a percentage variation from 87.72 to 98.

The six Wealthy trees in plot 2 produced 1168 apples, an average of 98.97 per cent of sound fruit. Individual trees bore from none to 4 wormy apples, yet the percentage variation ranged from 98.79 to 100.

The above data should be compared with the 58.62 per cent of sound fruit produced by one check Mackintosh tree, and the 44.73 per cent of worm-free fruit on a check Wealthy tree. The comparisons show a decided advantage accruing from spraying though there is a wide variation in the percentage of sound fruit.

A summarized tabulation of the results secured from all the plots emphasizes certain important points and is therefore given below.

Summary of plots

SERIES	PLOT	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
1	1........	16638	16515	99.26	123	.74	19	12	92	40	......
	2........	19994	19903	99.54	91	.46	5	3	83	33	1
	3........	20926	20830	99.54	96	.46	17	2	77	46	......
	4........	8969	8393	93.57	576	6.43	186	95	295	193	......
	Check....	5337	4540	85.06	797	14.94	379	166	252	285	3
2	1........	20802	20401	98.07	401	1.93	28	14	359	83	2
	2........	34019	33510	98.50	509	1.5	53	54	402	203	10
	3........	31119	30852	99.14	267	.86	60	23	184	122	......
	4........	16815	13113	77.98	3702	22.02	1422	578	1702	1782	35
	Check....	14670	9860	67.21	4810	32.79	2048	949	1813	2179	54
	Mackintosh:										
3	1........	272	240	88.23	32	11.77	7	3	22	6	......
	2........	638	611	95.70	27	4.24	5	1	21	6	......
	Check....	29	17	58.62	12	....	3	6	3	1	......
	Wealthy:										
	1........	1430	1374	96.08	56	3.92	4	......	52	5	......
	2........	1168	1156	98.97	12	1.03	1	......	11	......	......
	Check....	38	17	44.73	21	55.27	13	3	5	3	......

Summary of plots. A study of the entire data shows that conditions were fairly comparable in series 1 and 2, though the yield from the latter was somewhat greater. This larger yield in series 2 is in some measure offset by the trees being larger and more difficult to spray, not only on account of their size but also because of interplanted plum and peach trees. The percentages of sound fruit from the plots in these two series show a fairly uniform increase with additional sprayings, though in the case of series 1 there is no difference between the percentage of sound fruit produced by plots 2 and 3, each giving an average of 99.54. In series 2, however, there is a nearly uniform gain of 1/2 of 1 per cent from each spraying after the first. There is a marked contrast between the amount of sound fruit produced on the plots receiving one treatment just after the blossoms dropped and on similar plots sprayed once three weeks later, the benefit resulting from this treatment ranging from one-third to two-thirds that of the early spray. An examination of the data relating to end wormy apples shows a very interesting condition. In series 1, plot 1 there were 31; plot 2, 8; plot 3, 19; plot 4, 281 and in the check trees, 545. It will be observed that the decrease in wormy apples resulting from the various sprayings is very largely in the end wormy, while the poor results following the one late spray must be attributed in considerable measure to failure in destroying the young caterpillars entering the blossom end of the apple. The data relating to the check trees give an idea of the number normally attacking the apple at this point. The same thing is even better illustrated in the figures for series 2. Plot 1 has 42 end wormy; plot 2, 107; plot 3, 83; plot 4, 2000, while the check trees produced 2997 end wormy apples.

A careful comparison of these figures supports the well-established belief that the first spraying within a week or ten days after the blossoms fall is by all odds the most important so far as preventing wormy apples or controlling the codling moth is concerned. Under the conditions obtaining in series 1 and 2, the benefits resulting from the second and third application are comparatively slight and of themselves would hardly justify additional treatment. Should it be advisable to spray for fungous diseases of one kind or another, we would not hesitate to recommend the addition of poison, since even the small benefit recorded above would more than repay the cost of the poison, not to mention the protective or insurance value of these later treatments in case there was an exceptionally large second brood as in 1910.

Summary of three years' work. Conclusions based upon the results of one season are of comparatively slight value. We have therefore brought together in one table the data relating to the experiments of three seasons, 1909–11.

Summary of three years' work with the codling moth

Treatment	Plot	Series	Year	Total fruit	Clean fruit: Total	Clean fruit: Per cent	Wormy fruit: Total	Wormy fruit: Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
Sprayed once	1	1	1909	30177	29818	98.81	359	1.19	33	18	308	......
	1	2	1909	21264	21042	98.96	222	1.04	23	18	181	......
	1	1	1910	1839	1664	90.48	175	9.52	16	21	138	......
	1	2	1910	8135	6677	82.08	1458	17.92	160	27	1271	......
	1	1	1911	16638	16515	99.26	123	.74	19	12	92	......
	1	2	1911	20802	20401	98.07	401	1.93	28	14	359	......
	Grand total and per cent............			98855	96117	97.23	2738	2.77	279	110	2319	.394
Sprayed twice	2	1	1909	10316	10206	98.93	110	1.07	4	7	99	......
	5	1	1909	19275	19084	99.01	191	.99	10	9	172	......
	2	1	1910	2846	2756	96.84	90	3.16	6	1	83	......
	2	2	1910	7316	6105	83.45	1211	16.55	127	10	1074	......
	2	1	1911	19994	19903	99.54	91	.46	5	3	83	......
	2	2	1911	34019	33510	98.50	509	1.5	53	54	402	......
	Grand total and per cent............			93766	91564	97.65	2202	2.35	205	84	1913	.308
Sprayed thrice	3	1	1909	9680	9582	98.99	98	1.01	8	10	80	......
	6	1	1909	7710	7633	99	77	1	6	3	68	......
	3	1	1911	20926	20830	99.54	96	.46	17	2	77	......
	3	2	1911	31119	30852	99.14	267	.86	60	23	184	......
	Grand total and per cent............			69435	68897	99.22	538	.78	91	38	409	.185
Sprayed once, late	3	2	1910	7594	4355	57.35	3239	42.65	1485	326	1428	......
	4	1	1911	8969	8393	93.57	576	6.43	186	95	295	......
	4	2	1911	16815	13113	77.98	3702	22.02	1422	578	1702	......
	Grand total and per cent............			33378	25861	77.47	7517	22.53	[illegible]093	9[illegible]9	3[illegible]25	12.26
Unsprayed	Check.	1	1909	3251	2366	72.73	885	27.27	312	302	271	......
	"	2	1909	7015	5127	73.08	1888	26.92	674	630	584	......
	"	1	1910	711	202	28.41	509	71.59	186	240	82	......
	"	2	1910	2000	593	29.65	1407	70.35	700	324	383	......
	"	1	1911	5337	4540	85.06	797	14.94	379	166	252	......
	"	2	1911	14670	9860	67.21	4810	32.79	2048	949	1813	......
	Grand total and per cent............			32984	22688	68.78	10296	31.22	4299	2611	3385	20.95

The above data[1] summarize the work for the past three years,

[1] To give a fairer comparison between the results obtained in different years, the figures for plot 4, series 1, and plots 4 and 7, series 2, 1909 were omitted in the above tabulation, thus avoiding the undue preponderance, so far as feasible, of the results of any one season.

the figures being grouped so as to show the results from various applications. The single spray applied to the different plots during this period gave from 82.08 to 99.26 per cent of sound fruit or an average of 97.23 per cent for the three years, when comparisons are made between an equal number of plots in each year. It should be noted that the low percentages occurred in 1910, a season remarkable for the unusual destructiveness of the second brood and one presenting infrequent conditions which were accentuated by the small yield of the experimental trees. Excluding the data for this year, the lowest percentage of sound fruit obtained from one spraying was 97.52. Incidentally we would call attention to the fact that less than ½ of 1 per cent (.394 per cent) of the wormy fruit from the trees receiving but one spray were end wormy.

The six plots receiving two sprayings during this period produced from 83.45 to 99.54 per cent of sound fruit or an average of 97.65 per cent, the end wormy fruit constituting about ⅓ of 1 per cent (.308 per cent). It will be observed that the average gain in sound fruit resulting from this second application was .42 per cent and that there was a slight reduction in the percentage of end wormy.

It was unfortunate that in 1910 no plot received three applications and, as a consequence, the average percentage for this group is 99.22 of sound fruit, a yield undoubtedly relatively higher than would have been the case if two plots for 1910 could have been included. Even with this omission which, in a measure at least, is favorable to the three applications, the average percentage gain between two and three treatments is only 1.57 per cent, while the average percentage of end wormy is even smaller than in the preceding plots, namely, .185 per cent.

The three plots receiving one late application during 1910 and 1911 gave an average percentage of sound fruit of only 77.47, there being a range for individual plots from 57.35 to 93.57. This average percentage of sound fruit is approximately midway between that obtained from one spraying and the yield on the check trees. The percentage of end wormy, 12.26, is a great increase over that in the preceding plots and shows in a convincing manner where the late spray lacks efficiency.

The check trees during this period gave an average percentage of sound fruit of 68.78, the yield varying in individual plots from 28.41 to 85.06. This small yield of good fruit, it should be noted, occurred on trees producing relatively few apples. The average percentage of end wormy fruit for these plots is 20.95, a great increase in the average for the plots receiving one late spraying and very different from the data for the sprayed plots where the greater number of wormy apples have been injured by the second brood and are therefore side wormy.

A study of the wormy fruit on the check trees during the three-year period shows that nearly one-third (31.22 per cent) of the entire yield was affected and that over two-thirds (20.95 per cent) of this was end wormy. A comparison of the end wormy fruit produced on the sprayed trees shows at once that by far the greatest benefit accrues from the first spraying, since this reduced the percentage of end wormy to .394, a second bringing it down to .308, and a third to .185 per cent. The one late spray (three weeks after blossoming) reduced the end wormy, taking the check trees as a standard, by less than one-half, that is, to 12.26 per cent. The great value of the first application made within a week or ten days after the blossoms fall and preferably early in this period, is at once evident from these data.

Comparative yields. The following tabulation of comparative yields from the experimental plots will prove instructive, since those from the plots sprayed three times, sprayed late and checks have been raised pro rata to make up for a deficiency in the number of plots or a reduced number of trees in the plots and the figures thus indicate a fair comparative value. Those for the plots sprayed three times are undoubtedly somewhat higher than they should be, because there were no plots sprayed thrice in 1910, a year when the second brood of the codling moth was extremely abundant and as a consequence there was excessive injury.

Comparative summary of yields from experimental plots 1909-11

NUMBER OF SPRAYS	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT			
		Number	Per cent	Total	Total end wormy	Total side wormy	Total end and side wormy
1	98 855	96 117	97.23	2 738	389	2 459	110
2	93 766	91 564	97.65	2 202	289	1 997	84
3	104 151	91 863	99.22	807	272	596	50
1 late	66 756	51 722	77.47	15 034	8 184	8 848	1 998
Checks	98 952	68 064	68.78	30 888	20 730	17 988	7 833

It will be noted on referring to the above table, that the reduction in wormy apples is constant, whether we take the total, the total end wormy, the total side wormy or the total end and side wormy, with the increase in the number of sprayings, while the plots sprayed but once and late show a large increase in the wormy apples and the unsprayed or check plots approximately twice as many. The evidence is so plain that further comment as to the relative value of the different sprays seems unnecessary.

Conclusions. A study of these data as a whole justifies the conclusion for the Hudson valley at least that in normal years when the crop is abundant or fairly abundant, one thorough early spraying, within a week or ten days after the blossoms fall, should result in the production of 95 to 98 per cent of sound fruit. A slight gain will accrue from a second treatment about three weeks later, and an additional gain from the third treatment given the latter part of July. The benefit from the latter two sprayings is comparatively small so far as the codling moth is concerned, though ample to meet the cost of the poison and, in many instances, probably the expense of treatment. Should there be sufficient fungous disease to warrant applications for this purpose, there should be no question as to the advisability of adding poison in the later sprayings.

A small crop almost invariably means a larger percentage of wormy fruit and if the prospects are even fair for good prices, the third spraying (the latter part of July) would at least justify itself because of the additional protection from possible severe injury by the second brood. The second spraying, three weeks after the blossoms fall, might be advisable especially if the first application is not thorough for some reason or other.

Fungous affections are of comparatively little importance in the Hudson valley. Many of our fruit growers have been obtaining fair results with the single treatment, and the above data, we believe, show the reason why such is the case. Comparatively few have appreciated the importance of one thorough treatment at the proper time. With the information given above we believe that our Hudson valley fruit growers can ascertain for themselves whether more than one treatment is advisable. There is no reason why the progressive fruit grower should not watch developments and if wormy apples seem to be somewhat common in early July, protect himself against possible further injury by spraying thoroughly the latter part of that month and thus destroy many of the second brood larvae before they can enter the fruit. This second treatment would hardly be necessary more than once in three or four years, unless the light crop and high prices justified efforts to produce the largest possible quantity of sound fruit.

GIPSY MOTH

Porthetria dispar Linn.

Plates 9–12

The discovery in August last of a gipsy moth infestation at Lenox, Mass., renders most timely anything relating to this exceedingly destructive pest. A personal examination of the conditions compels us to hold that in all probability the insect was brought to Lenox with some recently set nursery stock. There was nothing in the local situation, so far as we could see, to justify the belief that the pest had been carried by automobiles. A similar infestation might easily occur west of the New York State line. This insect may be found elsewhere in the Berkshire region, or in fact in almost any place where nursery stock has been planted in recent years, provided it was grown in a locality where there was an opportunity for infestation. We hope that a careful examination of all such localities, wherever they may be, will show practical immunity from this pest. It must be recognized that this appearance of the gipsy moth in a section widely separated from the previously known infested district was to be expected and that similar infestations may develop in the future, even though there be the most careful and rigid examination of all trees and shrubs shipped out of the infested territory. There have already been, aside from the case mentioned above, several such instances. A small colony of brown-tail moth caterpillars was found in Westchester county in 1909, brought there with ornamentals grown in the vicinity of Boston, Mass. A similar condition (gipsy moth caterpillars being also present) obtained the following year in New Jersey just across the New York State line. Fortunately, exterminative measures were promptly adopted. These cases illustrate the danger of spreading both gipsy and brown-tail moths with nursery stock. It is our opinion that under present conditions we have in nursery stock a most important carrier of these insect pests to sections remote from the infested territory. A careful analysis of the situation would, in our estimation, justify the conclusion that this danger was much greater in the case of nursery stock grown upon American soil than with that shipped from Europe, since the latter is mostly imported as seedlings, while the larger shrubs and trees receive more personal attention abroad than in this country.

(Since the above was written, a small gipsy moth infestation has been found at Great Barrington, Mass., possibly carried on a freight car, since the center of the colony appears to be close to the railroad station.)

Description. There is great danger of the gipsy moth being brought into New York State and on this account we have prepared rather careful descriptions of the various stages including also certain microscopic features of service in recognizing the insect from remains of exuviae (larval or pupal) or even broken egg masses. This latter is of considerable importance in connection with shipment of nursery stock from infested regions, since even lifeless and therefore intrinsically harmless exuviae indicate the previous occurrence of the insect upon the stock in question and compel its classification as at least suspicious.

The egg masses of this insect, occurring from midsummer till the following spring, appear very much like a small section of fine sponge. They are round or oval, buff colored and each contains usually from four hundred to five hundred eggs. The eggs may be found on stones, in tin cans and in fact on almost any stationary object near at hand, not excluding plantain leaves and other vegetation. They are especially likely to be deposited on the under surface of limbs, fence rails, moldings, etc., on or in the vicinity of infested trees. The nearly globular, pale yellowish or salmon colored eggs are about one-twentieth of an inch in diameter and are well concealed in the mass by the buff colored scales from the under side of the female's abdomen. The micropyle of this egg (plate 9, figure 2) comprises about eleven slender, irregularly pyriform plates surrounded by approximately three rows of small, polygonal plates, these in turn merging into larger, thinner, irregular, hexagonal plates. This character is of great value in establishing the identity of individual eggs or a small portion of an egg cluster. It can be demonstrated best by thoroughly cleaning individual eggs by rubbing them with the fingers in alcohol, then sectioning the egg, drying the shell and mounting it in an air cell.

The egg mass of the definite marked tussock moth, H e m e r o c a m p a d e f i n i t a Pack. approaches in appearance that of the gipsy moth. The approximately oval egg mass of this insect is thinly covered with short, light buff or yellowish brown hairs and has a length of a little over half an inch. This egg mass is almost invariably deposited upon a filmy cocoon nearly one and one-quarter inches long and one-half inch in diameter and with moderately long, yellowish gray, barbed hairs entangled in the open web. The individual eggs of the definite marked tussock moth have a diameter of about one-sixteenth of an inch, are subglobular, the darker micropyle being in a marked depression and surrounded by a light yellowish brown, elevated ring, this in turn variably bordered by dark brown shading into pearly white. The micropyle of this species differs from that of the gipsy moth egg, in that there are usually but seven or eight rather stout, pyriform plates surrounded by a granular area (plate 9, figure 1).

The young gipsy moth caterpillar is slightly over one-tenth of an inch long just after it emerges from the egg. It has a black head and the brownish yellow body is well clothed with long hairs. There is a prominent hairy tubercle on either side of the segment next the head, which gives the caterpillar a peculiar, broad-headed appearance in its early stages. At this stage we find the peculiar aerostatic hairs, easily recognized by the bulb-like enlargement near the middle (plate 9, figure 6). The other hairs are distinctly barbed (plate 9, figure 5). The markings become plainer as the caterpillar increases in size.

The full-grown caterpillar is from two to two and one-half inches long and has a double row of conspicuous warts or tubercles down its back. The eight anterior, not counting the four blue ones just behind the head, blue; the twelve remaining, red. Similar tubercles occur on the side. The caterpillar of this species has large, coarse, yellowish and brown or black hairs, both minutely serrate (plate 9, figures 3, 5) and numerous finer, smaller, lighter hairs with minute reticulations on the surface. The full-grown caterpillars, like those of the well-known forest tent caterpillars, assemble in the day on the shady side of the trunks and under side of the limbs, sometimes forming clusters covering considerable areas.

The somewhat conical, dark brown pupa ranges from three-quarters to one and one-half inches long and is usually found in numbers lying among a few threads and securely attached to them by its terminal spine. The abdominal segments of the pupa are ornamented with symmetrically arranged, sparse clusters of short, yellowish hairs. Similar hairs also occur upon the thorax and at the anterior extremity of the pupa. A microscopic preparation of a portion of the empty pupal case shows the stout, barbed hairs and on the surface of the chitin irregularly placed, oval areas apparently due to a slight increase in pigmentation or chitinization (plate 9, figure 7).

The male and female moths differ widely. The former is a slender, oval, brown, black marked insect with feathery antennae and a wing spread of about one and one-half inches. It flies in the late afternoon and early evening. The female is much heavier and lighter colored. She has a wing spread of about two inches, is white or buff white and with more or less distinct, black markings, the abdomen being tipped with black.

Distribution in America. The gipsy moth is now well established in five of the New England states. Aside from the large colony found two years ago at Wallingford, Conn., and two small ones in the Berkshires, it is not known to occur west of the Connecticut river. Both Connecticut and Massachusetts have undertaken to exterminate these outlying colonies, and it is to be hoped that the gipsy moth may be kept for a long series of years east of the Connecticut river. This stream forms a natural barrier, the absence of thick forests and the large, open valley rendering it comparatively easy to check the progress of this enemy.

Condition of infested territory. There is no better way of comprehending what infestation by the gipsy moth or the brown-tail moth means than by a study of the conditions in the infested territory. It was our pleasure, in company with parties in charge of Government, State and private work against both the gipsy and brown-tail moth, to study the problem over a wide section of country. We have also seen representative infested areas almost annually for over twenty years and, as a consequence, can make personal comparisons between the present and earlier status. Generally speaking, there has been much progress in controlling the insects in the immediate vicinity of Boston, in the towns and cities where the pests have been established for a number of years. The residential areas as a whole are in excellent condition and, to the casual observer, appear free from any very destructive insect pest. This relatively desirable change has been brought about only by enormous expenditures. It has been recently estimated that the cost of control work in Massachusetts and portions of other New England states amounts to upwards of a million dollars a year. This makes no allowance for the actual damage inflicted. Such extended and thorough work means heavy appropriations, practical only in the more valuable residential or business territory and utterly beyond the resources of poorer cities and towns having extended tracts of low-priced lands. The discrimination of an entomologist is not needed to note the widespread and in some instances extremely severe devastations by both the gipsy and the brown-tail moth (plates 10, 11, 12 and 13). The Federal Government has in recent years been spraying strips two hundred feet wide on each side of the more important highways for the purpose of preventing spread by vehicles and incidentally this serves in a considerable measure to obscure the extent of the injury. Last summer there were hundreds and in some instances thousands of acres of woodland defoliated, although the strips along the highways were in excellent leaf, due to the thorough spraying with poison. These large areas of stripped forest or orchard lands show what would be the result were there a relaxation of control measures in the well-protected territory. In other words, relative immunity is extremely costly.

The conditions would be much worse than obtain at present, in spite of the enormous expenditure, were it not for important advances in methods during the last few years. The development of very efficient high-powered spraying outfits has materially reduced the cost of spraying and made it possible to protect woodlands, in large measure, for about $7 an acre. It has been found that pure or unmixed plantings of pine, if protected from invading hosts of caterpillars, are immune from injury (plate 12). Ash is not troubled by the gipsy moth, while the work of the last two years has shown that maple, hickory and locust are rarely damaged. Chestnut also appears to suffer but little if the young caterpillars have nothing else to feed upon. Apple, oak, birch and willow are favorites of both gipsy and brown-tail moth caterpillars and under favorable conditions may be the indirect cause of serious injury to adjacent, relatively immune trees.

There is also the possibility that the numerous parasites imported during the last few years may shortly prove efficient aids in checking these pests. It should be understood that conditions in the infested district are serious, especially in sections where low values prohibit expensive control measures.

Means of preventing spread. The prevention or hindrance of the spread of such an insect as the gipsy moth is most important and in large measure practical. The female does not fly and as a consequence the pest depends largely for dissemination upon the eggs or caterpillars being carried. The former may be readily distributed, since they are deposited upon a variety of materials, such as tree trunks, stones, bricks, boxes, crates, tin cans, and in fact almost any hard object near an infested tree or plant. Even railroad cars standing near infested trees have been burdened with eggs. Fortunately, there is a considerable chance that packing boxes, building materials, etc. will, if transported and infested, not be in the immediate vicinity of a desirable food plant at the time the eggs hatch. This one factor probably accounts for so few isolated colonies being found. Railroad cars, both passenger and freight, rarely stand for any length of time near trees which may be infested or at the time of egg-hatching adjacent to desirable food plants. Consequently there is not the serious danger of spread with freight and passenger trains running in and out of the infested territory, as would seem at the first thought. On the other hand, young trees or plants bearing eggs carry with them in most instances desirable food or are very likely to be set in the near vicinity of plants upon which the caterpillars can thrive. This is the reason why infested nursery stock must be regarded as a most important factor in carrying the gipsy moth to sections remote from the infested territory.

The crawling powers of the caterpillar are limited. Recent experiments have shown that the young caterpillars may be blown considerable distances by winds, and other evidence leads to the belief that under certain conditions they may even be carried by birds, especially by some of the larger species. There was undoubtedly a considerable local spread in the early days by caterpillars which were carried on vehicles traveling out of the infested region. Almost any moving object would serve this purpose. Automobiles are particularly effective and could easily pick up hundreds if not thousands of caterpillars in a short run through infested woods at the proper season of the year. This condition prompted and justified the large expenditures by the Federal Government for the purpose of freeing roadside trees from the pests and thus preventing a wide and rapid dissemination. The adoption of this policy has greatly reduced the danger of vehicles spreading the caterpillars, though the possibility of this still occurring, were there to be a change in conditions, should not be overlooked.

GREEN MAPLE WORM

Xylina antennata Walk.

Plates 14-16

The work of this insect was very prevalent here and there in the Hudson valley from Kingston north to Fort Edward and in the Mohawk valley to Fonda and its vicinity. This species, though comparatively unknown till recent years as an insect pest, was reported as defoliating many of the soft maples at Kingston. Green maple worms were responsible for stripping trees at Red Hook according to Mr R. N. Lewis. Many such maples and adjacent willows along the river from Glenmont to Kenwood were defoliated by the light green caterpillars of this insect. Similar work was very evident from Albany north to Troy. Defoliation of soft maples was reported from the vicinity of Hoosick Falls and it was stated that all the soft maples on the island near Fort Edward were similarly affected. Many soft maples in Schenectady and adjacent Scotia were attacked, the caterpillars appearing about May 20th. June 1st it was stated that there were about three inches of half-eaten leaves lying along the gutters in Mohawk avenue. There was also serious injury at Amsterdam in front of St Mary's Hospital on Guy Park avenue (plate 15) and in that vicinity. There were in this immediate region some fifty trees almost entirely defoliated with many more to the east showing signs of having been rather badly infested. June 9th caterpillars were not very abundant, though the statement was made that they had been excessively numerous prior to a three days' rain on the 5th to 7th, inclusive. The work of this insect in the vicinity of Albany and at Amsterdam is shown in plates 14-16.

Previous history. A similar outbreak on the soft maples at Schenectady occurred in June 1898, at which time many caterpillars were to be seen upon the affected trees and crawling upon the sidewalks and adjacent roads. There was also injury that year in a number of other localities. Outbreaks by this insect caused several complaints last year. There are comparatively few early records of damage by this species, though the caterpillars are frequently seen in orchards sometimes in numbers, and in 1896 on account of their prevalence under such conditions were denominated green fruit worms by the late Professor

Slingerland. The injury to fruit trees, however, appears to be slight compared to the damage to ash and maple trees.

Description. The moth (plate 17, figure 1) is ashy gray with indistinct, rather variable markings. There is such a close resemblance existing between this species and X. laticinerea Grote and X. grotei that only an expert in the group can reliably separate the three forms.

The caterpillars (plate 17, figure 2) are stout, smooth, light green, measuring from one to one and one-half inches in length when full grown and resembling in a general way, aside from color, some of our common cutworms. The head is pale yellowish green; there is a rather broad, yellowish white or white dorsal stripe along the body, a narrower, white subdorsal stripe, a broken, faint lateral stripe of the same color and an irregular, white stigmatal stripe, the upper margin of the last much broken or indentated by the body color. The tubercles are rather large and white and the skin is minutely spotted with the same color.

Life history. The caterpillars are not usually observed till the latter part of May or early June. They complete their growth some time in June (the past season it was early in June), enter the ground and transform to brown pupae an inch or more below the surface. They remain in this stage till September when most of the moths emerge. Though some hibernate as pupae, the majority winter as adults. It has been stated that in the South the eggs are deposited on the under surface of the leaves. No record of the oviposition in the North has been made.

Food habits. This insect evidently displays a marked preference for soft maple, though it frequently defoliates adjacent willow and maple. It is also well known as an apple tree insect. Doctor Riley has recorded injuries by this species on peach, oak galls, hickory leaves and those of other forest trees. It has been stated that it feeds also on rose buds. The late Professor Slingerland, in his bulletin, adds to the above, peas, plums, currants and quinces, and states that one grower found it necessary to watch the buds on grafted pears in order to prevent their being destroyed.

Natural enemies. Two Hymenopterous parasites, Mesochorus agilis Cress. and Meteorus hyphantriae Riley, and a Dipterous parasite, the red-tailed Tachina fly, Winthemia quadripustulata Fabr. have been reared from this caterpillar. The last-named species is one of the most effective enemies of the army worm, Heliophila unipuncta Haw.

Last season numerous birds, sparrows and robins in particular were observed at Amsterdam here and there upon the ground searching out and devouring the pests. One greedy robin was seen with three green fruit worms in his mouth. The birds were much more numerous among and under the infested trees than in other portions of the city. Only a relatively slight increase in their number would probably have checked the pest before the trees were defoliated. Dr W. G. VanName, zoologist of the State Museum, visited Amsterdam June 10th and made the following observations:

The green maple worms were then already much reduced in numbers, and it was evident that if the rate at which they were being destroyed by birds should continue, few would be able to transform to the pupal stage. Nine species of birds were actually seen eating or carrying away caterpillars, and nine others were apparently associated in this work. Considering the number of individuals, size and habits of each of the species seen eating worms, the following were apparently most destructive and in about the order named: English sparrow, robin, crow blackbird, Baltimore oriole, cow bird, cat bird, chipping sparrow.

The English sparrow takes first place solely on account of its superior numbers; the robin, cat bird, crow blackbird and oriole are individually more efficient. The cedar waxwing and yellow warbler were also seen carrying off caterpillars.

The following species, seen about or under the infested trees, were doubtless there for the purpose of feeding upon the pests: blue bird, rose-breasted grosbeak, red-eyed vireo, warbling vireo, bobolink, redstart, song sparrow. The king bird and phoebe were also seen, and though they feed chiefly on flying insects, appear to take some of the caterpillars, though this could not be established with certainty.

The majority of the above-named birds had nests within two or three hundred yards of the infested trees and could be seen carrying off the caterpillars (the robins and blackbirds often with two or three at a time) to feed their young. The caterpillars were evidently a great attraction to the birds, since there were at least two or three times as many birds as in apparently equally favorable though uninfested localities.

The following record, made between 9.30 and 10 a.m., will give an idea of the rate at which the birds were destroying the caterpillars, the numerals indicating the number actually seen eaten or carried off during the above-mentioned period, a time when the birds were less active than earlier in the morning: English sparrows 25, robins 13, cow birds 3, cedar waxwings 2, Baltimore orioles 2, crow blackbirds 1, chipping sparrows 2; total 48.

Control or remedial measures. A scrutiny of the history and habits of this insect justifies the belief that under normal conditions, parasites and birds should keep this pest under control. The recent severe, widely separated, though local outbreaks must be construed as another evidence of a deficiency in the number of insectivorous birds. These caterpillars are smooth and therefore form a most acceptable diet to many of our native species. More adequate protection to our birds must be classed as one of the most effective methods of keeping this insect in check.

Local outbreaks on the more valuable shade trees of cities and villages can be easily checked by thorough spraying with an arsenical poison, preferably arsenate of lead, using at least two pounds (15 per cent arsenic oxid) to fifty gallons of water and making the application as soon as there is evidence that a number of caterpillars are at work. Unfortunately, many such outbreaks are not detected till almost too late for the successful use of a poison. In such instances many of the descending caterpillars can be killed by inclosing the trunks of the infested trees with a low, overhanging barricade and then treating the collected larvae with hot water, kerosene or other contact insecticides. Small trees can be protected in large measure by jarring the caterpillars from them, and if sticky bands (tree tanglefoot is most efficient) are placed around the trunk and properly guarded, none can ascend to continue the destructive work.

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IRIS BORER

Macronoctua onusta Grote

Specimens of this boring caterpillar were received July 25, 1911 from Mr Waldo L. Rich of Saratoga Springs, N. Y., accompanied by the statement that about half of the Iris tubers in a bed were partly eaten by a grub. Mr J. W. Huyck also transmitted specimens from Saratoga about the same time and stated that these borers had practically destroyed a bed of Iris roots. He found over one hundred of the caterpillars in a bed about 6 x 8 feet long.

This species appears to have largely escaped the observation of economic entomologists. It was first reared from Iris by Doctor Thaxter. Henry Bird records in 1902, injury by this larva to Iris roots, and in a recent letter states that this insect is at times obnoxious in parks and on estates where large beds of Iris are used for landscape effect. The late Dr James Fletcher mentions several instances of injury in Canada in a report for the same year, while the following season Arthur Gibson gives a somewhat detailed note respecting the operations of this borer. Dr J. B. Smith also records injury by this insect.

Description. The parent moth (plate 17, figure 3) has a wing spread of about one and seven-eighths inches and is a typical Noctuid in form and color. The forewings are a variable dark purplish brown with a more or less distinct, broadly crenulate and dentate (the latter near the middle) subterminal line. The discal spot is very irregular, being narrowly lanceolate, with an indistinct, rounded, lobelike projection anteriorly. Near the basal third and a little behind the anterior margin there is an irregularly subtriangular area bounded by a narrow line of dark scales. Posterior of this there is a faintly outlined, oval area resting upon a somewhat more distinct, curved line of dark scales, and near the posterior margin a somewhat indistinct, V-shaped mark of similar scales. The anterior third of the wing back to the middle, and the distal fifth especially on the posterior two-thirds, is markedly darker, the margin with a distinct crenulation of darker scales. Hind wings mostly a yellowish brown with purplish brown near the tip. The thorax is thickly covered with purplish brown scales, the abdomen with light brown scales.

The pupa has a length of about one and one-half inches and a diameter of nearly one-quarter inch. It is chestnut brown, shiny. The anterior margin of the abdominal segments are coarsely and sparsely punctate, the posterior margins thickly and finely punctured. The cremaster is almost black, with two stiff, capitate spines apically and three others on each side.

The full-grown larva is about two inches long, white, the head brown and with rows of black spots laterally.

Life history and habits. The moth is secretive in habit and appears to be quite local in its operations, since Messrs Fletcher and Gibson record the work of this species in the same locality for three seasons in succession. The adults appear in the fall, September and October, and according to Mr Bird live but a short time. He is of the opinion that the eggs are laid scatteringly about the base of the Iris stalks, relying largely on the fact that winter burnings almost surely result in the local extermination of this species. He believes that the eggs hatch about the last week in May. The larvae first attack the stems some inches above the ground and gradually work downward, the full-grown caterpillars operating in the roots. Mr Bird states that the larval stages occupy a nine or ten day interval so far as he has followed them, and that there are probably six molts.

This borer has been recorded as attacking different species of Iris (all species seem to be acceptable according to Mr Bird), including the blue flag, the roots of German lily and also of the blackberry lily, Belamcanda chinensis. Under ordinary conditions this species appears to be held in check by parasites.

Control measures. Affected stems should be cut out and burned, thus destroying the caterpillars at the inception of the attack. It is probable that thorough spraying with an arsenate of lead applied about the time the insect begins operations, namely, the latter part of May, would be very effective in destroying this pest. Winter burning of the debris on Iris beds, if this can be done without injury to the roots, promises to be the simplest and most effective method of keeping this pest in check.

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NOTCH WING

Ennomos magnarius Guen.

The peculiar, linear series of polished, greenish brown or bronze colored eggs of this species on apple and pear have been received from time to time during recent years and mostly from Hudson river localities. There have been no records of serious injuries by the caterpillars, though this is a common form and a somewhat general feeder. It is widely distributed, having been recorded from northern Maine west to the Northwest Territory. It appears to be closely related to the European E. a u t u m n a r i a Wernb.

Description. The individual eggs are polished, greenish brown or bronze colored, have a length of 1.25 mm, a diameter of .7 mm, subrhomboidal in shape and are deposited transversely upon the flat surface of bark side by side in linear rows. An exceptionally fine series has a length of four and one-half inches (plate 8, figure 2).

The newly hatched caterpillar is a yellowish, dark green looper with a length about 2.25 mm. The large, orange yellow head has a diameter nearly twice that of the body, the labrum and antennae being whitish. The cervical shield is moderately large, yellowish, with a deep, median, subquadrate impression, the latter fuscous greenish. The dorsum of the remaining thoracic and body segments is mostly dark olive green with a rather conspicuous lateral margin of bright yellow, the latter extending and somewhat indeterminate on the anal segments. True legs yellowish orange, venter yellowish green, the prolegs mostly yellowish or yellowish green.

According to Beutenmueller the second stage is a pale green, smooth, somewhat shining and without any visible markings. The third stage is characterized by yellow incisures. In the fourth stage the head and the body beneath are quite flattened, the lateral edge being ridged below the spiracles.

"The full-grown larva is a dull dirty green mottled with greenish ocherous. The head is comparatively small, and the first segment is about equal the width, the remaining segments gradually increasing in size. The thoracic feet have the bases considerably swollen and ringed with ocherous. The pair of abdominal and anal legs are chocolate brown. Over the body are scattered irregularly small, elevated, pale yellowish spots, especially on the last three segments, which are conspicuously mottled. The cervical shield is dirty chocolate brown; on the second to tenth segments inclusive, are four minute black tuberculate spots; the fourth and fifth segments have an additional pair of spots. The transverse ridge on the fifth is very prominent, as is also the one on the underside of the sixth segment and the one on the eighth segment, and the two black tuberculate spots on the dorsum of the eleventh segment. Underside of body same as above, except the last three segments pale whitish-green. Anal plates tinged with lilac. Length 110 mm." (Beutenmueller)

The pinkish white pupa is covered with a mealy substance, the extremities of the segments roughened, the interspaces being semitransparent and yellowish. The change to the pupa occurs in an oval, elongated, whitish cocoon open at each end.

The parent moth (plate 8, figure 1) is a delicate ocher yellowish insect variably marked with purplish and reddish brown, especially at the extremities of the wings, the anterior pair with a conspicuous, almost hooked lobe near the middle. The male, with its pectinate antenna, has a wing spread of about one and five-eighth inches, while the larger, stouter bodied female has slender antennae and a wing spread of about two and one-eighth inches.

Life history. Oviposition occurs in September and October, individual females depositing from five hundred to six hundred eggs. These latter hatch the following May or June, the larvae attaining full growth from the latter part of July till the end of September. The pupal stage lasts from eighteen to twenty days, adults flying from early August until the last of October. There are specimens in the Lintner collection taken at Keene Valley, N. Y., August 7, 1894.

Food habits. This caterpillar appears to be a general feeder, it having been recorded by Beutenmueller on elm, maple, sweet gum, etc. It is rather common on black birch, feeds upon poplar and, as stated above, the eggs may frequently be observed upon apple and pear. It has also been recorded on lilac and chestnut.

Remedial measures. Should the caterpillars of this species become abundant they could probably be easily controlled, as in the case of other leaf feeders, by timely spraying with a poison, preferably arsenate of lead.

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MAPLE LEAF CUTTER

Paraclemensia acerifoliella Fitch

Plate 18

This peculiar insect was excessively abundant on the estate of Dr Wilby Meyer, North West Bay, Lake George, in the town of Bolton or North Bolton. The infestation though local was severe and included perhaps twenty-five acres. Some trees had their foliage very badly injured, there being in each leaf a number of oval holes and much of the tissue between dead, because of skeletonizing by the larva. The work is rather characteristic, since the caterpillar reaches out from its oval case, eating all that is within reach and then migrates to another spot. Infested leaves (plate 18) may therefore show one or more oval holes with circular skeletonizing here and there, the centers of some of the areas at least being occupied by an oval case, with a diameter of about five-eighths of an inch. The work is usually on the upper surface though the caterpillars occur also upon the lower side of the foliage. Viewed from below, an infested leaf is generally indicated by one or more dark spots surrounded by irregular, lighter, skeletonized, brownish areas. The injury was especially marked on the lower limbs of large trees and on small trees in the woods the feeding was confined mostly to the hard maple, adjacent soft maple practically escaping injury. A few of the larval cases accompanied by feeding were collected on oak and witch-hazel undergrowth. This latter appeared to be largely accidental. The ground was in many places thickly dotted with the circular larval cases. The late James Fletcher has also recorded rather severe injury to beech trees after the foliage on adjacent maples had been destroyed. At the time of our examination September 22d, some larvae were still feeding, though most of them had evidently forsaken the trees or were nearly ready to drop to the ground.

Previous history. Early records show this insect to be rather local in habit. The first notice of this species by Doctor Fitch states that injury was rather common during 1850 in the eastern section of New York State. The withered leaves began to be noticed in early August and continued to increase in numbers for three or four weeks. He observed that forest trees were mostly affected, those standing alone as shade trees in fields being practically exempt. This latter hardly obtained at Lake George last summer, since several badly affected trees were well separated from the adjacent woodland. The late Doctor Lintner recorded in 1888 serious injury by this insect to maples at Pittsford, Vt., nearly all the trees having the foliage brown and looking as though they had been scorched by fire. The work of this species has also been recorded from the state of Illinois, while the late Dr James Fletcher reported severe injuries to hard maples in the vicinity of Ottawa, Canada. This species appears to have a wide distribution in the northern part of the United States and southern Canada, it having been reported from New York, New Jersey, Illinois, the vicinity of Ottawa and also Kaslo, British Columbia.

Description. The small moth has been described by Doctor Dietz as follows:

Head russet-yellow. Palpi fuscous. Antennae blackish brown, pecten of first joint russet. Thorax dark brown, with golden green and bluish scales. Abdomen bronzed brown. Forewings dark fuscous, overlaid with deep, bluish purple scales; scattered over the disk and along the apical veins are some bright green, hairlike scales; both margins narrowly edged with golden. Cilia fuscous, sprinkled with bluish scales; under side fuscous brown, with purple reflection. Hind wings pale grayish fuscous, with a feeble, purple lustre, margin narrowly edged with pale metallic scales. Cilia pale fuscous; under side similar to upper. Under side of body dark fuscous, with some silver-white scales. Legs grayish, tinged with dark fuscous, basal half of tarsal joints paler.

Exp. 11.5–13.5 mm; 0.36–0.54 inch.

Doctor Fitch states that the tips of the wings are commonly bent inward, giving them when closed the appearance of a little pod enveloping the abdomen.

The pupa is about five-thirty-seconds of an inch long, pale yellowish, rather stout, the dorsum of the abdominal segments with a transverse row basally of rather stout, dark brown spines; cremaster represented by an indistinct short spine.

The full-grown caterpillar is slender, flattened, cylindric, dull white, the strongly depressed head and the third thoracic segments pale rusty brown. There is an interrupted, more or less distinct, broad, blackish stripe down the back.

The case (plate 17, figure 5) of the full-grown caterpillar is oval, about three-eighths of an inch long and composed of two pieces of a leaf fastened together at the edges and forming a shelter. Within this there is another pair of narrowly oval pieces of leaf, each with a length nearly a quarter of an inch. These are fastened together in the same way, and within this inner retreat the transformation to the pupa occurs.

Life history. Pupation occurs in the fall, and the winter is passed in the larval cases described above. These shelters usually lie upon the ground in immense numbers or fall with the affected leaves. The adults emerge and may be frequently seen, according to Doctor Fitch, during the month of May, flying by day or resting exposed upon the leaves in forests and along their borders.

Remedial measures. This species is evidently local in habit and there appears to be no reason why many of the hibernating insects could not be destroyed by burning over the ground in early fall, provided conditions admit of such treatment. It is very probable that thorough spraying, especially on the upper surface of the leaf, with arsenate of lead about the middle of June, would check this pest in a very satisfactory manner.

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LOCUST LEAF MINER

Chalepus dorsalis Thunb.

The locust leaf miner, a rather common insect on Long Island, was responsible, in large measure, for somewhat serious injury to the foliage of black locust trees at Syosset and Jericho, L. I. Mr Walter S. Funnell, editor of the Long Island department of the Brooklyn Daily Times, stated under date of August 10th that the leaves of locust trees at Syosset and Jericho were growing brown day by day, the leaves being apparently reduced to mere skeletons. Mr F. A. Bartlett of the Frost & Bartlett

Company, Stamford, Conn., reported the above species with the associated C. nervosa Panz. as doing a great amount of injury to locust trees on Long Island, many being as brown as though fire had run through them. He stated that the smaller, C. nervosa, appeared to be the more abundant of the two forms.

A personal examination of the locality September 19th showed that most of the injury was confined to trees less than thirty feet high, or to large ones in the near vicinity of this new growth. The damage was so pronounced that affected areas showed a distinct brown color, even at a considerable distance, though this had been obscured to some extent by the development of new leaves subsequent to the attack. The major portion of the injury appeared to result from skeletonizing the leaves by the beetles, the small trees noted above showing comparatively few evidences of having been mined by the grubs. A very few leaf miners, evidently belated individuals, were found.

This insect commonly occurs on large trees here and there throughout Long Island, though as a rule there is not material injury. The above described outbreak is undoubtedly irregularly periodic in character and appeared to be limited very closely to Syosset and adjacent Jericho. The trees, while checked, do not appear permanently injured and it is probable that there will be speedy recuperation.

Early history. The late Doctor Lintner, in his report for 1896, records similar injury to locust trees at Yaphank, L. I., the leaves appearing much as does elm foliage after extensive feeding by the elm leaf beetle. Doctor Chittenden states that this species is nearly always more or less troublesome to locusts in Maryland, Virginia and the District of Columbia, adding that the injury is usually most severe on young trees. Doctor Hopkins states that about 1892 thousands of locust trees died in West Virginia after the foliage had been destroyed three years in succession by this insect. The direct cause of the death of these trees, however, may have been due to abnormally cold weather. Serious damage during the seasons of 1904 and 1905 to locust trees along the Ohio river was recorded by Mr E. C. Cotton, the defoliation being general for a distance of over fifty miles, according to Mr Burgess. This insect is local in habit and appears to be decidedly more injurious in the latitude of Virginia. The late Professor W. G. Johnson reports this species as defoliating apple trees near woods, presumably locust trees.

Description. The adult beetle is about one-fourth of an inch long with the head, appendages, under surface and a median triangular area, widening posteriorly, on the wing covers coal black. The remainder of the wings and the dorsum of the thorax are orange red. The thorax is irregularly and deeply punctured and the wing covers strongly ridged and ornamented with deep, nearly flattened, thickly set rows of punctures.

The full-grown larva is a trifle over one-fourth of an inch long, with the head, thoracic shield, true legs and anal shield coal black, the remainder of the body being yellowish white; the segmentation is very distinctly marked and the abdominal segments bear conspicuous lateral tubercles, those on the second to seventh being tipped with black and with a black, chitinous point. The brown spiracles are circular.

The egg is short, oval in outline and flattened, the two sides being milk white when first laid.

The mine of this insect is equally visible on both sides of the leaf, pale green, slightly tinged with brown, its surface being slightly roughened and the margin irregularly undulated.

Distribution. This leaf beetle appears to be confined largely to the upper austral life zone. It is common throughout Long Island and probably occurs in the southern portion of the Hudson valley, at least. It has been recorded from Massachusetts, Connecticut, Pennsylvania, throughout New Jersey, Maryland, Washington, Virginia, West Virginia, southern Ohio, Kentucky, and generally distributed in Indiana and Missouri.

Food plants. The beetle feeds by preference on the leaves of the black locust. It has also been recorded as attacking the young leaves of red oak, has been found on white oak, beech, birch, hawthorn, apple, red clover, hog peanut and soja beans. The larvae have been observed in the leaves of false indigo (Amorpha fruticosa). It also occurs on several other food plants.

Life history. The beetles evidently winter in any sheltered place, and in the vicinity of Washington, at least, make their appearance as soon as the leaves of the locust trees have fully developed. At this time they eat small, oblong holes in the leaves, and later in the season skeletonize the upper surface. The eggs are laid on the under side of the leaves and are partly covered with an excrementaceous secretion. They hatch in about six to eight days, the young larvae breaking through the egg shell on the under side of the egg mass and gnawing at once through the epidermis of the leaf. The three to five larvae in an egg mass enter through the same orifice, excavate the interior of the leaf for from two to four days, desert the mine and wander to other leaves, often to a considerable distance, where each larva excavates a retreat of its own. The number of larval migrations under natural conditions has not been ascertained. Larval existence is never less than two weeks and probably averages about three weeks. Transformation to the pupa occurs within the mine, the duration of this stage being from six and one-half to ten days. There appears to be but one generation in the northern states, while in the latitude of Washington there may be two generations. The above outline of the life history is an abstract from a more detailed account by Chittenden.

Natural enemies. This insect is subject to attack in its southern range at least, by the wheel bug, Prionidus or Arilus cristatus Linn. This large, predaceous bug preys upon the larvae while still within the mine. Trichogramma odontotae How. is recorded as a common egg parasite, while Derostenus primus How. has also been reared from the eggs and is probably a secondary parasite. Two parasites of the larvae have been recorded, namely, Sympiezus urolatae How. and Spilochalcis odontatae How.

Control measures. These must obviously be restricted to the more valuable shade trees on lawns and roadsides and, as a rule, are unnecessary in New York State. Thorough and timely spraying with an arsenate of lead, using about two pounds (15 per cent arsenic oxid) to fifty gallons of water ought to be effective in protecting the foliage. The application should be made at about the time the leaves are full grown and in New York State the advisability of the treatment must be determined largely by the abundance of the insects. Numerous beetles and slight injury to many leaces in June are liable to result in severe damage during July and early August, unless repressive measures are adopted.

Jarring the beetles into inverted umbrellas or other mechanical collectors has been suggested for a few trees in yards or lawns. This would be especially applicable to the small trees which, by the way, are the most liable to injury. This treatment would have to be repeated every few days so long as the insects continued abundant.

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ROSY HISPA

Chalepus nervosa Panz.

This small and variable leaf-feeding beetle was found associated with C. dorsalis Thunb. in an outbreak which resulted in the defoliation of many locust trees at Syosset and Jericho. Mr F. A. Bartlett of the Frost & Bartlett Company, Stamford, Conn., reported this species as more abundant than the larger and better known locust miner. For a fuller account of the conditions, the reader is referred to a discussion of the preceding species.

Previous history. This small leaf beetle is quite variable in appearance and has been described under several different names, notably, inaequalis Web. and rosea Web. It has been recorded by Chambers as mining the leaves of linden and Eupatorium ageratoides, while Messrs Hopkins and Cotton found it feeding commonly on locust in association with the locust leaf miner. Arthur Gibson states that it is common in Canada on basswood, though it has never caused noticeable injury. William Beutenmueller reared this species from the foliage of asters and Eupatorium. Harris states that these insects may be found on the leaves of apple trees and very abundantly on those of the shadbush and chokecherry during the latter part of May and early in June. Harrington found the beetles upon oaks, hawthorns and elms, and adds that the larvae mine the leaves of various trees, including apple. Theodore Pergande reared this species from *Cassia nictitans*, while Messrs Hubbard and Schwarz found a pale variety or race very abundant on the leaves of *Robinia neomexicana* in the Santa Rita mountains of southern Arizona.

Life history. The life history of this species has been outlined by Saunders as follows:

> The eggs are small, rough, blackish and fastened to the surface of the leaf either singly or in clusters of four or five.
>
> The larvae, when hatched, eat their way into the interior of the leaf, where they feed upon its green, pulpy substance, leaving the skin above and below entire, which soon turns brown and dry, forming a blisterlike spot. The larva, when full grown, which is usually during the month of July, is about one-fifth of an inch long, oblong in form, rather broader before than behind, flattened, soft, and of a yellowish-white color, with the head and neck blackish and of a horny consistence. Each of the three anterior segments has a pair of legs; the other segments are provided with small fleshy warts at the sides, and transverse rows of little rasplike points above and beneath.
>
> The larva changes to a pupa within the leaf, from which, in about a week, the perfect insect escapes. Within these blisterlike spots the larva, pupa, or freshly-transformed beetle may often be found.

The beetles hibernate among dead leaves and other debris.

Description. This species, according to Wickham, may be separated from allied forms by the elytral punctures being arranged in eight rows and the acute costa. He states that the color is variable, usually with the head dark, the thorax and elytra pale with dark, irregular spots.

The beetle is about one-fifth of an inch long, tawny reddish above, with irregular, darker spots and lines upon the strongly ridged, deeply punctured wing covers. The legs are yellow. These characters serve to separate it readily from the larger *C. dorsalis* with which it is frequently associated.

Distribution. Horn states that this beetle occurs everywhere in the eastern regions and also in Arizona. Lugger reports this beetle as common in Minnesota, it being frequently found among dead leaves and rubbish in the vicinity of forests.

Remedial measures. It is hardly likely that this species would be sufficiently numerous to make treatment advisable.

An exceptional outbreak could undoubtedly be controlled by thorough spraying with a poison as described for the preceding form. This would of necessity be restricted largely to more valuable street and park trees.

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ROSE LEAF HOPPER

Typhlocyba rosae Linn.

This common pest of roses, frequently though inaccurately designated as thrips, is an European form which has obtained a wide distribution in this country. Signs of its presence are readily seen in the series of somewhat characteristic white spots along the midvein and in the vicinity of the other veins. These are, in the ordinary course of affairs, frequently followed by severe injury and many of the whitish or yellowish white, jumping adults. Badly infested foliage frequently has the under surface thickly specked with the white membranous cast skins of the young. This leaf hopper was exceedingly abundant and somewhat injurious to the foliage of young apple trees at Ghent, N. Y., in October 1909. This unusual attack was not unprecedented, since the late Dr C. V. Riley had earlier recorded this species as abundant on apple foliage. It has also been taken upon the leaves of plum, cultivated cherry, currant, grape, elm and soft maple.

Dr T. W. Harris, the first American to write of this species, thought that the insect might winter in the perfect stage concealed under fallen leaves and rubbish. This supposition has been repeated from time to time with no additional information respecting the life history of this species. Last winter and early in the spring the eggs of this species were found just under the bark of the new growth of rose bushes and the young issuing therefrom reared to maturity.

Description. The full-grown or perfect leaf hopper is about one-eighth of an inch long, yellowish white, the wings usually being whitish and semitransparent. The eyes, claws and ovipositor are brown.

The young present a general resemblance to the adult. They are distinctly smaller, especially when newly hatched, with only rudimentary wing pads and a very light green. They frequently harmonize so closely with the color of the under side of the leaf that it is difficult to recognize them.

The egg is semitransparent and has a length of .7 mm and a diameter of .2 mm. It is narrowly oval, the anterior extremity being broadly rounded, while near the posterior third there is a slight curve, the posterior extremity being narrowly rounded.

The eggs are deposited singly just under the new bark. Their location is indicated by an almost imperceptible, oval elevation in the bark about 1 mm long and presenting a slight greenish or yellowish discoloration occasionally accompanied by increased transparency due to the egg beneath. There is at one end of the elevation a very slight scar made at the time the egg was deposited. This wound is quite different from the elongate lenticels seen upon the wood. It is comparatively easy to expose the eggs by simply rupturing the bark on either side with a needle and raising it. Prof. R. L. Webster of Ames, Iowa, has found the eggs of this species in the bark of elm two or three years old. He also found nymphs on maple trees though no signs of oviposition.

Life history. It is evident from the above that the eggs winter in the bark of various trees and shrubs, especially rose and probably apple. April 17, 1911 material taken at Nassau, N. Y., contained a semitransparent, yellowish embryo with a length about one-third that of the egg and showing an indistinct segmentation. May 14th nymphs were numerous on the lower leaves especially, their presence being indicated by the rather characteristic white spots along the veins. The abundant growth above the affected leaves obscures, in large measure, the early signs of this insect. The injury becomes more marked as the season advances. May 25th the nymphs were about three-quarters grown, the first adults being observed June 3d. Pairing and the deposition of eggs is stated to occur about the middle of June. Owing to the fact that the insects were not numerous later in the summer we did not follow the life history of the species further. The abundant occurrence of this leaf hopper upon apple leaves in October shows that there must be more than one generation, possibly three under favorable conditions.

Remedial measures. The hibernation of the insect in the egg stage and the consequent somewhat uniform hatching of the eggs makes it comparatively easy to watch for the early indications of injury, namely, the series of characteristic white spots along the midvein and in the vicinity of other veins, and then spray with a contact insecticide, either a whale oil soap solution or a kerosene emulsion. This application if thorough and made to the under side of the leaves should destroy practically all of the delicate, comparatively slow-moving nymphs and prevent further injury during the season unless there be an invasion from nearby plants. This early treatment will be much more effective than anything that can be employed after the insects have become adult and able to jump and fly readily.

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PERIODICAL CICADA

Tibicen septendecim Linn.

Plates 19–24

The large size of the insects, their immense numbers, the accompanying roar, the spectacular injury and unique life history, all combine to excite popular interest in the periodical visitations of this remarkable species. The season of 1911 was marked by the appearance of the large Hudson river brood, the only one occupying any great extent of this populous watershed. A Cicada colony, especially if the insects occur by the millions, abounds in interest. The early part of the visitation is marked by the numerous dirty yellow, grublike pupae leaving their burrows by the thousands in late afternoon or early evening, climbing adjacent vegetation and rapidly transforming to the beautiful yellowish white, black spotted, red-eyed insects which at this time cling to foliage and stems and appear not unlike blossoms, and by the following morning have assumed the more sombre colors of the hardened adult. Later the empty pupal shells may be seen clinging to trunks, branches and leaves, while the black, red-winged adults rest upon the foliage or sit motionless on trunk or branch. Hundreds may be driven to flight by shaking small trees. Cicada notes may herald the rising of the sun and if the day remains clear, the sound gains volume with the increase in temperature and, in the case of numerous colonies, resembles the distant hum of a busy factory. The serenade may be continued long after dark on moonlight evenings.

Life history. This insect presents an extraordinary life cycle, requiring in the northern states seventeen years to complete its transformations, though the adult existence is relatively short. The same species completes its transformations in the southern states in thirteen years. The Cicadas appear in this latitude the latter part of May, usually from May 20th to early June and may continue to July, a few persisting into August. The pupa emerges about dusk from its circular hole or burrow about half an inch in diameter and climbs the nearest support. Here it fixes itself firmly and prepares for the final transformation, which latter is an extremely interesting process and may occupy about an hour and a half. The established pupa is illustrated on plate 19, figure 1, while the first sign of the impending change, namely, a split along the back, is shown at plate 19, figure 2 and only five minutes later at plate 19, figure 3. Two minutes later we have a condition shown at plate 19, figure 4, while five minutes after the insect is half way out of the pupal shell (plate 19, figure 5) the withdrawing of the tender wings and legs from their horny cases is a matter of some difficulty and proceeds relatively slowly. One stage of this, taken seven minutes after the above mentioned illustration, is shown at plate 19, figure 6, while two minutes later (plate 20, figure 1) the developing insect had already commenced to turn back, and a minute later (plate 20, figure 2) had nearly freed its legs, this process being complete (plate 20, figure 3) 1 minute later and within another minute (plate 20, figure 4) the perfect insect was resting upon the empty pupal shell, and six minutes later (plate 20, figure 5) it was hanging beside the empty shell and the wings were beginning to develop. The developing wings are better seen in a dorsal view (plate 20, figure 6) which represents the pupa as it is turning back in an effort to withdraw its limbs, while six minutes later (plate 21, figure 1) we have the same Cicada clinging to a leaf and with its limp, milk white wings about half expanded. This latter process is rapid and the wings were nearly extended one minute later (plate 21, figure 2) and practically fully developed (plate 21, figure 3) in two minutes. The limp wings gradually stiffen and are then wrapped around the body (plate 21, figure 4). The insect hardens during the night, the wing veins become dark red, the body black and we have the well-known Cicada (plate 21, figure 5).

The adults, as demonstrated by Prof. A. L. Quaintance, feed to some extent though there never seems to be any material injury as a result. The Cicadas may be observed throughout the day resting upon the foliage or branches and occasionally flying a short distance. They seem to be very local in habit. The principal injury, as is well known, is caused by the female in the cutting of slits for the reception of eggs. This operation has been described by Mr Ira H. Lawton as follows:

After finishing one fissure the female moved slowly forward about two steps, depressed her ovipositor about 45°, and setting her saws in motion, first alternately and then simultaneously, rapidly penetrated the bark, but the ovipositor was soon elevated to 25°. After penetrating to the full length of her ovipositor and filling that chamber with eggs, she swung a little to one side and through the same hole in the bark excavated the opposite chamber and filled it with eggs. The making of each chamber occupied a little over twenty minutes or a total of forty-five minutes for the whole. During the cutting of a fissure, the saws made about eighty strokes to the minute, and after making four, the female would rest for a time. The heads of the Cicadas were directed, in the main, from the tree but not invariably so, as some worked with their heads toward the trunk of the tree.

A female with the ovipositor partly inserted is shown at plate 21, figure 6.

Oviposition. The female exercises very little choice in selecting twigs in which to deposit eggs. Mr William T. Davis of Staten Island has recorded oviposition in between seventy and eighty kinds of trees, bushes and herbaceous plants. The limbs of oaks and hickories are favorites, though on Staten Island the black birch and sweet gum were frequently severely injured. Oviposition in the twigs of pine and the smooth sumac, Rhus glabra, appears to be comparatively rare. Poison ivy is not exempt.

One female may make as many as fifty of these slits (plate 22) in a twig, and after depositing her complement, which is said to be four hundred to five hundred, drops to the earth and dies. Oviposition commenced at Nyack in 1911, according to Mr Lawton, June 22d, the eggs beginning to hatch within five weeks, namely, the latter part of July. Eggs taken in the vicinity of Albany hatched in the office August 5th. The young Cicadas are slender, grublike creatures about one-tenth of an inch long. They are as lively as ants, and after running about on the tree for a short time, drop to the ground and bury themselves. Their strong forelegs are well adapted for digging and are undoubtedly of great service in searching for the tender succulent rootlets on which they feed. The Cicadas grow so slowly and require so little food that but slight injury to trees or shrubs appears to result from their presence. They remain at moderate depths, especially during the ealier and latter portions of their existence though at times they have been found a number of feet below the surface. There is little change during the subterranean existence, except in size, between the newly hatched young and the full-grown nymph, which latter has on the thorax four scalelike appendages, the rudimentary wings. The insects make their way to the surface in the spring of the seventeenth year through a smooth, firmly compacted gallery which may even pierce the hard surface of a pathway or roadside and under certain conditions may be covered with a conelike chamber made of mud pellets.

Description. The periodical Cicada (plate 21, figure 6) may be easily distinguished from the common dogday Cicada or harvest fly, Cicada linnei Grossb. by the eyes and veins of the wings being bright red. More or less of the ventral surface of the abdomen (especially in the male) and the legs are dull red. The dorsal surface of the body is almost entirely black. The periodical Cicada is more slender than the stouter dogday Cicada, which latter has green markings on the thorax, greenish eyes and bright green wing veins.

Distribution. The Hudson valley brood is one of the best known, since it occurs throughout a populous section. Aside from the New York localities given in detail below, it has been recorded from Connecticut, District of Columbia, Indiana, Maryland, Michigan, the entire state of New Jersey, North Carolina, Pennsylvania, Virginia and West Virginia. An examination of the map indicating the distribution of this brood, shows that it is largely confined to the eastern slope of the Appalachian mountains, the few records in the central states apparently being isolated colonies. There are authentic records of the appearance of this brood extending back to 1724.

Comparative abundance. It is difficult to give any very exact data respecting the comparative abundance of an insect appearing only once in seventeen years, nevertheless the following observations indicate an apparent increase in some localities with a reduction in others, compared with the brood appearing in 1894. The Cicadas were about the same at Copake Falls

(H. D. Harvey) and less numerous at Ghent (Thomas F. Hartigan); equally numerous at West Taghkanic (S. S. Simmons); there were slight changes in the infested territory at Annandale (H. D. Lewis); hardly as abundant at Fonda (Frank Jansen); equally abundant or more numerous at Middletown (Eugene Smith) and at Mountainville (R. G. Doxey); twice as abundant at Goshen (C. B. Coleman); much more numerous at Schaghticoke (Fred M. Askins); somewhat more numerous at Highland (W. D. Tallman); not so abundant at Marlboro (H. C. Dawes); equally numerous at Milton (A. E. Bell); more abundant at Port Ewen (Silvanus VanAken); more abundant at Saugerties (C. E. Davis); equally numerous at Walkill (J. T. Halmes) and fewer at Thomson (Letitia H. Dixon).

There were undoubtedly a number of localities where the insect failed to appear this season though present in 1894. Most of these might easily be explained if we knew all the facts. Mr W. T. Davis, of New Brighton, states that in 1877 there were a great many Cicadas in the garden of the home place, and though the same fruit trees are standing and the conditions as regards vegetation have remained practically unchanged, yet he failed to find any of the insects the past season. He concludes that they have undoubtedly been exterminated by the house sparrows which have become very numerous in that section of Staten Island. The destruction of forests and the death or removal of shade and fruit trees is bound to result in the local extermination of the Cicada. Many such instances have doubtless occurred in the vicinity of growing cities and villages. Weak colonies are also very likely to become exterminated by birds. Mr Silvanus VanAken of Port Ewen states that the insect has failed to appear in some localities where it occurred seventeen years ago. No statement is given as to the cause. Mr Eugene Smith of Middletown states that there were great differences locally in the numbers of the insects. Practically all the others reporting upon this question concur in stating that the insect has not failed to appear in any locality where it occurred in 1894.

The relative abundance of the insects in limited localities at least, is indicated by the number of holes made by the pupae as they emerge from the ground. In some places the insects were so numerous as to literally give a honeycombed appearance to hard surfaces. This phenomenon was reported by the following: S. S. Simmons, West Taghkanic; H. D. Lewis, Annandale; E. P. Wheeler, New Hamburg; J. H. Mills, Rhinecliff (roadside honeycombed); Eugene Smith, Middletown; R. G. Doxey, Mountainville; C. B. Coleman, Goshen (twenty-five holes in one square foot); Fred M. Askins, Schaghticoke; A. E. Bell, Milton; C. E. Davis, Saugerties; J. T. Halmes, Wallkill; N. D. Rand, West Camp (one thousand holes in twenty-five square feet); C. W. Hyatt, Peekskill, and Annis E. Thomson, Yonkers.

Time of appearance. The periodical Cicada is most remarkable because of the regularity with which it deserts its subterranean retreats. A careful study of this insect in 1894 led the late Doctor Lintner to decide that the first specimens appeared above ground May 20th, though it subsequently developed that adults emerged that year May 19th on Staten Island. Miss Annis E. Thomson, Loweree Summit, Yonkers, states that the first Cicada pupa appeared above ground last season May 13th, transforming to the adult the next day. The thin, rocky soil of that locality probably explains this somewhat early emergence. Mr Davis states that the first Cicada appeared on Staten Island May 22d. Mr George A. Lintner transmitted to this office a living specimen taken at Summit, N. J., May 20th, while Mr Ira Lawton reported the occurrence of perfect insects on that date at Nyack, Mr R. G. Doxey at Mountainville and Mr Samuel H. Cox at Bangall. Mrs Matthew Hart recorded the appearance of Cicadas at Castleton May 22d, while Mr N. D. Rand observed them at West Camp May 23d. They were observed at Annandale, Arlington, and Saugerties May 24th by Messrs H. D. Lewis, W. H. Hart and C. E. Davis, respectively, and reported from near New Baltimore Station by C. H. Van Orden May 25th. They were seen May 27th at Athens by Mr O. Q. Flint and the following day at Ravena and Fonda by Messrs Bronk VanSlyke and Frank Jansen, respectively. The first specimens taken in the vicinity of Albany were found May 29th at the Rural Cemetery and were evidently among the first to come above ground, though it is possible that a few emerged on the 28th.

It will be seen by scanning the above dates of appearance that they were progressively later as we ascend the river, with the exception of the appearance at Castleton May 22d. There may have been some local cause for this apparent irregularity.

Several instances of accelerated or delayed emergence were brought to our attention. Mr H. D. Lewis of Annandale states that he observed a few living, fully developed Cicadas and several recently vacated pupal shells in 1910. The arrival of the main body in that locality in 1911 was later than in 1894. He found that the first appearing individuals seemed to be diseased and lived only a few hours, possibly dying as a result of adverse weather conditions. Mr J. H. Mills, Rhinecliff, also stated that many died shortly after leaving the soil.

There is another record of Cicadas appearing in 1910 in New York State, though this latter appears to apply to a different brood. Mr William T. Davis of Staten Island states that he found the insects abundant at Half Way Hollow near Wyandanch, L. I., in 1910, though repeated examinations in that locality last season failed to disclose any signs of the insect. He is inclined to believe that this appearance represents another brood which can hardly be the case with the few found in 1910 by Mr Lewis at Annandale.

Date of the first cry or song of the male. This, like the record for the last appearance and last recorded note, varies considerably, ranging in the different localities from May 22d to June 5th. The detailed records are as follows: May 22d, R. G. Doxey, Mountainville; May 25th, S. S. Simmons, West Taghkanic; May 27th, H. D. Lewis, Annandale; June 5th, Frank Jansen, Fonda; May 29th, Eugene Smith, Middletown; May 23d, C. B. Coleman, Goshen; June 10th, W. D. Tallman, Highland; May 27th, H. G. Dawes, Marlboro; May 30th, Silvanus Van-Aken, Port Ewen; May 26th, C. E. Davis, Saugerties; May 27th, N. D. Rand, West Camp; May 22d, C. W. Hyatt, Peekskill and May 30th, Annis E. Thomson, Yonkers.

Persistence of Cicadas. It is well known that the Cicadas remain above ground for several weeks, and in connection with ascertaining the distribution of the insect, two queries were asked designed to supply data respecting the period during which these insects could be either seen or heard. Parties reporting gave the date when they last saw the insect from June 12th to July 18th. The individual records are as follows: July 4th, R. G. Doxey, Mountainville; July 8th, S. S. Simmons, West Taghkanic; July 18th, H. D. Lewis, Annandale; July 4th, E. P. Wheeler, New Hamburgh; June 12th, Eugene Smith, Middletown; July 2d, C. B. Coleman, Goshen; July 4th, Sylvester Bulson, Stony Point; July 19th, W. D. Tallman, Highland;

June 21st, H. C. Dawes, Marlboro; July 1st, Silvanus VanAken, Port Ewen; July 8th, C. E. Davis, Saugerties; July 12th, N. D. Rand, West Camp; July 6th, C. W. Hyatt, Peekskill, and June 13th, Annis E. Thomson, Yonkers.

The date when the last cry or song of the male was heard is also of value in determining this period, it ranging from June 10th to August 2d or 6th. No one conversant with the party can question the record given by Mr Davis, though there is a bare possibility that Mr Bulson may have been mistaken. The detailed records are as follows: July 12th, S. S. Simmons, West Taghkanic; July 14th, H. D. Lewis, Annandale; June 12th, Eugene Smith, Middletown; July 8th, C. B. Coleman, Goshen; July 10th, W. T. Davis, New Brighton, S. I. (he records hearing a belated individual August 2d); August 6th, Sylvester Bulson, Stony Point (one male nearly over his head); June 27th, Silvanus VanAken, Port Ewen; July 8th, C. E. Davis, Saugerties; July 6th or 7th, C. W. Hyatt, Peekskill, and June 10th, Annis E. Thomson, Yonkers.

Above-ground chambers. These peculiar structures which excited so much attention in 1894 could doubtless have been found in many localities the past season. Mr H. D. Lewis of Annandale reports their rare occurence in a few places; Mr C. B. Coleman, Goshen, found a very few; Mr R. G. Doxey, Mountainville, observed them in low spots; Mr. W. T. Davis of New Brighton, S. I., states that they were rather common in the William Brook woods; Mr Silvanus Bulson found them numerous at Stony Point. Investigations at New Baltimore and at the Graceland Cemetery in the vicinity of Albany showed these above-ground chambers to be rather common though, as a rule, they were not nearly so perpendicular as appears to have been the case in 1894. On scraping away dead leaves the chambers were to be found mostly in an oblique or horizontal position, a few being vertical (plate 23). We fail to find even one locality where they were so numerous as represented by the photographs of the late Doctor Lintner, taken seventeen years ago.

The variety C a s s i n i i appears to have been nearly overlooked though Mr William T. Davis of Staten Island records finding small numbers of this form June 16th near Willow Brook and Westerleigh. Mr Isaac Wort, Rossville, gave Mr Davis two specimens taken by him in that locality June 18th.

Appearance of the Cicada in the Hudson valley. The detailed records given below show that the Cicada appeared during 1911 on the western end of Long Island, on Staten Island and in practically all of the counties on each side of the Hudson river from New York City north to Saratoga and Washington counties, the northernmost limit recorded the past season being at Thomson, Washington county. The insects extend some miles back from the Hudson river, probably to the Massachusetts state line in the vicinity of Annandale and in Orange county, possibly some twenty miles or more from the Hudson river. There is, in addition, a recently discovered populous colony near Fonda in Montgomery county.

Albany county. Near Albany Cicadas were extremely abundant in Graceland Cemetery, Normansville; were heard at Clarksville by J. Shafer Bartlett; evidences of their work were observed in Coeymans near Coeymans creek from the West Shore Railroad, and they were reported from Dunnsville by the Albany Evening Journal. A complaint of injury by this insect to orchard trees was received from Mrs E. K. W. Vanderzee who lives near Feura Bush. Cicadas were very abundant at Kenwood just south of Albany and numerous in Wildwood valley and probably other sections of the Albany Rural Cemetery at Menands. The insects appeared to be rather generally distributed in Ravena here and there southward to the Greene county line. Mr Bronk Van Slyke of Ravena states that they were present in his orchard and that seventeen years ago they were very numerous, seriously injuring it, and that on the occasion of the preceding appearance, thirty-four years ago, the insects destroyed a nearby orchard. Cicadas were reported in 1894 from New Scotland, Voorheesville and Bethlehem Center in addition to some of those named above. It is very probable that it also appeared in these localities in 1911.

Columbia county. Cicadas were reported as being present at Claverack by Mr G. G. Atwood of the Department of Agriculture. Mr H. D. Harvey writes that they were very abundant at Copake Falls,[1] near Hillsdale. Mr Thomas T. Hartigan of Ghent states that up to June 9th Cicadas had appeared in small numbers compared to those which obtained in 1894, when there seemed to be millions of the insects. Observations on the New York Central trains showed numerous signs of Cicada work from a little south of Hudson nearly continuous to North Germantown.

[1] The Copake Falls record given above refers to the colony reported in 1894 from Hillsdale.

Evidences of their work were abundant about two miles south of Germantown and three or four miles south of that station. At Kinderhook small numbers were reported in the orchards of Mr Edward VanAlstyne and William Hotaling. Mr VanAlstyne states that there was a numerous colony on another farm of his some two miles west of the home place. There were abundant evidences of Cicada work in a patch of woods about one mile south of Niverville on the Albany Southern Railroad. Scattering insects were reported at North Chatham on the farms of W. W. Woodward and Theodore Horton. Along the line of the New York Central Railroad there was evidently an abundant colony one-half mile south of Stockport and two miles south of this station they were even more numerous. The insects were also reported from Stuyvesant Falls. Mr S. S. Simmons, West Taghkanic, states that Cicadas were abundant in that locality some eight miles east of the Hudson river and only a few miles from the southwestern corner of Massachusetts.

Dutchess county. Mr H. D. Lewis reported the Cicadas as very numerous at Annandale, they appearing first May 24th. The insects were very abundant in portions of a small orchard near the residence of Mr Lewis's father, some trees being very badly infested, while less than fifty feet away comparatively few Cicadas were to be seen. The orchard some distance from the house, which was badly infested in 1894, showed comparatively few this year. Mr Lewis states that the insect occurred here and there on the ridges from the river practically to the Connecticut state line. Cicadas were excessively abundant on the estate of Warren Delano near the river. They were literally present in millions, immense numbers of pupal shells being observed clinging to the branches and lying at the base of the large oaks and maples. Probably several quarts could have been scooped up around almost any one of the trees. The Cicadas were exceedingly numerous on this estate in 1894. Mr W. H. Hart noted Cicadas for the first time in his Arlington orchard May 25th. Early plowing resulted in turning up pupae so abundant in some places that there appeared to be more insects than soil. Mr Samuel H. Cox reported millions of Cicadas in the vicinity of Bangall. They were rather numerous near the Barrytown station. Mr H. D. Lewis of Annandale states that several orchards in Barrytown were ruined, even trees set some fifteen years ago. In one instance a recently set orchard had the two rows next a badly infested woodland severely affected, while all of the other trees practically escaped injury. There were a few signs of Cicada work visible from the New York Central tracks two to four miles north of Camelot, while injured twigs were abundant four miles north. There was evidenty a numerous colony along the New York Central tracks one-half mile north of Chelsea and extending for fully one and one-half miles. The work of this insect was most apparent on rocky knolls or hills covered with a scrubby oak growth. Cicada injury was very evident south of Dutchess Junction, while the woodland on the hills to the east appeared to be severely injured. The work of what appeared to be a moderately small colony was observed just north of Fishkill Landing, this colony being fully a mile long. At Hyde Park the evidences of Cicada work were rather prevalent, there being abundant signs of injury one-half mile south, and a little farther south the work was even more prevalent and practically continuous from that point to Poughkeepsie. Mr Everett P. Wheeler of New York states that the Cicadas became very numerous at New Hamburg and were destructive to young branches of trees, particularly peach and elm. Observations from the New York Central Railroad disclosed signs of this insect's work here and there in the vicinity. The Poughkeepsie News states that the insects were present in millions on the river road near "Carnwath," the grass was completely covered with the pupal cases, while the roar of the singing could be heard for miles. Another locality mentioned was on the Ruppert farm south of the driving park. Dr Z. D. Patterson of Red Hook states that the Cicadas were a great menace in that locality. Mr Joseph H. Mills, forester for J. J. Astor, reports an infested locality of one and one-half acres of lawn and shade trees at Ferncliff near Rhinecliff. There was on the average about four quarts of pupal shells under about twenty trees, one having five quarts within a radius of eight feet. Rhinecliff and vicinity appears to have been one of the localities greatly favored by Cicadas. The insects were present at Staatsburg, evidence of their work being plainly seen from the New York Central tracks some one-half mile south of the station, and more evident two to three miles farther south. Cicada work was abundant also at Tivoli, some trees having their tips killed while a few small ones had most of the branches destroyed. The colonies along the New York Central Railroad were practically continuous and abundant from Tivoli south to Rhinecliff.

Greene county. The work of Cicadas was observed from the West Shore Railroad about two miles north of Alsen to one mile south, a colony nearly three miles long. The insect was reported from Athens by Mr J. Q. Flint as follows: On land belonging to Mr Egbert Hallenbeck at Morrison Hill south of Athens; on land of Mr Edward A. Guthrie on the Sporenburgh road; on that of Miss Anna Brandow on the Catskill road. The insects were exceedingly abundant at Morrison Hill and were doubtless generally prevalent in that section. They were reported as being present at Cairo by Miss Ida M. Bonesteel. Cicadas were said to occur at Leeds. Mr C. H. VanOrden reported the appearance of the insects between West Coxsackie and New Baltimore Station on the 25th, they being in full cry on the 27th. There was a large colony about a quarter of a mile south of New Baltimore Station on the West Shore Railroad. The noise was loud enough so that the insects could easily be heard a quarter of a mile. An orchard about midway between Ravena and New Baltimore Station was very badly infested by this insect and it was reported as being present a half mile or so east of New Baltimore Station. Cicada work was seen from the West Shore Railroad from about one-half of a mile to a mile and a half south of the West Athens station. The insects were reported as very abundant at West Coxsackie.

Montgomery county. A large colony was recorded by Mr Frank Jansen on the sand flats about three miles west or northwest of Fonda, the insects occurring there by the millions and making the woods ring with their noise about half a mile from his house. Mr Jansen states that he knows they were in that locality in 1894 and adds that his wife heard them on the occasion of their previous advent, namely, 1877. The local papers refer to this colony as being in Mr Nare's woods and state that the birds were devouring many of the insects. This appears to be a hitherto unrecorded locality for the periodical Cicada.

Nassau county. Miss Grace K. Wandless reported Cicadas as being abundant at Garden City.

New York county. Mr Waldemar Cruger, 85 West 181st street, found insects, presumably in that locality, and reports Cicadas as rather scarce in the Bronx. He observed fifteen to twenty on a tree at Fort Schuyler.

Orange county appears to be one of the strongholds of the Cicada, since its work was seen here and there in the woods along the river, while reports from various localities in this county agree in considering the insect extremely abundant. Many of the tips of the branches in the woods in the vicinity of Balmville just north of Newburgh were killed by this insect. Mr C. B. Coleman, Goshen, states that it is difficult to find in that locality a farm where the insect does not occur in considerable numbers, many of the trees appearing as though they had been swept by fire. Near Highland Falls the work of this insect was conspicuous at a distance. There were millions of Cicadas, according to C. M. Dayton, at Leptondale some ten miles from Newburgh. The work of the insect was very abundant in woodlands in the vicinity of Middlehope. Mr Eugene Smith reports the Cicada as occurring in millions in the country surrounding Middletown, while press dispatches allege serious injury resulting from the work of this species. Millions were to be seen at Mountainville, town of Cornwall (R. G. Doxey). According to the Montgomery Standard there were millions of the insects along the banks of the Wallkill valley, notably in the grove belonging to Charles Mould near Bodine's Bridge. Several Newburgh papers record an abundance of Cicadas in the near vicinity of the city. South of the city they were very abundant on the Highlands and at a place about four miles north of West Point the colonies appeared to extend well toward the summit of the ridges and some distance back from the river. The Middletown Argus reports the insect at Demerest's Heights, Warwick. Cicada work was rather abundant in the woodlands north and south of West Point. Mr William T. Davis of Staten Island was at West Point June 3d and states that one of the most impressive sights was the number of Cicadas which occurred on the mountain side. They commenced singing with the rising of the sun. "Stronger and louder grew the song until it was continuous like the hum of some busy factory. This lasted till the sun went down." (Davis)

Putnam county. There appears to have been no record of the periodical Cicada occurring in Putnam county in 1894. The work of this insect was evident in 1911 here and there along the Hudson river. Injured twigs were observed on the hills just north of Cold Spring, apparently local, while a little north of Peekskill in Westchester county evidences of oviposition were observed almost continuously north to Garrison. About one mile farther north Cicada work was observed and was prevalent for a distance of some two miles. Evidences of Cicada injury were extremely abundant along the New York Central Railroad north from Cold Spring nearly to Dutchess Junction and undoubtedly including the section in the vicinity of the New York

Central station, Storm King. There are no records of the occurrence of this insect in the eastern part of the county.

Queens county. It is presumed that the Cicada occurred in small numbers in Queens county, since it was observed in Suffolk and occurred abundantly in the not distant Westchester and Richmond counties.

Rensselaer county. The presence of Cicadas at Castleton was reported by Mrs Matthew Hart. In the town of East Greenbush they occurred in large numbers northeast of the village near Elliott's Station on the Albany Southern Railroad. Mr James Elliott remembers their appearance in both 1894 and 1877. They were not so abundant seventeen years ago as in 1877. At East Schodack, they were reported by James Loweree as very abundant on the Thomas Collins' farm near the residence of John Coons and about two miles west of the village of Nassau. He states that they also occurred on the farm of Augustus Byers. Abel Merchant reports that Cicadas were numerous on Dusenbury hill about three miles east of the village of Nassau and between the residences of Joseph Miller and Stephen Miller just off from the cross road near what is known as the Cold Water Tavern. The insects occurred scatteringly in the vicinity of the village of Nassau. In North Greenbush, Cicadas were very abundant on the grounds of the Forbes Manor estate and northeast on Quackendary kill according to Julius Keastner. They were also numerous farther to the north opposite Maple Beach Park. Mr M. B. Hartley of Schenectady states that there was a large colony on the river road leaving North Troy or Lansingburg and near the shore at a point called "The Riffs." There was a rather abundant colony along the line of the Albany Southern Railroad just south of Schodack Center and also in the vicinity of Stop 77. There was a large colony near the Boston and Albany tracks one mile south of the East Greenbush flag station. Mr Fred M. Askins reported a very numerous colony in the town of Schaghticoke for about two miles along the Hudson river and south of Reynolds, the ground being honeycombed in places by their galleries. The only record we have for this county in 1894 was that for Bath-on-the-Hudson (really Forbes Manor, North Greenbush) where the insects were rather abundant.

Richmond county. Cicadas were generally distributed in the wooded areas on Staten Island (except in the small, so-called pine barren region) according to Mr William T. Davis of New Brighton who has kindly supplied us with the following data.

The insects first appeared May 22d. They were reported by Mr C. W. Leng on the 23d at West New Brighton, and on the same day by Mr Isaac West at Rossville near the other end of the island. They appeared earlier or were more numerous in some places than in others. At Great Kill they were very common in a grove of sweet gums and could be seen flying and heard singing on May 26th. There were many more males than females at that early date.

Rockland county. This appears to be another Cicada stronghold. The results of oviposition were observed on Iona island and vicinity, the insects probably covering most of the Dunderberg mountain to the south. Mr Ira Lawton reports the occurrence of the Cicada at Nyack. They were recorded in swarms near Suffern by Mr M. S. Daniels and reported by Mr Sylvester Bulson as occupying a territory about six miles square between Haverstraw and Fort Montgomery. This brood was reported by Dr J. A. Lintner in 1894 from Palisades on the Hudson and was doubtless more or less prevalent throughout the county.

Saratoga county. Rev. David C. Davies of Mechanicville transmitted specimens of Cicadas collected by himself on the Bemis Heights battlefield in the town of Stillwater. He states that there were hundreds of the pupal cases to be seen. He also sent specimens taken on the farm of George Lape, a mile and a half from Mechanicville and about a mile west of the Hudson river. The trees in this locality were full of the insects and their singing could be heard for some distance. He also states he heard of a colony on the east side of the Hudson and northeast of Stillwater in a locality known as Chase's Hill, a place where they appeared in 1894. The local press records the appearance of great numbers of the Cicadas on the Guy Fitch farm about three miles northwest of Mechanicville. Mr George B. Thomas observed Cicadas about four and one-half miles south of Schuylerville and one-quarter of a mile west of the Hudson river. There was a clump of bushes and trees about one rod wide and twenty rods long which were nearly covered with the insects.

Suffolk county. Mr William T. Davis, of New Brighton, states that occasional Cicadas were found in localities on the western end of Long Island. He adds that he was unable to find any specimens whatever after three visits to the Half Way Hollow Hills where the insects were so abundant in 1910, and he is therefore led to conclude that this earlier appearance represents an independent brood. Mr Charles Watkins of Wyandanch informed Mr Davis that he had seen two Cicadas (in 1911) in the nearby lowlands, and Mr Frederick M. Scott assured Mr Davis that he had heard a few singing about the village but never in the hills. Mr Davis visited Babylon, L. I., on July 21st and was unable to find any one who had seen Cicadas reported from that vicinity by the Brooklyn Eagle. We have been unable to obtain any other records respecting the occurrence of this brood upon Long Island in 1911.

Ulster county. Just south of Esopus station many locust trees along the West Shore Railroad showed the effects of Cicada work, and the same was true of oak about one mile farther south. At Highland the insects were reported extremely abundant in the woods near the station, though no injured twigs were observed. Mr H. W. Ford reported, under date of July 5th, hearing only a few of the insects. Mr W. D. Tallman states that the insects were rather abundant at Highland and that they appeared in small numbers one-half mile west of Clintondale, some seven miles from the Hudson river. They seemed to be more abundant than in 1894. Many dead tips were observed from the West Shore Railroad one-half mile south of Malden. Cicada work was very abundant in the woods just above Marlboro, the colony being more or less continuous from there to Milton where similar conditions obtained. Mr H. C. Dawes, three miles south and west of Marlboro, found Cicadas very scarce in his neighborhood. Mr Arthur E. Bell of Milton reports the insect about as abundant as in 1894 and is of the opinion that it did not fail to appear in any locality where it occurred that year. Serious injury resulted in some places. Many Cicadas were reported from the woods back of New Paltz. Dr J. R. Gillett May 30th stated that the insects occurred all along the line from Highland to New Paltz. About one-half square mile of mountain land was abundantly infested by the Cicadas at Port Ewen according to Silvanus VanAken, the insects failing to appear in some localities where they occurred in 1894. Very little injury came to his notice. He reports another colony one and one-half miles southeast of Port Ewen. Miss Ethel H. Dann observed great numbers of Cicadas at Saugerties. Mr C. E. Davis of that locality states that there is an infested area some six miles from Saugerties and one mile west of the Hudson, the insects occurring by the millions and so abundant that it was necessary to lead horses in cultivating crops. Mr William Waldele, Saugerties, reports the Cicadas so numerous that nearly every leaf, limb and part of recently set apple trees were covered with the insects. Mr J. T. Halmes, writing from Wallkill, states that June 30th the Cicada cry was almost continuous, especially when crossing the Shawangunk mountain between the Wallkill valley and Ellenville, the cry apparently stopping as he entered Sullivan county. Returning to Wallkill three weeks later he observed that the insects had disappeared and that the oaks and chestnuts especially had been severely injured, it appearing as though fire had scorched the young branches. Mr N. D. Rand of West Camp reports an infestation one-quarter of a mile wide along the Hudson, the insects occurring by the millions and extensive injury to apple and peach trees in particular, resulting. Just south of West Camp station on the West Shore Railroad injuries by Cicada were very evident. This insect was recorded by Dr J. A. Lintner in 1894, in addition to certain localities given above, from Quarryville.

Washington county. Miss Letitia H. Dixon transmitted specimens collected in Governor Dix's woods at Thomson and states that the insects were there seventeen years ago. Mrs William G. Drake, now of New Jersey, informs us that she remembers very well Doctor Fitch collecting periodical Cicadas in 1877 at Fort Miller, only a short distance from Thomson. There appears to have been no published record of this occurrence in 1894.

Westchester county. Mr R. W. Trine is responsible for the statement that Cicadas were thick on his property, "the Kitchawan Hills," Croton Lake, located on the Mount Airy road to Croton. The insects did not occur in the village though they were pretty generally distributed in that section. Mr G. G. Atwood of the Department of Agriculture reports the insect very abundant at Dobbs Ferry and Katonah. Messrs Edward and Robert Broom of Mount Vernon record many pupal cases in that locality. Mr A. J. Bolton of New Rochelle reports large numbers of Cicadas, probably millions, on Twin and Hunter islands. The insect was also reported as occurring by millions at New Rochelle and in the Pelhams. Mr C. W. Hyatt found Cicadas abundant about four miles north and three miles west of Peekskill. Mrs E. H. Kingsland reports thousands of Cicadas at Pelham. Abundant evidences of this insect were observed from the New York Central tracks just north of Ossining, injuries being rather numerous from there to Croton on Hudson. From Scarboro along the New York Central tracks south nearly to Tarrytown evidences of Cicada oviposition were rather abundant. Miss Annis E. Thomson, of Yonkers, reports thousands of Cicadas at Lowerre Summit and Park Hill. It is probable that the insect was pretty generally distributed throughout the western and southern portion of the county, at least.

Natural enemies. A large and excessively numerous insect such as the Cicada affords abundant provender for many natural enemies. Cats and dogs have been reported as eating the pupae as they emerge from the ground. Miss Annis E. Thomson of Yonkers reports feeding twenty of the insects in succession to a cat without any ill effects. Skunks, groundhogs and gray squirrels have been observed in earlier years feeding upon the Cicadas, and it is probable that several other quadrupeds do not ignore this article of diet. There were several reports of domestic fowls, probably all kinds, feeding greedily upon the insects. Birds, such as hawks, crows, robins and sparrows, feed readily upon this species. More than one farmer reports no pulling of corn and unharmed cherries as a result of abundant Cicadas in the vicinity. A flock of crows hanging over a woodland and scolding on the approach of man, is very likely to signify a colony of Cicadas. The English sparrow appears to be particularly fond of this insect and is undoubtedly largely responsible for its local extermination in the vicinity of cities.

There are several insect enemies of the Cicada. Mr J. C. Guffin, Albany, reports having observed one of our largest dragon flies feeding upon a Cicada. His attention was attracted by the Cicada note and sounds of a struggle. An investigation disclosed the two insects on a nearby mullen stalk. The dragon fly was seen to bite off the head of the Cicada, eat into the thorax, and after a time, becoming alarmed, fly away with the remainder of the body. Mr O. Q. Flint, Athens, reported darning needles numerous in the vicinity of a locust colony. Ants have also been observed to attack Cicadas though they probably content themselves with preying on the dying or dead.

The fungus Massospora cicadina was reported rather prevalent in a number of localities. Mr William T. Davis of Staten Island found numerous males and females infected with the disease at West Point June 3d. It was observed in Graceland Cemetery near Albany as early as June 9th, while at New Baltimore it was rather prevalent June 10th and 13th. Occasional specimens could be seen flying even after most of the abdomen had dropped off as a result of the fungous infection. Mr R. G. Doxey, Mountainville, reports the occurrence of the fungus. Mr H. D. Lewis of Annandale recorded many dead and dying insects, some infected with fungus June 16th.

The local presence of the disease was also reported by Mr S. S. Simmons, West Taghkanic; Eugene Smith, Middletown; C. B. Coleman, Goshen; Fred M. Askens, Schaghticoke; Sylvester Bulson, Stony Point and C. W. Hyatt, Peekskill.

Adverse weather conditions are undoubtedly responsible for the untimely death of many insects. Miss Annis E. Thomson states that on June 10th, 11th and 12th there were three terrific thunder and lightning storms which killed *every* Cicada. Not one was seen alive after June 12th. Between the storms, the birds feasted on the insects and the children picked the wings from the multitude of dead bodies in the roadways.

Injuries. The reports of injuries as a result of a Cicada visitation usually characterized the damage as very severe, and in localities where the insects are exceptionally numerous, many of the young twigs, in some instances most, may be killed by the numerous oviposition scars. This looks badly in midsummer and gives a very unfavorable impression, whereas in reality the damage is confined largely to the small limbs, and in the case of good sized trees amounts to but little more than a somewhat general heading back. Some correspondents state that affected trees look as though they had been swept by fire. In certain cases fruiting trees had the limbs so badly injured that they broke with the weight of the young apples. The proportionate injury to young trees is undoubtedly much greater than in the case of large ones, and in certain instances may result in the ruin, if not death of individual trees.

The Cicada is relatively local in its habits, and as a consequence the injury is rarely widespread and mostly confined to comparatively low value forest trees. This disinclination of the Cicada to fly is well illustrated by conditions obtaining on the farm of Mr H. D. Lewis at Annandale. There were a number of trees in one orchard very badly infested with the insects while within fifty feet there were many others practically free from Cicadas. Mr Lewis reports one case where two rows of a young orchard near a woodland were severely affected, while other parts were practically free from damage. Mr R. G. Doxey, Mountainville, records the killing of newly set fruit trees.

Preventives of injury. The major portion of the visible injury at least is caused by the female as she makes slits in the twigs with her sawlike ovipositor for the reception of eggs. It is purely a mechanical injury. Small trees in the vicinity of a numerous colony can be easily protected by inclosing them with a fine netting during this egg-laying period (plate 24). It is equally obvious that some attention to the probabilities of injury in the future would suggest refraining from planting young trees near infested woodlands for at least several years prior to the expected appearance of the insect. Similarly, trees in the locality where Cicadas were abundant might well be trimmed very little or not at all for one or two years prior to the advent of the insects, thus leaving a superabundance of wood and mitigating to considerable extent the probable injury.

Practical experience has shown that it is possible by systematic and persistent collecting to protect moderate sized trees from serious injury. The adoption of such measures would be justified only by some exceptional conditions. Their efficacy depends largely upon the somewhat local habits of the insect.

Spraying the issuing pupae with a contact insecticide, such as a kerosene emulsion, whale oil soap solution or other material will destroy immense numbers, and where the insects are exceptionally abundant and the trees valuable, may be profitable. Mr H. D. Lewis of Annandale reports that spraying trees infested by the insects, with a commercial lime-sulfur solution diluted one part to forty appears to drive out the Cicadas. This method might prove of value in the vicinity of woodlands and assist in keeping the insects restricted largely to the wild growth. It is possible that spraying with a lime-sulfur wash, as mentioned above, or with a bordeaux mixture, may prove of considerable service in preventing oviposition.

Bibliography

Very many popular notices, accurate and otherwise, have appeared in the press of the country during the past season. The insect has also figured in many scientific accounts from time to time. The following brief bibliography, in connection with the citations the works contain, will enable the student to ascertain the more important facts respecting this remarkable species.

1897 **Lintner, J. A.** Injur. and Other Ins. N. Y., 12th Rep't p. 272–98.
1905 **Felt, E. P.** N. Y. State Mus. Mem. 8, 1:231–37.
1907 **Marlatt, C. L.** U. S. Dep't Agric., Bur. Ent. Bul. 71, p. 1–181.

A REPORT UPON THE CONDITION OF THE SHADE TREES OF THE CITY OF MOUNT VERNON, N. Y.

The Entomologist, under the guidance of Alderman Whitmore and Commissioner of Public Works Harlow, examined the shade trees of Mount Vernon Tuesday afternoon, June 20, 1911. It was obviously impossible to make a careful examination of all the injured trees in the city. Our investigations were therefore limited to what were considered typical localities. At the outset we were informed that some 2136 trees were sprayed last spring, largely for the purpose of controlling the false maple scale.[1] Many of these, mostly hard maples, show signs of severe injury from one cause or another.

An examination of the trees disclosed the fact that the leopard moth[2] is generally present in the city and, furthermore, that it is liable to cause, if allowed to breed unrestricted, serious injuries within a few years. We observed no maples so badly infested with this insect as to justify holding the pest responsible for the recent and sudden death of individual trees, or even of good sized limbs, though we did find certain trees, mostly soft maples, which were rather badly infested by this species.

Our investigations also showed that a "pin-hole" borer[3] or "Ambrosia beetle" is generally present on the dead and dying trees. This insect is just entering the maples, attracted by their unhealthy condition and therefore can not have a causative relation to the present sad state of many hard maples in Mount Vernon.

There was also found on a number of these trees, a moderate sized, reddish-brown, yellow-marked beetle,[4] which, like the "pin-hole" borer, is an inhabitant of diseased or dying trees. At Park avenue and East Sibley street, near the church, there were fifteen out of about twenty hard maples with at least the lower limbs seriously affected, a few of the smaller having practically all the foliage destroyed. The type of injury observed here was limited to trees marked or recorded as having been sprayed. We were informed that this was done in March.

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[1] Phenacoccus acericola King.

[2] Zeuzera pyrina Linn.

[3] Xyloterus sp.

[4] Neoclytus erythrocephalus Fabr.

These maples were young trees which presented every appearance of having recently been in as thriving and vigorous a condition as nearby unharmed maples, which latter were not marked as having been sprayed, and no record was submitted to show that they had been so treated. These trees, both the injured and the nearby unharmed ones, were young and fairly well separated. There was no evidence of overcrowding, though this would doubtless occur later if all the trees grew and were allowed to remain.

At Park and Oakley avenues there were nineteen hard maples perhaps more seriously affected out of about twenty-six sprayed and presumably treated in the same manner as those discussed above. These trees were smaller than those in the preceding lot, and some at least of the injured maples even had the tips of their branches well separated from those adjacent. They presented every indication of having recently been in a thriving condition and there could have been no crowding for several years at least. At North Fulton and Clinton avenues most of the hard maples were killed on one block. These trees were larger than those discussed above. Even here one could hardly consider the maples crowded, though in a year or two such a condition would probably develop. One of these trees was cut down and the larger limbs, the trunk and the base of the roots carefully examined for insect and other injuries.

On Beechwood avenue in another part of the city we examined several small hard maples marked as having been sprayed. This work, we were informed, was done later and the injury was not so severe, though three out of some seven or eight hard maples were affected to some extent.

Several other trees in this general section of the city were examined. One was dying but the trouble appeared very different from the injury under discussion. The entire top was dead and there was a vigorous growth of shoots at the base of the larger limbs. This type of injury we have seen here and there in the vicinity of New York City. Another affected tree was observed. The foliage presented a generally unhealthy condition. The trouble appeared to be similar to, or possibly identical with, the bacterial affection which was so prevalent on hard maples in the Hudson valley two years ago. The condition of this tree is very different, in our estimation, from the severe injury noted elsewhere. There are undoubtedly other trees here and there in the city which are dying from one cause or another. It would be surprising were conditions otherwise.

Our findings in connection with the major portion of the injured maples are as follows:

1 The trouble is practically limited to hard maples.

2 It is confined very largely to the lower limbs or portions of the tree most easily reached by spraying outfits of the usual type. This phase of the injury attracted our notice at the outset. Small trees, those not more than eighteen or twenty feet high, were more frequently killed than moderate sized ones. The lower branches of these latter were usually in a dying condition; sometimes the lower third or the lower half of the limbs were thus affected. On large trees, such for example as those in front of Alderman Whitmore's residence, the injury was mostly limited to a few of the lowest limbs.

3 Only trees marked as having been sprayed or so recorded, presented the characteristics common to all the hard maples showing this sudden and severe injury, namely, dying branches with withering, usually discolored leaves accompanied by a brown, lifeless inner bark near the middle portion of the branches and the trunk.

4 A careful examination of the trees in the above mentioned localities which, we were informed, were typical of conditions obtaining in Mount Vernon, compels us to exonerate insects. The injury is utterly unlike the work of any insect pest. There is no connection between the abundance of the leopard moth and the severity of the attack. Were this insect the cause we would expect the trouble to show first on the silver or soft maples. This opinion is based not only upon a superficial examination of a number of trees, but also a detailed one of the tree cut down on North Fulton avenue and also a number of limbs which were removed from various other trees.

5 The injury to the affected trees is restricted largely to the trunk near the base of the larger limbs and to the lower branches, places easily reached with the ordinary spraying equipment. Repeated examinations of dying limbs showed green, apparently vigorous bark at both the base and the tip, while for a variable length of the branch the inner bark was brown and dead or nearly so. Some limbs on the more badly affected trees had practically all the inner bark dead, simply indicating that the injury had pro-

gressed farther. Furthermore, this affection was uneven and varied greatly within a few inches, indicating that it might have resulted from some external application. This was true also of the tree cut down. The tips of the branches and the trunk below the limbs had a green, apparently healthy inner bark, while much of the inner bark between these extremes had turned brown and was dead or nearly so. We explain this condition by holding that the thicker bark of the trunk would succumb less quickly to an injurious application than the thinner bark just above. The smaller limbs, especially at the top of the tree, escaped serious injury because of the difficulty of spraying them thoroughly. The lesser injury to the later sprayed trees is probably due to the increased pressure of the sap hindering the penetration of the spray material. It is well recognized among entomologists that bark borers working near the middle of the trunk of the tree, namely, near the base of the larger limbs, may girdle the trunk at this point and cause a successive and rather rapid death of both extremities of the tree. We have repeatedly seen this in the case of bark borers[1] working in the trunks of white pine, and the same process may be observed in hickories succumbing to the injuries of the deadly hickory bark borer,[2] a pest now very prevalent in the vicinity of New York City. The spray material appears to have girdled limbs and trunks by destroying the vital inner bark and produced a condition similar to that resulting from bark beetle attack. These insects can not be held responsible for the injury, since the great majority of the affected limbs and trunks show practically no indications of insect injury.

6 It is our opinion that the trouble is largely if not entirely due to injury caused by the material sprayed upon the trees.

7 We would advise the prompt removal of the dead trees and the early burning of the wood so as to prevent "pin-hole" borers or Ambrosia beetles breeding out and possibly causing serious trouble later. We would favor leaving trees showing fair signs of vigor till it was evident that they were beyond hope.

8 The leopard moth is well distributed throughout the city and, if allowed to multiply freely, may ruin many trees. A judicious cutting out of the borers and the destruction of the

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[1] Ips sp.

[2] Eccoptogaster quadrispinosus Say.

moths so far as practicable would do much to avert trouble. There are other insect pests which also need attention.

9 In conclusion, we would emphasize the fact that not all the sickly trees were injured by the application. Moreover, the majority of the sprayed maples were infested by insects and therefore less able to withstand injury. Had the season been as early as usual, it is probable that the damage would not have been so severe. Nevertheless, the use of oils or oily preparations on living plants is attended with a certain amount of danger.

EXPERIMENTS WITH HEAT AS AN INSECTICIDE

There are numerous places where it is impractical to employ gases, contact insecticides or arsenical poisons for the destruction of injurious pests, and in some of these situations heat may be available. The work of Dean[1] indicates the possibilities along this line in the case of several well-known mill pests. It seemed advisable to test this with other insects, and the heat-loving, oriental cockroach, *Periplaneta orientalis* Linn., was selected as presumably a very resistant form. The work began with insects in vials, then in jars and finally in jars or pasteboard cylinders in a small room. In all instances observations were possible throughout the test and the thermometers were corrected by comparison with standard instruments. Great care was exercised so to place the vials or jars containing the insects that the walls could not become unduly heated with consequent burning of the contained roaches.

The apparatus employed in experiments 1 to 3 consisted of a candy jar about eight inches high, in which was placed an ordinary stab file supported on three wooden blocks so as to separate its metal base from the glass bottom. A piece of soft pine was fastened to the tip and from this a dairy thermometer suspended so that it hung nearly in the middle of the jar and touched no metal, its bulb being nearly an inch and a half from the bottom of the jar and its top just below the cover. The insects subjected to the test were suspended in the same way as the thermometers. They were placed in two dram vials, the free end being covered with coarse cheesecloth and the vials hung so that they were nearly eight inches from the bottom of the candy jar and free from contact with any metal. The candy jar in turn was placed on wooden blocks in a shallow pan partly filled with water, protected by an asbestos mat and placed on a gas plate.

Experiments 4 and 5 differed in that a quart fruit jar was placed inside the candy jar described above. The insects were provided with a slanting piece of cardboard for a support though nothing was placed in the bottom.

Experiments 6 to 8 differed from the preceding in that the insects were better protected. Small blocks of wood were

[1] Dean, G. A. Econ. Ent. Jour., 1911, 4:142-58.

placed inside the fruit jar, and on these a circular piece of corrugated cardboard so that the latter could not come in direct contact with the glass bottom. The fruit jar, in addition, had the lower half lined by corrugated paper in such a way that it was impossible for the insects to come in direct contact with the heated glass walls. The thermometer rested lightly upon this cardboard bottom, the whole being covered with cheesecloth as before.

Experiments 9 to 13 were conducted in a photographer's dark room about five feet five inches by four feet eleven and one-half inches and eleven feet high, the necessary heat being secured from a gas heater and a gas plate. The insects were placed in cardboard cylinders with netting at each end, or in a lantern globe similarly inclosed. One was put upon the floor, a second on a shelf about four feet high and just inside of a window, so that developments could be watched, while the third was placed upon a higher shelf some six feet from the floor. The observations in experiments 10 to 13 inclusive, tabulated below, relate to the insects on the shelf, since they were the only ones that could be watched. Owing to the small dimensions of the dark room and the rather wide shelves, it was found that there was a considerable difference between the temperature at the floor and five feet above. In experiment 13, for example, a temperature of over 125° was maintained five feet from the floor for more than five hours, while a maximum thermometer located on the floor registered but 112°.

Observation, whether the insects were in vials, fruit jars or the relatively much larger dark room, showed that the cockroaches became uneasy when the temperature reached about 112° to 114°F; they exhibited evident signs of distress at 116° or thereabouts and succumbed at a temperature of about 120°. This is a comparatively moderate heat and it would seem entirely practical, in the case of hotel kitchens and similar places where there must of necessity be a good sized heating plant, to destroy the pests with this rather moderate temperature. In practice it would be unsafe to plan for less than thirty minutes at a temperature of 120° if one would obtain satisfactory results. It might be necessary to prolong this period even more in apartments where the insects could retreat in cracks or take refuge under bagging or similar material which would afford some shelter from the heat. It is perhaps unnecessary to add that the filling of all cracks and crevices would immensely facilitate the control of this and other household pests, whether we resort to heat or some other method for the destruction of the insects. Heat is also applicable, though the duration of the treatment would probably have to be greatly extended, for the destruction of wood and bark borers in specially selected material, such as that used in the manufacture of souvenirs. It may also prove of value in destroying young larvae in manufactured articles prior to storage and thus greatly reduce the loss on such materials subject to insect attack.

Experiments with heat

TEMP.	RANGE OF TEMPERATURE AND BEHAVIOR OF INSECTS										DURATION OF HEAT					EFFECTS NEXT MORNING
	100°		110°		115°		120°		125°		100°	110°	115°	120°	125°	
	Time	Behav.	Time	Behav.	Time	Behav.	Time	Behav.	Time	Behav.						
Exp. 1			1.35	a.	1.51 2.35	q. u. m.	2.40 2.43	u. u. m.	3.11 3.35	q. d.		1 h. 41 m.	1 hr. 25 m.	33 m.	1 m.	Dead
Exp. 1a					1.55	u.	2.43	u. m.	3.11 3.55	q. d.			2 hr.	1 hr. 12 m.	44 m.	Dead
Exp. 2							9.55 10.17	s. m. q.	10.38	d.				43 m.	1 m.	Dead
Exp. 2a					10.47 11.25	sink. d.	10.35		10.38 10.40	q. s. m.			50 m.	12 m.	5 m.	Dead
Exp. 3			9.50 9.55 4.50	s. m.	3.15	a.						7 hr.	1 m.			Alive
Exp. 4	10		10.05	burned frantic	10.12	d.					12 m.	10 m.	2 m.			Note rapid rise in temperature Dead
Exp. 5					10.45		10.53		2.09 2.10	down			3 hr. 25 m.	3 hr. 17 m.	1 m.	Dead
Exp. 6					3.25		3.45 4.03	d.					38 m.	18 m.		Dead
Exp. 7					10.14	s. m.	9.58 10.39 10.50	f. m.					52 m.	20 m.		Dead
Exp. 8							11.45 12.45 1.03	no m. d.						1 hr. 20 m.	6 m.	Dead
Exp. 9	2.45	u.	3 p. m.	u.	4.15 4.45	w. m. f. m.					2 hr.	1 hr. 45 m.	35 m.			Dead
Exp. 10	2.53	u.	3.15	u.	4 4.45	a.					1 hr. 52 m.	1 hr. 30 m.	45 m.			Alive[1]

Exp. 11	9.50	u.	10.20	u.	10.40		12.10 12.35	d.			2 hr. 45 m.	2 hr. 15 m.	1 hr. 55 m.	25 m.		Dead [1]
Exp. 12	9.45	u.	10.05	u.	10.30		10.55 11.35	d.	11.40 12.30		2 hr. 45 m.	2 hr. 25 m.	2 hr.	1 hr.35m.	50 m.	Dead [1]
Exp. 13	10.40	u.	10.55	u.	11.15 11.33	u. m.	11.55		12.55 1 4 p. m.	d.	5 hr. 15 m.	5 hr.	4 hr. 20 m.	4 hr. 5 m.	3 hr. 5 m.	Dead [1]

u.= uneasy; m.= movements; f.= feeble; q.= quiet; d.= dead; a.= active; s.= slight.

[1] In 10, 11, 12, 13, the observations refer to those roaches placed above the floor.

NOTES FOR THE YEAR

The following are brief accounts of some of the more injurious or interesting species which have been brought to our attention during the past year.

The false cottony maple scale (Phenacoccus acericola King) and the cottony maple scale (Pulvinaria vitis Linn.) have occasioned numerous inquiries, especially in the southern portion of the State. Both of these species have been repeatedly noticed in the publications of this office, and in this connection we would call attention to the report appearing on another page, upon conditions obtaining in Mount Vernon last summer, and emphasize the desirability of employing the safer whale oil soap solution in efforts to control these pests. Canker worm injury continues in southeastern Westchester county, as reported by Henry Bird and several other correspondents. This species is easily controlled and serious effects resulting from its activities must be charged to either indifference or ignorance.

The European Phytonomus meles Gyll., kindly determined by Prof. E. G. Titus, was reared June 21, 1908 from clover heads collected in the vicinity of Albany. The record shows the establishment in the State of an European species closely related to the introduced and very destructive alfalfa weevil, Phytonomus posticus Gyll., and is therefore of more than usual interest. Trichius affinis Gory was reared from decaying black cherry.

FRUIT TREE INSECTS

Hoplia trifasciata Say. Mr Roy C. Draper states, under date of May 14, 1911, that this beetle was abundant on the blossoms of a small pear orchard in Greece. He adds that the trees were covered with the insects which were gnawing out the sides of the fruit buds. He estimated that at least one-third of the buds were thus affected. Similar injury has been recorded by Messrs Webster and Mally in Bulletin 17, n.s., United States Department of Agriculture, Division of Entomology, page 98. Such depredations are unusual and generally limited in extent. Prompt spraying with arsenate of lead, using six to ten pounds to fifty gallons of water, would probably be the most practical method of checking this insect. Hand picking, in the case of small or low trees, might be equally or even more effective.

Say's blister beetle (Pomphopoea sayi Lec.). This large, usually rare blister beetle is nearly an inch long and is easily distinguished from allied forms by its rather stout, olive green body and the shining black, orange banded legs. It was exceptionally abundant this year, having been reported as feeding upon locust blossoms at Castleton, Slingerlands, Fonda and Hartford by Messrs Matthew Hart, R. S. Nards, Frank Jansen and Smith Bowen, respectively, the dates varying from May 30th to June 14th. Mr Arthur Ward of Philmont reported this beetle as destroying cherry blossoms June 21st. The abundance of this blister beetle was also noted at Cambridge and Schuylerville by Messrs J. G. Ward and A. C. DeGarmo, respectively, though no record was given as to the food habits. It is possible that a portion of these reports was stimulated by the desire to locate colonies of the periodical Cicada, though this could hardly be the entire explanation.

This insect was reported in 1909 as swarming upon roses and other plants, devouring much foliage and causing considerable injury in Voorheesville, Albany county, and Quaker Street, Schenectady county, while in 1900 it was rather abundant and injurious to peach trees at Clarksville. The late Doctor Lintner records this species as feeding upon wheat, the leaves of butternut and on locust blossoms, and states that ordinarily it is rare, only individual specimens being taken. These outbreaks last but a week, and as the grubs feed upon grasshopper eggs the species is beneficial on the whole, even though occasionally committing local depredations. It is possible that the insects could be driven from valued fruit trees by the use of long switches or jarring, or even the employment, when weather conditions are favorable, of a dense smoke. It is better to attempt some such method than to kill the beetles by hand picking or by the use of poisons. The latter can not be used with safety upon trees in bloom, to say nothing of its being against the law.

Red-humped apple caterpillar. (Schizura coninna Abb. & Sm.). This is one of our most striking caterpillars on account of its coral red head, the prominent hump of the same color on the first abdominal segment, and a similar swollen area near the posterior extremity. The full-grown caterpillar is about one and one-quarter inches long, black, with a series of rather conspicuous yellowish dorsal and sublateral lines with white between. There are prominent black tubercles on the body, which are especially well developed on the thoracic and first abdominal segments, on which latter they form conspicuous conical processes on the top of the swollen red portion. This stage is so peculiar that it is easily recognized. The young caterpillar presents an approach to these conditions, as will be seen from the following description:

Length 6 mm. Head shining jet black, bilobed, with a pair of submedian setose tubercles. Body mostly yellowish orange, mottled obscurely with reddish and with narrow sublateral and lateral yellowish lines. Dorsally there are submedian rows of rather large, black, setose tubercles, those on the thoracic segments and on the 1st, 8th, 9th and 10th abdominal segment, especially the latter, being markedly larger. These abdominal segments show a slight enlargement. There are also sublateral, lateral and suprastigmatal lines of smaller, black, setose tubercles. The true legs are black, while the prolegs are yellowish, the apexes laterally being dark brown or black.

The parent moth is rather inconspicuous with dark brown fore wings, grayish on the outer margin, a dot near the middle, a spot near each angle and several longitudinal streaks along the hind margin, all dark brown. The female deposits her eggs in clusters on the under side of the leaves during the month of July. They hatch soon and the young caterpillars at first consume only the under surface of the leaf, leaving the upper unbroken, though as they increase in size the entire leaf is devoured. The caterpillars are social in habit, remaining in rather compact groups when not feeding and attain maturity in this latitude during August or early September. This gregarious habit frequently results in one or more branches being entirely stripped. There is but one brood in the North though in the South there are said to be two generations. This pest is seldom abundant, and while displaying a marked preference for apple, also occurs on plum, cherry, rose, thorn and pear. It is easily controlled by thoroughly spraying with an arsenical poison, preferably arsenate of lead (15 per cent arsenic oxid) used at the rate of about two pounds to fifty gallons of water.

Numerous specimens of the small, grayish Tachinid, A c t i a p i l i p e n n i s Fallen, were reared in early August from the red-humped larvae of this common pest received from Amenia, N. Y. Nothing seems to have been published earlier respecting the food habits of this parasite in America, though it has been recorded from the White Mountains, N. H., New Jersey, District of Columbia and southern Illinois. It was first studied in America by

Professor Townsend who redescribed it under the name of Thryptocera americana.

Forest tent caterpillar (Malacosoma disstria Hübn.). This pest was exceedingly abundant and destructive about a decade ago, defoliating considerable areas of hard maples and stripping many apple trees. Apparently this species is becoming numerous again, since it was reported as stripping woodlands by Townsend Cox, Setauket, and as present in some numbers on the estate of Warren Delano, Annandale, a number of trees being defoliated. Mr Bronk VanSlyke of Ravena found small numbers of the caterpillars in his orchard, while Dr C. S. Merrill of Albany brought in a number from Warrensburg and stated that the pests were on everything in the village. Dr W. E. Britton of New Haven, Conn., found evidence showing that the caterpillar had been abundant at Jay, Essex county, cocoons being present in July on the trunk of nearly every tree, including pines, and on fences and stone walls. On the under side of large branches of apple trees one could see patches five or six inches in diameter, of the cast skins or exuviae of the caterpillars.

This scattering appearance in widely separated localities may be the forerunner of a great abundance of this pest in the next two or three years. It is certainly advisable to watch for their appearance and if they become numerous upon orchard or valued shade trees, resort promptly to remedial measures, such as thorough and early spraying with an arsenical poison, preferably arsenate of lead.

A peculiar apple miner. In connection with our studies of the codling moth discussed earlier, we found an exceptionally fine example (plate 8, figure 4) of the work of a miner operating just under the skin of the apple. This insect appears to work in a similar manner under the bark of apple twigs, making a long, narrow, serpentine mine. The miner is never abundant and the adult has not been reared, though from the character of its work the insect has been tentatively referred to the genus Mamara. Doctor Howard[1] published a brief notice accompanied by an illustration of the work of this insect in Delaware, while ten years later, Mr A. L. Quaintance[2] recorded this species from the Ozark mountains

[1] 1898, U. S. Department of Agriculture, Division of Entomology, Bul. 10, n. s., p. 87-88

[2] 1908, Entomological Society of Washington Proceedings 10:2

and also in Massachusetts. Prof. H. T. Fernald, in a recent letter informs us that repeated attempts to rear the adult have been unsuccessful.

San José scale (Aspidiotus perniciosus Comst.). There have been some complaints the past season to the effect that the scale has multiplied to an unusual extent, especially late in the summer and during the fall, even in orchards where there has been more or less thorough spraying. Investigation of several such cases disclosed the fact that this abundance of the scale was most marked on trees in localities where the treatment was not thorough for some reason or other. Examinations in several orchards where the scale has been prevalent for years, showed exceedingly gratifying conditions so far as checking this pest was concerned.

The concentrated lime-sulfur washes, commercial or home-made, are being used very largely to the exclusion of the earlier preparations. There has been a slight tendency on the part of some to blame the newer washes for unsatisfactory results here and there, though we have been unable to obtain any reliable data in support of any such contention. Results where thorough work was possible have almost invariably been good or even excellent. The manufacture of the home-made concentrated wash has been rendered easier during the last year or two, and in a few instances most excellent results have been secured by cooperation in the making of this preparat'on. This is usually possible in a neighborhood where there is considerable demand for a lime-sulfur wash, since there is almost invariably a steam plant of some kind which can be readily adapted for this purpose. The invariable result, if the work is properly systematized, is a good product and a marked saving to the community. One great advantage of this wash is that it can be made up in advance if this seems advisable and the necessary storage capacity is available, or it can be prepared just before using, provided the plant has sufficient capacity to meet the local needs.

SMALL FRUIT INSECTS

Raspberry Byturus (Byturus unicolor Say). The small, yellowish brown beetles referable to this species were rather abundant May 17, 1911 in the raspberry patch of Mr S. R. Taber, Milton, N. Y. They were particularly numerous upon the lower leaves and displayed a marked preference for the unfolding leaf or the unopened bud, eating a circular hole into the latter, the beetles evidently feeding to a considerable extent upon the more tender opening leaves, gnawing between the veins, and as the foliage expands they produce a series of irregular, somewhat linear, skeletonized areas sometimes extending through or breaking through to the under surface of the leaf. In an adjacent patch there were as many as eight or ten of these insects upon individual hills and, in some instances, a number of buds had already been destroyed. Beetles were observed in copulation, This insect was also reported by Mr J. S. Carpenter of Marlboro as being very abundant and injurious to his raspberry bushes.

The pale yellowish brown beetles appear in early May and feed upon the tender leaves and buds. In the case of bad infestations most of the tender leaves may be partly or almost entirely skeletonized. The larvae feed in the fleshy head of the fruit. The most satisfactory method of controlling this species is early and heavy applications of arsenate of lead, preferably just before the beetles appear. In the case of bad infestations it may be advisable to supplement this poison application by spraying with kerosene emulsion, designed to kill the beetles by contact.

Garden flea (Smynthurus arvalis Fitch). An examination May 17, 1911 in the raspberry patch of Mr S. R. Taber, Milton, N. Y., showed that the supposed red spider was this species, a comparatively innocuous form having no connection with the abundance of red spider last season. These small, yellowish garden fleas were rather numerous upon some hills, two and three being frequently seen upon a leaf and, in some instances, five or six were readily found upon one leaflet. This latter, however, was exceptional. The garden fleas did not appear to be inflicting any material injury, possibly causing a very slight rasping here and there upon the surface of the foliage. There was so little damage caused by this species that remedial measures were not considered necessary.

Four-lined leaf bug (Poecilocapsus lineatus Fabr.). Currant shoots showing serious injury (plate 26) by this pest were submitted for examination in early June by Hon. Albert Yeomans, Walworth, accompanied by the statement that this insect had inflicted serious damage upon an extended planting of currants. This pest belongs to the family of true bugs or Hemiptera, is a rather common general feeder and occasionally becomes excessively abundant, as was the case about 1892 at Ithaca, N. Y. The parent insect is angular in shape, nearly three-eighths of an inch long, black, with conspicuous yellowish green or yellowish longitudinal stripes. It is extremely rapid in motion, secretive in habit and is rarely observed. The young or nymphs are vermilion red and, like the adult, seek shelter. The most characteristic and usually the only apparent evidences are the oval, brown spots on the developing leaves. These are caused by the bugs sucking the green, succulent matter from the interior of the leaf, the affected areas soon collapsing, turning brown and dying. These spots measure about a tenth of an inch in diameter and may be exceedingly numerous. Occasionally the injury is so serious as to result in the wilting and death of many of the leaves.

The eggs of this plant bug, deposited during late June and early July in slits in the shoots, hatch early the following May and the young attain full growth about the second week in June. The adults are so agile and resistant to insecticides that it is practically impossible to destroy them. Watching for early signs of the young or nymphs, indicated by the occurrence of discolored spots described above, and then promptly spraying with a kerosene emulsion, the standard formula diluted with about five parts of water, is the most promising method of checking this insect. The treatment should be exceedingly thorough and the apparatus adapted to underspraying in order to catch as many of the pests as possible. Ordinarily, remedial measures are not necessary.

SHADE TREE PESTS

Spiny elm caterpillar (Euvanessa antiopa Linn.). The large, spiny, black, red-spotted caterpillars of this butterfly feed in colonies, usually near the tips of limbs, and frequently defoliate branches and occasionally considerable portions of trees. This insect was exceptionally abundant in New York State, causing complaints from Long Island, throughout the Hudson valley and from some other sections. The caterpillars were quite numerous and injurious to Carolina poplars and willows in particular, at East Hampton. Specimens of this pest were received from Belleport, L. I., Amenia, Hillsdale, Greenwich, Ballston Spa, Gloversville, Chestertown, Ticonderoga, Elmira, and Oneonta, accompanied by reports of more or less serious injury. This insect has also been reported as being abundant upon the elms of Binghamton and of Dunkirk. Local observations at New Baltimore, Ravena and the vicinity of Albany disclosed more or less injury by this caterpillar, though most of it was restricted to branches or portions of trees.

The gregarious habits of the caterpillar make its feeding conspicuous and therefore facilitate its early detection. It is comparatively easy to check these leaf feeders by the judicious application of an arsenical poison, preferably arsenate of lead, it being feasible to restrict the treatment to the infested limbs and those adjacent. Limbs bearing clusters of caterpillars can also be cut off and the pests crushed. Ordinarily, remedial measures are not necessary.

Elm leaf beetle (G a l e r u c e l l a l u t e o l a Müll.). Injuries by this pest have been exceptionally severe and general on Long Island and in the Hudson valley at least. The damage was so general that the elms of many communities could easily be recognized in midsummer at a distance of several miles because of the contrast presented by the brown, dead foliage.

The elms of Amaganset at the eastern end of Long Island were very severely injured, and the same would have been equally true of East Hampton had it not been for the spraying earlier in the season. Even with this protection there was considerable injury. The brown foliage of elms was a rather common feature of the landscape on both sides of the Hudson river from Yonkers north to Albany. Mr Henry Bird reports the pest abundant at Rye. The injury to more or less isolated trees in woodlands or on the edges of fields and some distance from the highway was very evident during the past season.

Many of the trees in Albany were badly eaten by the elm leaf beetle, this being especially marked on Clinton avenue, Lark and Hamilton streets and those adjacent to the two latter. The elms of Menands and Watervliet were very seriously affected, this being especially true in the southern portion of Watervliet. Almost every tree in this section had the foliage severely injured and in many instances it was completely destroyed. The damage in Watervliet appears to have been more widespread and general than has been the case for the past twelve or fifteen years. Many of the elms of Green Island were severely injured, though the work of the insect was not nearly so general as at Watervliet. The same was true of Cohoes, while Waterford had very many trees which had been seriously affected. There was also general injury in North Troy or Lansingburg, many of the trees having practically all the foliage destroyed. The elms of Hoosick Falls suffered greatly, and, to a less extent, those of Valley Falls and Johnsonville.

The elms of both Stillwater and Schuylerville were very severely injured, many having the foliage practically destroyed. There was serious and general injury at Ballston Spa and considerable damage at Saratoga Springs in spite of the spraying. The trees of Fort Edward and Hudson Falls were practically defoliated by the insect, especially near the centers where the infestation is of longest standing. A number of the elms in these communities had died and others were in a greatly weakened condition owing to the injuries of successive years. The damage at Glens Falls was evident though not so severe, the difference undoubtedly being due to the spraying of the past season.

An examination of the elms both in the city of Albany and along the Delaware and Hudson railroad shows an interesting condition. The trees on the streets traversed by trolleys are, as a rule, more severely injured by the beetle than those on adjacent thoroughfares. The elm leaf beetle has not obtained a foothold west of Slingerlands on the Susquehanna division of the Delaware and Hudson railroad. This is a section not traversed by the electric car. A very different condition obtains on the southern portion of the Saratoga and Champlain division of the Delaware and Hudson railroad comprising a section which has for some years had electric car service. Evidences of severe injury are to be noted along most of the route north of Glens Falls, manifest exceptions being Gansevoort, Round Lake and Lake George. The two former are off the line of the electric cars and the latter has probably not had trolley service for a sufficient time to allow general infestation. The elm leaf beetle, as is well known, is very prolific and naturally quite local in its habits. The electric cars, traversing as they do many of the tree-lined streets of various communities, afford abundant opportunities for the collection and dissemination of the beetles. The distribution of the badly infested areas lends weight to the belief that the electric car is an important factor in the dissemination of this pest.

There are numerous other localities not served by the electric lines where injury has been severe, especially in the last few years. Even comparatively isolated groups of elms in front of a farmhouse may be badly injured. Many of these places are along highways traversed by numerous automobiles, and it seems very probable that the comparatively recent general use of these vehicles has also been of material service in distributing this pest.

The exceptionally dry weather of the last few years has had a serious effect upon many trees and has doubtless accentuated, by reducing the vitality of the trees, the injury inflicted by the elm leaf beetle. It is also possible that climatic conditions have been unusually favorable for the increase of this pest. Nevertheless, present conditions would seem to justify the expectation of more widespread and general injury in the future than has obtained in the past. The experience of communities infested by the elm leaf beetle for a decade or more has shown that unless the trees are adequately protected, many are bound to succumb to attacks by this insect. Thousands of elms have perished during the last twenty years from this cause alone in the cities of Albany and Troy and many more are in a precarious condition owing to lack of adequate protection in recent years, due either to no spraying or indifferent work.

The problem at the present time is to secure the general recognition of the necessity for protecting our elms if the trees are to be kept in even a fairly good condition. Repeated defoliations in the past have resulted in the wholesale destruction of trees, and under the changed conditions of the last decade or thereabouts, even more general injury may be expected in the future. A number of communities in the Hudson valley have been spraying their elms for some years and, in some instances at least, those interested in the work have been inclined to blame the failure to secure good results upon the insect itself, climatic conditions or some other than the true cause. The facts of the case are that thorough spraying with a modern equipment should result in keeping the leaves green, vigorous and practically intact throughout the season, even in localities where the elm leaf beetle is exceedingly abundant and not excepting trees adjacent to those practically skeletonized by the pest. The essentials are timely and thorough sprayings. Examinations of conditions in several communities the past season force us to the conclusion that most of the unsatisfactory results following spraying operations are due to careless or slovenly work. It is impossible to stand at a distance and spray an elm tree in such a way as to secure approximately fair control. It is a rather common occurrence to find the lower limbs fairly well sprayed, while the upper branches are almost untouched by the poison and, as a consequence, the latter are severely injured by the beetle. Good poison and efficient apparatus can be easily secured and in most instances has been obtained. The weak link in the chain of practice at present is the time and method of application, particularly the latter. Spraying trees is a disagreeable, hazardous occupation and in order to secure the best results, it is necessary to make the compensation such as to result in a keen competition for the position of nozzle man. The application of business principles would justify the placing of this work in the hands of a party who at least understood the rudiments involved (a skilled forester would be even better) and giving him authority to insist upon any reasonable standards in methods and operation. Let this man be held rigidly accountable for unsatisfactory results following spraying operations and we shall see a marked change in the elm leaf beetle situation.

The elm leaf beetle is not such a serious pest in Europe, and it would seem, in view of the probable continuance of the severe injury of the last few years, as though a serious effort might well be made to secure natural enemies, since they appear to be very effective checks upon this beetle in European countries.

Bronze birch borer (Agrilus anxius Gory). Dying or dead white birch trees, especially the ornamental weeping birches on lawns, have been a rather common sight during recent years in cities in the western part of the State. It is now stated that all the birches in Geneva have been killed or practically so, while many of those in Elmira and Ithaca have been destroyed. The writer has noted dying birches in Rochester and several villages in that general section. The past season our attention was called to a group of dying birches at Lansingburg, showing that this insect has commenced its nefarious work in the eastern part of the State. Similar injury or something closely resembling it was observed on the grounds of the Hotel Sagamore, Lake George.

The signs of injury are very characteristic, it requiring but little experience to recognize the work of this pest. Usually the thin foliage and dying condition of the upper branches are the first evidences of trouble. A more careful examination may show well-marked, annular ridges around some of the smaller branches, accompanied frequently by reddish or rusty brown spots here and there on the white bark, indicating the operations of a borer beneath. This indentification can be confirmed by cutting into the bark, especially where there are ridges, and the disclosing in the inner bark or sapwood of a flattened, usually more or less sinuous channel. Advanced injury is usually characterized by numerous interlacing galleries in the bark of the upper branches, the limbs above being mostly dead. The cause of this trouble is a flattened, whitish, rather delicate grub about three-quarters of an inch long, with a large, flattened anterior extremity and a pair of horny, serrate processes at the opposite end of the body.

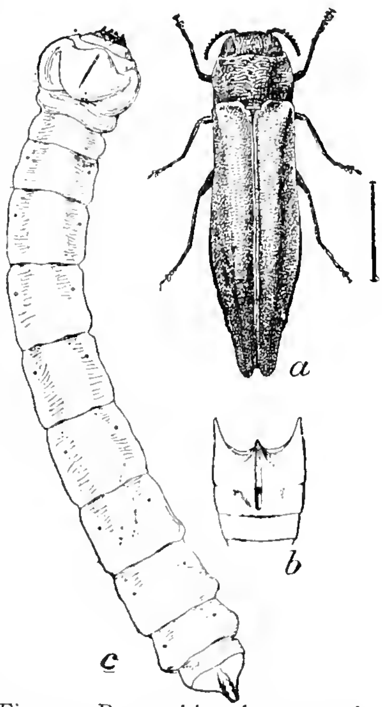


Fig. 3 Bronze birch borer: *a*=female beetle; *b*=first abdominal segments of male from below; *c*=larva from above, all enlarged about 3½ times. (After Chittenden, U. S. Dep't Agric. Div. Ent. Bul. 18, n. s.)

The destructive work of this pest is confined to the inner bark and sapwood, places inaccessible to ordinary applications, consequently spraying or the application of deterrent substances are of little or no value. The grub winters in its burrow, transforming to a pupa in the early part of May, the moderately robust, olive brown beetle from three-tenths to nearly one-half an inch long appearing the latter part of May or early in June. The only satisfactory method of checking this borer is to cut and burn, at some time prior to the appearance of the insect, all infested trees or portions of the same. Limbs that appear but slightly affected are usually doomed, since the galleries generally girdle or nearly girdle the limb and it is only a question of time before the branch must succumb. It is much better to remove such and burn the wood at once, rather than to allow the beetles to escape and attack adjacent trees. It is obvious that the more thorough the work the greater will be the benefits resulting from this treatment. This applies not only to isolated groups but to all the trees in a given section. There should be the fullest possible cooperation in an effort to check this pernicious enemy.

White marked tussock moth (Hemerocampa leucostigma Sm. & Abb.). This well known city pest has been rather abundant in Albany, defoliating or nearly stripping many of the horsechestnuts and lindens (plate 25), though the elms and maples do not appear to have been seriously affected. The work of this caterpillar was also observed on horsechestnuts in particular, though to some extent on lindens at Menands, Watervliet, Green Island and Cohoes.

It is comparatively easy to remove from infested trees during the winter, the conspicuous snow-white egg masses (plate 27, figure 2) attached to filmy cocoons. This is very effective, since the female moth is wingless and rarely does more than crawl onto the surface of the cocoon prior to laying her eggs. The crawling powers of the caterpillar are also very limited; consequently this insect is an extremely local pest. It is also amenable to thorough and timely sprayings with a poison, preferably arsenate of lead (15 per cent arsenic oxid) using about two pounds to fifty gallons of water and making the application when the caterpillars are small and therefore most susceptible to any such poison.

European elm case bearer (Coleophora limosipennella Dup.). This introduced species has been known for some years in the vicinity of New York City and on Long Island. The curious brown, somewhat flattened cases of the larva are quite characteristic and are sometimes accompanied by rather serious injury. It was surprising last June to discover the larvae and work of this insect in a somewhat out of the way location near the Connecticut line in South Salem, some forty miles from New York.

FOREST PESTS

Hickory bark borer (Eccoptogaster quadrispinosus Say). The pernicious activity of the hickory bark borer has been most evident in the eastern part of New York State, particularly in the immediate vicinity of New York City during the last three years. An examination of the hickories in Prospect Park, Brooklyn, in 1909 showed that a large number of the magnificent trees in that extensive park were so seriously affected that it would be necessary to cut out many in order to save the remainder. Last year there were complaints of injuries in the region of the Bronx, while the destructive work of this borer has been continued during the past season. Its nefarious operations were reported by Mr Henry Bird of Rye.

Diseased or dying hickories are to be found in many places in the Hudson valley. A personal investigation of conditions in the vicinity of Tivoli showed that a number of trees had been killed by this borer during the past two or three years, and that many, possibly the majority, in that section were so seriously infested that it was only a question of a few months before they must also succumb to the attack. The severe droughts of the last two or three years have undoubtedly been favorable to the development of this pest, since the vitality of many trees has been lowered and they have thus been rendered

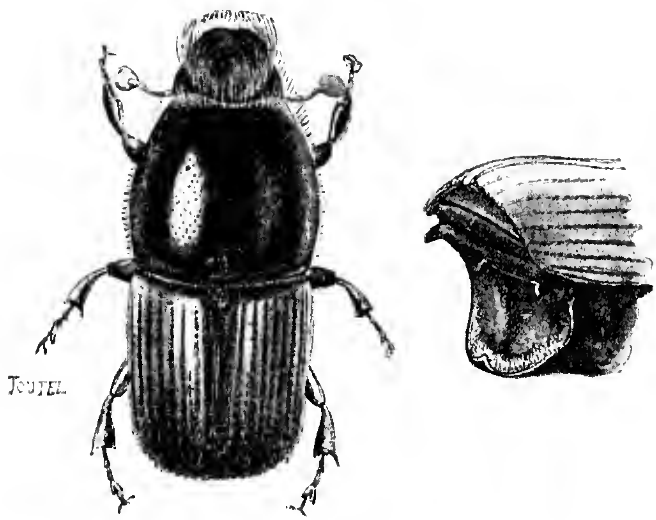


Fig. 4 Hickory bark borer from above and side view of the posterior extremity of the male (author's illustration)

more susceptible to attack by insect enemies. It is also possible that the extremely cold weather of several years ago had a deleterious effect upon the trees. The insect is now so abundant in many sections that unless radical measures are adopted, many trees will be destroyed another year.

The preliminary signs of injury, such as wilting leaves and dead twigs in midsummer, are exceedingly important because they indicate serious trouble before it has passed the remedial stage. Examination of injured trees in the fall or during the winter may show particles of brown or white sawdust in the crevices of the bark, and in the case of some trees a few to many circular holes appearing as though they had been made by number eight buckshot. The recognition of this sawdust is quite important, since the dark brown or black, rather stout, cylindrical parent beetle about one-fifth of an inch long invariably starts its gallery under a protecting scale of bark, the sawdust mentioned above being the only external evidence. Such trees are more dangerous to the welfare of adjacent living hickories than others which may be fairly peppered by the numerous exit holes. The external evidences cited above should be supplemented by cutting down to the sapwood. The exposure there of longitudinal galleries one to one and one-half inches long, about one-eighth of an inch in diameter and with numerous fine, transverse galleries arising therefrom and gradually spreading out somewhat fan shaped, is conclusive evidence as to the identity of this pest. In very early stages of the attack the longitudinal gallery described above, with a series of minute notches for the reception of eggs on either side, may be all that can be found. Only a little experience is necessary before one can recognize the characteristic galleries of this borer. These are almost invariably to be found somewhere upon infested trees, since an attack is rarely discovered before at least some of the grubs have commenced working across the bast fibers.

The insect passes the winter in oval cells as stout, whitish, brown-headed grubs about one-quarter of an inch long, the beetles appearing in the latitude of New York from the last of June to the last of July. There is only one generation in this section of the country. This greatly facilitates the control of the pest, since it is not necessary to guard against a midsummer infestation.

There is only one thing to do in the case of a serious infestation such as that indicated by dying trees or branches. All badly infested trees or portions of trees should be cut and at least the bark burned before the following June, in order to prevent the grubs then in the bark from maturing and changing to beetles which might another season continue the work in previously uninfested trees. It is particularly important to locate the hickories which have died wholly or in part the past summer, because they contain living grubs. General cooperation over an extended area in the cutting out of infested trees and burning of the bark as indicated above, will do much to check this deadly enemy of hickories. This destruction of the insects does not prevent the utilization of the wood and timber commercially, provided the bark is destroyed within the time limits given above. Slabs from saw logs and fire wood with the bark on should all be burned during the winter.

This also applies to trimmings and small limbs which have no commercial value. If it is impractical to work up logs and burn the slab wood, the insects can be destroyed by a prolonged submergence in water or by removing only the bark and burning that.

Two-lined chestnut borer (A g r i l u s b i l i n e a t u s Weber). An investigation of conditions on the estate of Mr Norman de R. Whitehouse at Old Westbury, N. Y., showed that there were probably some two hundred red oaks which had been killed by this pest. Most of the affected trees were small with a trunk diameter of less than six inches and were usually well shaded and therefore presumably less vigorous.

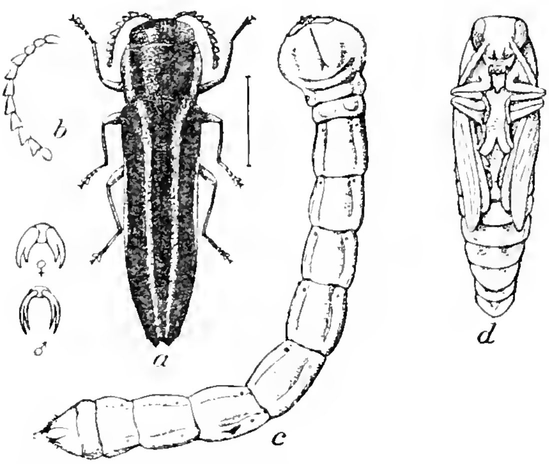


Fig. 5 Two-lined chestnut borer: *a*=adult beetle, enlarged; *b*=antenna of same, enlarged ♀=claws of posterior tarsi of female, somewhat enlarged; ♂=same of male, somewhat enlarged; *c*=larva, enlarged; *d*=pupa, enlarged. (After Chittenden, U. S. Dep't Agric. Div. Ent. Cir. 24, 2 ser. '97)

A few of the rather scarce, larger trees were also affected. One group consisted of three with diameters of about fifteen, twelve and nine inches, respectively. They had died during the summer, probably in late August or early September, and were standing near a tree about nine inches in diameter which had evidently been killed the preceding season. This is an instance of the beetle being somewhat local in habit and conditions comparable to those frequently noted in the case of the allied bronze birch borer, A g r i l u s a n x i u s Gory, another pernicious enemy of trees. The galleries of this chestnut and oak pest were rather common in oak stumps at Nassau in a wood lot where limited annual cutting was the practice though there was no evidence here of serious injury to living trees. Injury was also reported from Garden City.

The work of this insect is easily recognized by the irregular, anastomosing galleries traversing the inner bark and frequently girdling the tree. Many of these galleries are only about one-sixteenth of an inch in diameter, though the mature grubs cut a channel nearly a quarter of an inch wide. The beetle is nearly three-eighths of an inch long, black, and with the wing covers marked with two golden yellow stripes as illustrated in the figure. The borer or larva is long, slender, flattened, the part just behind the head considerably swollen, and a milk white or yellowish color except the mouth parts and the peculiar minutely serrate anal processes, which are dark brown. This borer winters in its gallery, usually with the slender body abruptly bent near the middle. The pupa is white like the larva.

This borer is a well-known enemy of chestnut and oak, there being several records of serious injury in various parts of the country. It would not be surprising if this outbreak was an indirect result of the chestnut blight. Most of the chestnuts near Old Westbury, L. I. have been killed by the disease, though there are still hundreds dead or dying and therefore presenting favorable conditions for borer infestation. Beetles issuing from the chestnut, in the absence of this food plant, must necessarily concentrate their attack upon adjacent oaks or perish. Since these borers winter in the affected trees, the cutting out and removal or burning of the wood before growth begins in the spring will do much to check the trouble and thus destroy many borers which normally would mature and attack other trees the following season.

MISCELLANEOUS

Abia inflata Nort. The false caterpillars of this species were transmitted by Leonard Barron from Garden City, N. Y., under date of June 8, 1911 accompanied by the statement that they were destroying Lonicera in that section.

Larva. Length when extended 2.2 cm. Head brownish, the ventral third fuscous whitish. Body mostly yellowish and sooty yellowish. There is down the middle of the back a broad, variably yellowish stripe broken by a series of median, quadrate or rectangular spots as follows: on the annulets of the anterior portion of each segment two transverse, irregularly quadrate spots and on the broader posterior annulet a distinctly larger, quadrate or irregularly quadrate, black spot. The color of this posterior annulet is a deep orange and gives the impression of a partially transverse band bounded sublaterally with an irregular, rather large, black spot. Sublaterally there is a broad, fuscous yellow stripe and laterally a yellowish white stripe, the boundary between the two being marked by an irregular line of black spots arranged much as those on the dorsum. Venter, true legs and prolegs (the latter, sixteen in number, being located on the second to the ninth and fourteenth segments, respectively) whitish. At the base of each proleg there is a short, oblique stripe of yellowish.

June beetles. Last spring, May or June beetles were exceptionally abundant here and there in the Hudson valley, attracting notice by invading lighted dwellings and feeding upon various forest trees, especially oak and chestnut. In the vicinity of Albany were taken several species, namely Lachnosterna grandis Sm., L. fusca Froh., L. hirticula Knoch, L. hirsuta Knoch, while the usually rare Polyphylla variolosa Hentz, was very common at Schenectady in early July, though no damage was observed, according to Richard Lohrmann. The above list of species should not be considered as exhaustive, since it includes only those forms taken in connection with other collecting.

The young or larvae of the May or June beetles are the well-known white grubs of our grasslands, which are sometimes rather injurious to strawberries, potatoes and some other crops planted upon sodland badly infested by these pests. Occasionally the grubs become so numerous in old seedings as to eat off practically all the roots and make it comparatively easy to roll up the sod with a potato hook or similar implement. The life history of the species may be summarized as follows: The eggs are laid by the parent beetles in loose soil and hatch about a month later; the grubs slowly increase in size for at least two years, and from the middle of June till the middle of September of the second or third year, construct earthen cells in which the transformation to the pupa occurs and from which the beetles emerge the following spring. Fall plowing is frequently advised since the breaking up of the earthen cells containing the soft, white pupae is invariably followed by the death of the insect. Injuries to crops can be avoided in large measure by refraining from planting those susceptible to attack upon badly infested sodland. A well-planned rotation of crops is one of the most efficient methods of preventing the undue multiplication of these insects.

Cecropia moth. This large insect, Samia cecropia Linn., as is well known, is subject to attack by a number of parasites, one of the most efficient of these being Frontina frenchii Will. The puparia of this fly are sometimes very numerous in the cocoon of the host (plate 27, figure 3) which in the case illustrated contained forty-one puparia.

Cotton moth (Alabama argillacea Hübn.). The unusual flights of this species attracted the notice of several entomologists. Prof. C. R. Crosby of Cornell called our attention to the presence of the moths at Ithaca. Writing under date of September 28th, he states that the insects covered the ground beneath the street lights, by the thousands. They were numerous at Schenectady, " masses sometimes covering whole sides of buildings near electric lights," according to Richard Lohrmann. Mr Henry Bird of Rye also reported the appearance of the moths and recorded a marked preference by them for the thin-skinned Concord grape as compared with the thicker skinned Salem, hundreds being observed feeding upon the fruit. He states that the punctures made by the moths were exceedingly minute and left no immediate trace, though it is probable that the keeping qualities may be affected. A great abundance of this insect was noted September 23d in Philadelphia by Dr Henry Skinner, while Doctor Britton, state entomologist of Connecticut, records the presence of hundreds at New Haven, Conn., September 25th. Prof. H. T. Fernald reports the capture of a number of moths the last week in September at Amherst, Mass., and Arthur Gibson records their presence at St Thomas and Sarnia, Ontario. These appearances are interesting, as they probably indicate extended flights. These insects are no menace to residents of the North, since they appear unable to live upon any other than the cotton plant.

Depressaria atomella Hübn. Larvae of this species were transmitted by Mr John Dunbar of Rochester, under date of March 25, 1911, accompanied by the statement that they devoured the blossoms of Cytisus albus. The infested plants were obtained by him from another florist in the city, who in turn had imported them from Holland the preceding fall. Adults were reared April 20th and were apparently the above-named southern and central Europe form, though the specimens were so rubbed that a positive identification was impossible. A description of the larva is given below.

Larva. Length 1.5 cm. Head yellowish brown, the most of the labrum, the sutures of the clypeus and the posterior lateral portion of the sides of the head fuscous or dull black; labial palpi tapering, light brown, the sutures transparent; maxillary palpi with the basal segment whitish transparent, the distal segment cylindric, with a length one-half greater than its diameter, fuscous. Thoracic shield brownish yellow, laterally dark brown or black, these markings being produced on the posterior margin nearly to the median line where they are bidentate and also forming an indistinct, broad tooth near the base of this mesal projection. Body: General color yellowish brown with rather broad, submedian, fuscous yellowish stripes, the latter dotted with dark brown, submedian tubercles; sublaterally there is a dark brown stripe; laterally and ventrally the color is fuscous yellowish; anal plate fuscous yellowish; true legs shining black or piceous; prolegs dark brown, except the posterior which are fuscous yellowish; thoracic segments with a submedian small, and a little more laterally, a larger, dark tubercle; sublaterally there is a larger, compound tubercle and laterally a smaller tubercle on the anterior and posterior annulae; abdominal segments with submedian tubercles on the anterior and posterior annulae, those of the latter slightly more lateral, the anterior annula also with a rather large lateral tubercle, all of these unisetose.

Gracilaria. A number of azaleas injured by a leaf feeder were brought to our attention the past winter. Some of these were collected by Mr T. F. Niles in a greenhouse at Yonkers, the azaleas having been imported. Similar trouble was also called to our attention by Mr John Dunbar of Rochester.

An examination of the leaves shows that the caterpillars usually turn over the tip, webbing it down with fine, silken strands, and eating away the tissues of the infolded undersurface. The injured portion turns dry and the retreat contains numerous small, black particles of frass. The whitish, silken cocoons may frequently be found on the leaves close to the affected area, though an occasional one is spun under a marginal roll. One moth was reared and through the courtesy of Dr L. O. Howard of the Bureau of Entomology, determined as a species of Gracilaria near violacella by Mr August Busck. The immature stages are described below.

Larva. Length 7 mm. Head greenish yellow, the labrum and mouth parts light brown, the body mostly pale green, the posterior margins of the segments lighter, the three posterior segments yellowish tinted. Fine, almost invisible hairs origin-ate from minute tubercles; venter mostly yellowish; true legs whitish transparent; prolegs yellowish green; abdominal segments 1, 2, 6, 7 and 8, apodal.

Pupa. Length 6 mm, slender, yellowish green, the dorsum of the head a brownish shade, that of the abdominal segments brownish, the color being distinctly darker on segments 2 to 6. Antennal cases long, extending beyond the tip of the abdomen, those of the posterior legs to the penultimate segment, those of the yellowish green wing cases to the fifth abdominal segment.

Exuvia. Length 6 mm, slender, whitish, protruding from a cocoon such as that described above. Antennal cases extremely long, slender, multiarticulate; dorsum of the abdomen slightly chitinized and rather thickly set with chitinous dots.

Sooty Crambus (Crambus caliginosellus Clem.). A number of these grass webworm caterpillars were received under date of June 21, 1911 from Mr R. L. Skinner, Greenwich, N. Y., accompanied by samples of the work and a statement to the effect that they had destroyed a field of popcorn. He also adds that he had similar trouble in this field several years before. There was serious and somewhat general injury by grass webworms in 1905, corn planted upon sod or in the vicinity of grass suffering severely and even grassland being badly affected. The full-grown webworm caterpillars appear very much alike, being dull whitish or purplish with a darker head and about three-quarters of an inch in length. The young caterpillar of the sooty Crambus has a pale amber head and is a dirty translucent white with irregular, reddish spots on the middle of the body. Scattered, light colored hairs occur above the head and the body.

The female may deposit as many as one hundred and seventy-five eggs, which are dropped indiscriminately. The partly grown caterpillars winter in the protection of grass stubble, and in plowed grassland commence feeding upon the corn as it appears above the ground. Some stalks may be nearly girdled and the worms are frequently embedded in cavities they excavate. As many as thirty caterpillars have been found in a hill, some stalks of which were entirely destroyed, while in others the plants were small, yellow and sickly.

Injuries to corn and other crops by this insect and its allies must be considered more or less accidental, especially as the depredations are usually more marked on the borders of fields adjacent to grass than elsewhere. An excellent preventive is to keep corn and other crops liable to suffer from these pests as distant from grasslands as practical and avoid planting upon recently turned sod. Plowing of infested land in late summer or early fall, August or early September, should result in most of the caterpillars perishing before the following spring. This can not always be done, and danger of injury by species of webworms which feed in the early spring may be obviated to some extent by delaying the plowing as late as possible so as to give the caterpillars an opportunity to complete their growth before another crop is planted. Early spring plowing may only aggravate the injury by retarding the development of the caterpillars, with the result that when corn or some other crop appears, it is speedily devoured by hordes of half-starved webworms. Extra heavy seeding is also advantageous under these conditions, since there is a greater liklihood of some stalks escaping injury.

Lunate onion fly. (Eumerus strigatus Fallen). Numerous specimens of this European fly, kindly identified by Mr W. R. Walton through the courtesy of Dr L. O. Howard, were reared August 19, 1911, from Iris roots received from Saratoga Springs, N. Y., which had also been badly injured by the Iris borer, Macronoctua onusta Grote. There appears to be no published record of this insect having been found in America, though Dr F. H. Chittenden kindly informs me in a recent communication, that flies were reared in the Bureau of Entomology from Amaryllis bulbs received from Buffalo, N. Y., in October, 1906, and also from bulbs from Connecticut and Brownsville, Texas. The species is evidently widely distributed. The establishment of this insect in America is of more than passing interest, since it is recorded as attacking onions in Europe. Verrall.[1] states that the maggots sometimes destroy the entire crop quite as the larvae of Merodon affect Narcissi. The larvae occurred in July and pupated in the bulbs or in the neighboring earth. Dr J. Ritzema Bos[2] finds that one to several maggots may occur in the heart of an onion, causing a decay accompanied by a black discoloration. He is of the opinion that there are two generations annually and describes the full-grown maggots as one-third to nearly one-half of an inch long, dirty grayish yellow and granulated in appearance. Francis Walker[3] records this species as generally distributed in Great Britain and adds that the larvae belong-

[1] 1901, British Flies 8.615.
[2] 1891, Tierische Schädl. u. Nützl. p. 634.
[3] 1851, Insecta Britannica, Diptera, 1:241-42.

ing to the genus feed on bulbous roots. Verrall states that it is recorded from all North and Middle Europe and also from Italy. It would seem as though this insect might become a serious enemy of American bulbs, particularly the onion.

This onion fly is noticed most frequently in economic literature under the generic term Eumerus, though the discovery of Meigen's 1800 paper may necessitate the substitution of Zelima for the better known Eumerus. This species has also been redescribed a number of times, the recognized synonyms being Eumerus aeneus Macq., E. funeralis Meign., E. grandicornis Meign., E. lunulatus Meign., E. planifrons Megn., E. selene Lw. (not Meign.) beside another probable synonym, Syrphus acanthodes Rossi and two varieties. In view of the possible economic importance of this insect a description of the adult and an illustration of the wing are given below.

Adult. Length 6 to 7 mm, head rather small, slightly swollen, hemispheric; eyes in the male narrowly contiguous. Face in the male grayish black, with a sparse, yellowish pile, in the female dark grayish with scattering, short setae. Antennae dark brown in the male with grayish reflections, black in the female, the inner face hoary; the two basal segments short, the third narrowly oval, with a length nearly twice that of the two preceding. Frontal triangle of the male with golden yellow setae; vertex bluish in the

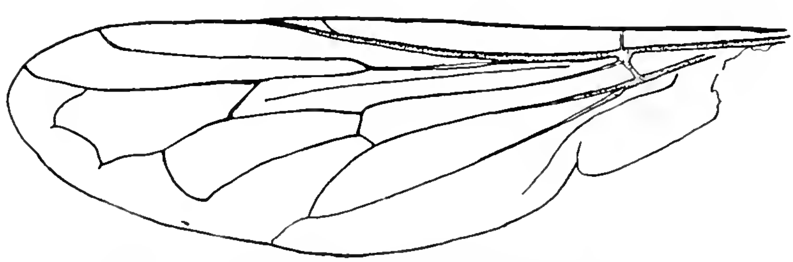


Fig. 6 Wing of lunate onion fly, *Eumerus strigatus*, enlarged (original).

male, aeneous in the female and with a thick pile which is black on the vertical triangle and otherwhere mostly tawny. Disk of thorax and scutellum aeneous, the former with submedian, hoary, evanescent stripes and short, coarse setae. Abdomen bronzy black with three lateral oblique, white, lunate bands, the posterior pair in the male largely obscured by coarse, yellowish setae, the latter also thick on the apex of the abdomen. Wings grayish, the stigma tawny. Halteres yellowish white. Legs mostly black, the tip of the coxae, femora, the basal third and the apex of tibiae, and the three basal tarsal segments yellowish or tawny red; the femora has about twelve short, stout spines on the distal half of its ventral margin.

Xylophagus lugens Loew. The large, carnivorous larvae of this species, easily recognized by the elongate, heavily chitinized conical head, were found at Nassau, N. Y., in decaying chestnut bark from which Winnertzia pectinata Felt was subsequently reared. Two sizes of larvae were observed but they all produced adults within a short time and probably represent variations in nourishment or possibly sexual differences. The larva presents a close general resemblance to that of the allied Xylophagus abdominalis Lw. occurring in decaying pine bark, except that in the latter the three segments behind the head are each well chitinized dorsally.

Larva. Length about 2.5 cm, whitish or dirty white, the head slender, conical, heavily chitinized and with a length greater than the body diameter (plate 27, figure 4). The segment behind the head is well chitinized dorsally, except for two narrow, irregular sublateral lines. The next following has a pair of irregularly subquadrate submedian chitinous plates. The incisures dorsally and ventrally are marked by slight, median thickenings, pseudopodous in character and bordered by a narrow line, in places doubled, of chitinous points. Near the middle of each body segment there is laterally a sparse group of four or five rather long, fulvous hairs. Anal plate chitinized, produced as a pair of submedian stout processes, each ornamented with several long, fulvous hairs. The submedian anal spiracles are located on this plate and are distinctly darker.

Pupa (plate 27, figure 4). Length 1.5 cm, diameter 3.5 mm; color dark brown anteriorly; including the first three abdominal segments, the posterior segments yellowish brown. The antennal cases are short, diverging, conical, reddish brown structures, with a stout cephalic horn at the external basal angle; dorsum of thorax dark brown. Wing covers and leg cases dark brown. Abdominal segments with a distinct, rugose, darker thickening on the anterior and posterior margins, the latter with moderately stout, rufous bristles laterally; terminal segment about half the length of the preceding, with a median process or knob bearing a pair of stout, conical, diverging processes, the latter apically with a fuscous, chitinous spur.

Psilocephala melampodia Loew. The white Dipterous larva of this species was collected April 8, 1911 under decaying pine bark at Albany, N. Y.

Larva. Length 2.5 cm, diameter 2 mm. Head small, chitinous, light brown, the anterior extremity darker; short, stout antennae appear to be present. There are a few sparse setae on the ventral surface of the head. Posterior margin of head with sublateral fuscous markings which appear to unite in a fuscous median line extending back apparently to a fuscous ocular spot near the anterior extremity of the second body segment. General coloring of the body yellowish white, the anterior and posterior segments slightly smaller than the median ones.

Pupa. Length 1.5 cm, the thoracic segments somewhat swollen, the abdominal segments of a nearly uniform diameter, each separated by a strong constriction; color a variable yellowish brown and dark brown, the deeper coloring being confined largely to the wing and leg cases and the abdominal incisures. Anterior extremity truncate, the lateral angles bearing the short, subconical antennal cases; thoracic horns short, subconic. Wing cases extending to the middle of the second abdominal segment, the leg cases to the anterior margin of the third abdominal segments. Abdominal segments 9, with a rudimentary 10th, each separated by a deep constriction; near the middle of segments 1–7 a stout conic spine laterally and posteriorly an irregular, sparse band of short, stout setae. Posterior extremity produced, apically with a pair of submedian, long chitinous processes.

The adult was reared May 1, 1911, permitting the identification of the above described early stages.

Blood worms (Chironomus species). A good sized, living blood worm, some 8 mm long and dark red, was brought into the office January 6, 1911 from the Bender Hygienic Laboratory, accompanied by the statement that it was blown from the nose of a lady who had suffered from several attacks of nosebleed, the larva being found upon her handkerchief. The specimen was transmitted to the Bender Laboratory by Dr J. E. Vigent of Red Hook, N. Y. The blood worms are stated by Johannsen to feed upon the small, red worms known as Tubifex or other small creatures presumably containing hemoglobin in the blood. It hardly seems possible that this creature could have been responble for the nosebleed; it may have been taken into the mouth accidentally when drinking and, in a fit of coughing, thrown up into the upper respiratory passages.

Teratology. Deformities of antennae and other appendages are comparatively common among insects, though asymmetrical modifications of the body, aside from those due to hermaphroditism, are comparatively rare. An interesting malformation of the abdomen was detected in the case of a specimen of Winthemia quadripustulata Fabr. (plate 8, figure 3) taken at Poughkeepsie, N. Y., July 17, 1903. It will be noted from an examination of the illustration that the second abdominal segment is wanting on the right side, while on the left it appears to have attained almost a normal development.

Protective mimicry. The posterior extremity of many female Lepidoptera is protected with a thick tuft of scales. This structure is especially well marked in the Sesiidae. Professor Beutenmueller has given illustrations of the tufts in the case of a number of species. This structure is presumably protective and is doubtless of some value in maintaining equilibrium while the insect is in the air. It is not improbable that these scale tufts are intimately connected with a scent gland so that when expanded they are of material service in attracting the opposite sex. We have shown at plate 17, figure 4 the expanded tuft of Pyrausta theseusalis Walk. as it exists upon a museum specimen which evidently died with the tuft fully expanded. Superficially, this expanded tuft resembles some of the downy, floating seeds, such as that of the dandelion. A closer examination shows this circular, apparently homogeneous organ to consist of two closely apposed, semicircular parts each overlapping the other slightly.

Leptosyna quercivora n. nom. This specific designation is proposed for L. quercus Felt 1911, preoccupied by L. quercus Kieff. 1904.

PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1911. Forty-four are given with titles,[1] time of publication and a summary of the contents of each. Volume and page numbers are separated by a colon, the first superior figure gives the column and the second the exact place in the column in ninths: for example, 75:1025[12] means volume 75, page 1025, column 1 in the second ninth; that is, nearly one-fourth of the way down.

Insects in the Grain. Country Gentleman, November 3, 1910, 75:1025[12]

A summary, economic notice of the Angoumois grain moth, Sitotroga cerealella Oliv. and a short biologic account of a mite abundant in chaff. It is probably Tyroglyphus longior Linn.

Codling Moth in the Hudson Valley. Country Gentleman, December 15, 1910, 75:1174[22]

Summary account of work of Carpocapsa pomonella Linn. in 1910, showing that over 90 per cent sound fruit may be obtained with but one spraying, even when there is a small crop and the second brood of the moth is abundant.

The Greenhouse White Fly. Country Gentleman, December 22, 1910, 75:1198[12]

A brief account of Aleyrodes vaporariorum Westw. with special reference to control measures.

Recent Experiments with the Codling Moth. Economic Entomology Journal, 3:474–77

Summary of experimental data obtained in 1910.

Repelling Squash Bugs. Country Gentleman, December 29, 1910, 75:1222[16]

A brief account of the squash bug, Anasa tristis DeG. with a short notice of the striped cucumber beetle, Diabrotica vittata Fabr.

A New Lestodiplosis. Entomological News, January 1911, 22:10–11

A description of Lestodiplosis peruviana reared by C. H. T. Townsend from Hemichionaspis minor Mask.

[1] Titles are given as published and in some instances they have been changed or supplied by the editors of the various papers.

Do Sprays Poison People? Country Gentleman, February 16, 1911, 76:154[11]

A general discussion of the application of poisons to vegetation, the effects thereupon and the possibility of thus poisoning domestic animals and human beings. The need of care in using these materials is emphasized.

Miastor and Embryology. Science, 1911, 33:302–3

A summary discussion of the adaptability of Miastor larvae to embryological work.

Two New Gall Midges (Dipt.). Entomological News, 1911, 22:109–11

Asphondylia vincenti and Hyperdiplosis eupatorii described from the island of St Vincent. The former was reared from fruits of Jussiaea linifolia and J. suffruticosa and the latter from a conical leaf gall on Eupatorium.

Endaphis Kieff. in the Americas (Dipt.). Entomological News, 1911, 22:128–29

Arthrocnodax (Endaphis) abdominalis from Peru and Endaphis americana from Arizona described as new. Both were reared from foliage infested with gall mites, Eriophyes.

Fumigation-poisoning. Country Gentleman, March 9, 1911, 76:235[16]

A summary discussion of methods of fumigating for grain insects.

Insects and Scale Pests Common to New England and Best Remedy for Each. Massachusetts Fruit Growers Association Reports 12–16, 1906–10, p. 7–12

A brief discussion of spraying followed by observations on the case bearers, canker worms, the oyster scale, scurfy scale and the San José scale.

The Increase and Control of San José Scale. Massachusetts Fruit Growers Association Reports 12–16, 1906–10, p. 37–40.

Summary discussion of control measures for Aspidiotus perniciosus Comst.

The Latest and Best Methods of Controlling Insects and Fungous Pests Attacking our Fruits and Ornamentals. Massachusetts Fruit Growers Association Reports 12–16, 1906–10, p. 84–93

Spraying methods with special reference to controlling the more common insect pests and fungous diseases.

Fruit Tree Insects and Their Control. Massachusetts Fruit Growers Association Reports 12–16, 1906–10, p. 141–57

The San José scale, codling moth, plant lice and apple maggot were discussed in detail, especially the first two.

Summary of Food Habits of American Gall Midges. Entomological Society of America Annals. 1911, 4:55–62

A summary of the food habits of the Itonidae and a comparison of our knowledge with that relating to European species.

A Generic Synopsis of the Itonidae. New York Entomological Society Journal, 19:31–62

A systematic arrangement of the genera with the synonymy. The following new genera were erected: Mycophila, Ceratomyia, Cordylomyia, Corinthomyia, Epimyia, Didactylomyia, Coccidomyia, Erosomyia and Diadiplosis. Meinertomyia and Xenodiplosis were proposed for the preoccupied Pero Mein. and Allodiplosis Rübs. not Kieff.

Elm Beetle. Country Gentleman, March 30, 1911, 76:313[12]

Spraying with arsenate of lead is advised for controlling Galerucella luteola Müll.

Spraying an Apple Orchard. Country Gentleman, March 30, 1911, 76:314[11]

Thorough spraying with a lime-sulfur wash and arsenate of lead is advised for the control of the San José scale and codling moth, respectively.

Some Spraying Compounds. Country Gentleman, March 30, 1911, 76:314[22]

The preparation and use of the lime-sulfur wash is briefly discussed. A kerosene emulsion or whale oil soap solution is advised for the oyster scale and arsenate of lead for the codling moth.

26th Report of the State Entomologist on the Injurious and Other Insects of the State of New York. New York State Museum Bulletin 147, p. 1–180, 1911 (Issued April 5)

Contents

Brown Mite. Country Gentleman, April 6, 1911, 76:337[33]

A discussion of control methods for the brown or clover mite, Bryobia pratensis Garm.

Miastor larvae. Canadian Entomologist, April 1911, 43:134–35; Science, April 14, 1911, 33:583; Economic Entomology Journal, 1911, 4:296; Entomological News, May 1911, 22:227; New York Entomological Society Journal, 19:200–1

Brief directions are given for finding these larvae and the cooperation of entomologists in collecting invited.

Gipsy and Brown-tail Moths. Country Gentleman, April 13, 1911, 76:358[23]

A discussion of the moth situation in New England as shown by the report of the state forester of Massachusetts.

Bean Weevil. Country Gentleman, April 27, 1911, 76:409[44]

Summary discussion of control measures for Bruchus obtectus Say.

Endaphis hirta n. sp. Entomological News, May 1911, 22:224

Original description of a Ceylonese species reared from Dactylopius.

A New Species of Lasioptera with Observations on Certain Homologies. Psyche, April 1911, 18:84–86

Original description of Lasioptera portulacae Felt with observations on the development of the acicula and the homology of the basal pouch in Asphondylia and the terminal lobes in females of other groups.

A Summer Spray. Country Gentleman, May 18, 1911, 76:480[45]

A brief discussion of summer sprays for the control of San José scale, Aspidiotus perniciosus Comst.

Cutworms in the Garden. Country Gentleman, May 18, 1911, 76:482[11]

Cutworms and their habits are described in connection with methods of controlling the pests.

Apple Borers. Country Gentleman, May 25, 1911, 76:502[36]

The habits and methods of controlling the round-headed borer, Saperda candida Fabr. are briefly discussed.

Insects. Country Gentleman, May 25, 1911, 76:502[41]

A brief notice of Chermes floccus Patch on spruce and of the birch borer, Agrilus anxius Gory.

Two New Gall Midges. Canadian Entomologist, June 1911, 43:194–96

Toxomyia rubida and Lobodiplosis coccidarum reared respectively from the aecidiospores of Uromyces and larvae preying on the eggs of Dactylopius, are described.

Billbugs in Corn. Country Gentleman, June 22, 1911, 76:586[17]

A brief economic account of the work of Sphenophorus species in corn.

Salt and Cutworms. Country Gentleman, June 22, 1911, 76:586[36]

Salt is considered to be of little service in controlling cutworms, pests most injurious when prolonged dry weather prevents normal plant growth.

Cicadas in New York. Country Gentleman, June 22, 1911, 76:590[42]

General observations on the abundance and distribution of the 1911 brood.

Rhopalomyia grossulariae n. sp. Economic Entomology Journal, 1911, 4:347

Description of a species destroying gooseberry buds in Ohio.

Rose Beetles. Country Gentleman, June 29. 1911, 76:607[16]

Arsenate of lead advised or the use of netting.

Silver-spotted Skipper. Country Gentleman, June 29, 1911, 76:607[28]

An outline is given of the life history of this butterfly.

Four New Gall Midges. Entomological News, July 1911, 22:301–5

The new genus Toxomyia is erected. Asphondylia pattersoni reared from flowers of Citharexylum quadrangulare; Toxomyia fungicola reared from teleutospores of Puccinia on Emilia sonchifolia; Contarinia lycopersici from flowers of Lycopersicum esculentum and Hyperdiplosis coffeae from fruits of Coffea liberica are described.

Rose Leaf Hopper, Typhlocyba rosae Linn. Economic Entomology Journal, 1911, 4:413–14

Method of oviposition described.

Miastor. Economic Entomology Journal, 1911, 4:414

Observations on the food habits and biology.

Three New Gall Midges (Dipt.). New York Entomological Society Journal, 19:190–92

Holoneurus occidentalis, Lasiopteryx schwarzi and Hyperdiplosis americana are described, all reared from a decaying branch of wild fig.

Hosts and Galls of American Gall Midges. Economic Entomology Journal, 1911, 4:451–75

A tabulation of the galls and food habits of American Itonidae.

New Species of Itonidae. Economic Entomology Journal, 1911, 4:476–84

A new genus, Kronomyia is erected and the following species are described: Joanissia pennsylvanica, Kronomyia populi, Oligarces ulmi, Winnertzia pectinata, Rhizomyia hirta, Dasyneura communis, D. gibsoni, D. pergandei, D. smilacifolia, Cystiphora viburni, Asteromyia nigrina, A. reducta, Lasioptera allioniae, L. arizonensis, Neolasioptera agrostis, N. squamosa, N. trimera and Rhopalomyia gnaphalodis.

ADDITIONS TO COLLECTIONS, OCTOBER 17, 1910–OCTOBER 14, 1911

The following is a list of the more important additions to the collections:

DONATION

Hymenoptera

Thalessa atrata Fabr., black long sting, July 6, Mrs M. S. Miller, Boonville.

Rhodites bicolor Harr., spiny rose gall, old galls on rose, June 19, A. N. Baker, Bellport

Cynips ? prinoides Beutm., gall, September 14, J. A. Douglass, Oriskany Falls

Tremex columba Linn., pigeon tremex, adults on hickory, September 12, Sterling Wallace, New York City.

Caliroa cerasi Linn., cherry and pear slug, eggs on cherry, June 3, H. C. Sharpe, Schenectady

Kaliofenusa ulmi Sund., elm leaf miner, larvae on elm, May 30, J. H. Livingston, Tivoli. Same, May 31, Madam Howe, Kenwood. Same, June 16, Stephen Graff, Johnstown

Trichiocampus viminalis Fallen, poplar sawfly, larvae on poplar, August 30, W. H. Harris, Greenfield Center. Same, August 13, F. C. Helme, Chester

Abia inflata Nort., larvae on Lonicera, June 8, Leonard Barron, Garden City

Trichiosoma tibialis Steph., cocoon and pupa on Crataegus, April 10, Holland. Through State Department of Agriculture

Coleoptera

Eccoptogaster rugulosus Ratz., adult, August 8, Fisher Hyle, Germantown

E. quadrispinosus Say, adult on hickory, August 13, R. L. Cushman, Yonkers

Gymnetron teter Fabr., adult, June 21, C. E. Brisbin, Schuylerville

Rhynchites bicolor Fabr., rose curculio, adults and work, October 26, Miss G. W. Sargent, Lenox, Mass.

Pomphopoea sayi Lec., Say's blister beetle, adults, May 31, R. S. Nards, Slingerlands. Same, May 31, Smith Bowen, Hartford. Same, on locust blossoms, June 5, Matthew Hart, Castleton. Same, June 8, C. M. Winne, Castleton. Same, June 8, A. C. DeGarmo, Schuylerville. Same, June 14, Frank Jansen, Fonda. Same, June 16, J. G. Ward, Cambridge. Same, on cherry, June 20, Arthur Ward, Philmont. Same, June 21, C. E. Brisbin, Schuylerville

Meloe angusticollis Say, oil beetle, adult, September 15, C. E. Fairman, Lyndonville

Tribolium confusum Duv., confused flour beetle, adults, November 29, Miss E. Bush, Albany

Chalepus dorsalis Thunb., locust leaf miner, adults on locust, August 30, H. L. Frost & Bartlett Co., Stamford, Conn.

C. nervosa Panz., adult on locust, August 30, H. L. Frost & Bartlett Co., Stamford, Conn.

Systena taeniata Say var. blanda Melsh., adult on bean, June 29, J. F. Rose, South Byron

Galerucella luteola Müll., elm leaf beetle, larvae, June 28, F. B. Wicks, Ticonderoga. Same, larvae, pupae and adults on elm, July 6, H. L. Satterlee, Highland Falls. Same, eggs on elm, July 21, Miss S. L. Bell, Amsterdam. Same, adult on elm, August 7, Miss F. A. Wood, Poughkeepsie

Melasoma scripta Fabr., lined cottonwood beetle, egg, larvae and adult on poplar, August 18, Bloodgood Nurseries, Flushing. Through State Department of Agriculture

Crioceris asparagi Linn., asparagus beetle, adults on asparagus, May 19, John J. Hicks, Jericho

C. duodecim-punctata Linn., twelve-spotted asparagus beetle, adults on asparagus, May 19, John J. Hicks, Jericho

Saperda candida Fabr., round-headed appletree borer, adults on apple, May 25, W. H. Shutts, Claverack

Plectrodera scalator Fabr., banded poplar borer, adult, July 26, A. F. Onderdonk, Webster Groves, Mo.

Monohammus confusor Kirby, pine sawyer, larvae on pine, March 14, C. Y. Flanders, Tribes Hill. Same, June 5, Leland Wadsworth, Troy. Same, June 6, F. B. Pickering, Ballston Spa

Phymatodes variabilis Fabr., variable oak borer, adults, reared from oak, June 5, James Feeney, Meadowdale

Desmocerus palliatus Forst., cloaked knotty horn, adults on elder, June 2, F. T. Huxley, Amsterdam

Neoclytus erythrocephalus Fabr., adult on maple, June 16, Mount Vernon. Through State Department of Agriculture

Euphoria inda Linn., bumble flower beetle, adult, May 30, E. A. Baldwin, Schenectady

Anomala lucicola Fabr., light-loving grapevine beetle, adult, June 21, C. E. Brisbin, Schuylerville

Serica sericea Ill., adult, June 21, C. E. Brisbin, Schuylerville

Hoplia trifasciata Say, injuring pear blossoms from Greece, May 16, R. C. Draper, Rochester. Through State Department of Agriculture

Canthon laevis Dru., tumble bug or dung beetle, adult and dung ball, May 27, J. B. Scudder, Coxsackie

Amphicerus bicaudatus Say, work on cherry, June 23, R. H. Gibbes, Schenectady

Thelydrias contractus Mots., adult, pupal, larval skins, June 20, L. H. Joutel, New York City

Agrilus bilineatus Web., two-lined chestnut borer, larva on chestnut, August 30, S. K. Clapp, Brown Station. Through C. R. Pettis, superintendent state forests

Dicerca divaricata Say, adult, June 21, C. E. Brisbin, Schuylerville

Alaus oculatus Linn., eyed snapping beetle, adult, June 26, George Fischer, Albany

Byturus unicolor Say, raspberry Byturus, adults on raspberry, May 15, J. S. Carpenter, Marlboro

Attagenus piceus Oliv., black carpet beetle, larvae, October 3, Mrs James Wilson, Rochester

Anthrenus scrophulariae Linn., Buffalo carpet beetle, larvae, October 3, Mrs James Wilson, Rochester

Silvanus surinamensis Linn., saw-toothed grain beetle, adults, April 12, P. Cleveland, Scotia. Same, in flour, May 31, W. I. Seiver & Co., Angelica. Same, June 20, Bates & Broman, Middleburg

Diptera

Tabanus atratus Forst., horse-fly, adult, July 14, J. D. Collins, Utica

Thecodiplosis piniradiatae Snow & Mills, cotypes on Monterey pine, March 16, V. L. Kellogg, Stanford University, Cal.

Anopheles punctipennis Say, malarial mosquito, adult, October 6, R. M. Moore, Rochester

Siphonaptera

Ctenocephalus canis Curt., dog flea, adult, August 4, Miss M. E. Drew, Highland Falls. Through State Department of Health

Lepidoptera

Euvanessa antiopa Linn., spiny elm caterpillar, larva, June 2, Miss Mabel Todd, Gloversville. Same, June 3, L. W. Draper, Amenia. Same, on elm, June 3, M. G. Thomas, Ticonderoga. Same, June 5, H. N. Babcock, Elmira. Same, June 6, C. L. Morey, Greenwich. Same, on elm, June 6, F. B. Pickering, Ballston Spa. Same, June 6, S. D. Zeh, Hillsdale. Same, June 14, C. A. Russell, Frankfort. Same, June 17, A. N. Baker, Bellport. Same, chrysalis, June 14, E. W. Rankin, Albany. Same, June 9, M. F. Winchester, South Amenia

Basilarchia astyanax Fabr., larva on oak, May 30, William Wells, Flushing

Samia cecropia Linn., Cecropia moth, cocoon, May 6, G. E. Ward, Ravena. Same, adult, May 24, Livingston McEwan, Albany

Callosamia promethea Dru., Promethea moth, cocoon on lilac, December 9, J. H. Carpenter, Elnora. Same, April 25, John J. Hicks, Jericho. Same, April 28, Miss F. B. Darling, Syracuse. Same, June 6, C A. Russell, Frankfort

Tropaea luna Linn., luna moth, adult, May 29, Mrs N. A. Pierce, Solsville. Same, May 29, Mrs M. E. Wheeler, East Nassau

Telea polyphemus Cram., Polyphemus moth, adult, May 29, Mrs N. A. Pierce, Solsville. Same, cocoon and moth, July 15, J. A. Reed, Watervliet

Hyphantria textor Harr., fall webworm, larvae, August 25, P. L. Huested, Sparta. Through State Department of Agriculture. Same, September 12, A. G. Seifield, Hopewell Junction. Same, on apple, June 9, A. T. Bennett, Tivoli

Alypia octomaculata Fabr., eight-spotted forester, larva, June 23, F. N. Powers, Utica. Same, on grapevine, July 6, F. A. King, New York City

Macronoctua onusta Gr., larva on iris, July 28, W. L. Rich, Saratoga. Same, August 2, through J. N. Huyck, Albany

Xylina antennata Walk., green maple worm, larvae on maple, May 30, C. O. Horning, Amsterdam. Same, on soft maple, June 6, W. B. Westervelt, Newburg. Same, adult, April 27, C. J. Herrick, Albany

Papaipema nitela Guen., stalk borer, larvae, July 17, A. G. Harris, North Pelham

Heliothis armiger Hübn., corn worm or boll worm, larva in corn, October 13, H. B. Winters, Brooklyn. Through State Department of Agriculture

Melalopha inclusa Hübn., poplar tent maker, larvae on Carolina poplar, June 30, M. C. Albright, West Coxsackie

Datana ministra Dru., yellow-necked appletree caterpillar, July 20 Charles Fremd, North Rose. Same, August 25, F. M. Brooks, Athens

D. integerrima G. & Rob., black walnut caterpillar on pecan, July 28, Miss E. L. Keller, Eden

Schizura concinna Sm. & Abb., red-humped appletree caterpillar, July 12, A. G. Davis, Schenectady. Same, on apple, July 21, W. L. Bosworth, Amenia

Notolophus antiqua Linn, rusty tussock moth, eggs on box, March, nursery stock, Holland. Through State Department of Agriculture

Hemerocampa leucostigma Sm. & Abb., white-marked tussock moth, eggs, March 22, Thomas Tupper, Corning. Same, larva, May 29, J. A. Hepworth, Marlboro

H. definita Pack., eggs on poplar, April 5, Rochester. Through State Department of Agriculture

Tolype velleda Stoll., larch lappet moth, caterpillars on pear, July 25, West Coxsackie. Through State Department of Agriculture.

Malacosoma americana Fabr., apple tent caterpillar, June 5, G. F. Maclure, Saranac Lake

M. disstria Hübn., forest tent caterpillar, June 11, Townsend Cox jr, Setauket. Same on maple, June 13, Miss A. Humphrey, Warsaw

Bombyx mori Linn., silk worm, cocoons on mulberry from North Italy, July 21, Arthur Paladin, Albany

Alsophila pometaria Harr., fall canker worm, moths and eggs, November 30, T. F. Niles, Rye. Through State Department of Agriculture. Same, eggs, February 23, White Plains. Through State Department of Agriculture. Same, moth, April 26, J. F. Hummer, Potsdam

Ennomos subsignarius Hübn., snow-white linden moth, eggs on beech, April 28, J. N. Smith, Margaretville.

E. magnarius Guen., eggs, February 16, P. M. Eastman, Coxsackie. Through State Department of Agriculture

Thyridopteryx ephemeraeformis Haw., bag worm, larvae, August 13, Mrs William Frech, Bayside

Cnidocampa flavescens Walk., Oriental slug caterpillar, cocoon on Japanese maple, March 23, nursery stock imported from Japan. Through State Department of Agriculture

Sibine stimulea Clem., saddle-back caterpillar, larva, August 30, C. L. Van Loan, Catskill. Same, larvae, September 29, R. MacGregor, Brooklyn

Euclea delphinii Boisd., larvae, August 25, Mynard DeFreest, Voorheesville

Phobetron pithecium Sm. & Abb., hag moth, larva, July 27, J. J. Barden, Sodus. Same, August 14, B. O. Burgin, St Johnsville

Zeuzera pyrina Linn., leopard moth, adult, July 21, Mrs H. W. Struss, New York City

Podosesia syringae Harr., lilac borer, pupa, March 14, Hermann Von Schrenk, St Louis, Mo.

Phlyctaenia rubigalis Guen., greenhouse leaf tyer, moth, January 7, J. Dunbar, Rochester

Crambus caliginosellus Clem., sooty web worm, larvae on corn, June 23, R. L. Skinner, Greenwich

Mineola indigenella Linn., leaf crumpler, larvae on Crataegus, November 4, P. L. Huested, Port Chester. Through State Department of Agriculture

Plodia interpunctella Hübn., Indian meal moth, adult in graham flour, September 20, I. A. Weston, Syracuse

Evetria ? turionana Hübn., pine bud tortrix moth, larvae on pine, August 29, D. M. Munger, Glen Cove

Depressaria ? atomella Hübn., adults on Cytisus, April 19, John Dunbar, Rochester

Bucculatrix canadensisella Chamb., birch leaf Bucculatrix, larvae, work on yellow birch, September 7, A. N. McGeoch, Lake Placid. Through State Conservation Commission

Phyllonoryter hamadryadella Clem., white blotch oak leaf miner, on oak, October 10, Miss M. B. Steward, Goshen. Same, June 30, J. N. Briggs, Coeymans

Tinea pellionella Linn., clothes moth, adult, May 1, I. A. Weston, Syracuse

Neuroptera

Corydalis cornuta Linn., Dobson fly, adult, June 29, A. E. Milligan, Schuylerville

Hemiptera

Tibicen septendecim Linn., seventeen-year Cicada on apple twigs, showing oviposition scars, April 13, H. D. Lewis, Annandale. Same, adult, May 20, G. W. Lintner, Summit, N. J. Same, adults, May 28, Edward and Robert Broome, Pelham Bay Park. Same, adult, May 29, G. E. Ward, Ravena. Same, adults, June 3, A. J. Bolton, New Rochelle. Same, June 8, G. B. Thomas, Schuylerville. Same, June 12, R. J. Davey, Mechanicville. Same, June 13, Frank Jansen, Fonda. Same, June 16, F. M. Askins, Schaghticoke. Same, June 10, D. C. Davies, Mechanicville. Same, adults and pupal cases, May 29, S. Bulson, Stony Point. Same pupal cases, May 26, J. Johannsen, Raritan Bay Park, Tottenville. Same, eggs on locust, July 1, A. G. Harris, Pelham

Ceresa bubalus Fabr., Buffalo tree hopper, eggs on peach, April 22, H. B. Filer, Buffalo

Enchenopa binotata Say, two-spotted tree hopper, nymphs on bittersweet, June 15, Miss E. C. Humphrey, Watervliet

Pachypsylla c.-gemma Riley, galls on Celtis occidentalis, May 19, White Plains. Through State Department of Agriculture

Phylloxera caryaecaulis Fitch, hickory gall aphid, adults in galls on hickory June 2, Mrs A. J. Ferber, Rutherford, N. J.

Chermes floccus Patch, gall on spruce, May 15, H. W. Wesson, Eggemoggin, Me. Through Country Gentleman

C. abietis Linn., spruce gall aphid, galls and adults on spruce, June 10, R. T. Conover jr, Bedford

C. pinicorticis Fitch, pine bark aphid, adults on pine, June 11, Arthur Clark, Garrison

Hamamelistes spinosus Shim., adults on birch, June 17, C. W. Goodyear, Tarrytown

Pemphigus ulmifusus Walsh, half grown galls on red or slippery elm, May 27, Stephen Graff, Johnstown

Phyllaphis fagi Linn., woolly beech aphis, adults on beech, June 15, M. N. Gardner, Brewster. Same, on beech, June 17, C. W. Goodyear, Tarrytown

Gossyparia spuria Mod., elm bark louse, adults on elm, June 10, J. D. Rogers, Round Lake. Same, May 31, Madam Howe, Kenwood

Phenacoccus acericola King, false cottony maple scale, adults on maple, May 29, Miss E. M. Briggs, Oneonta. Same, on hard maple, September 9, Miss J. N. White, New Rochelle, through State Conservation Commission. Same, on maple, June 8, T. R. Lawson, Troy. Same, larvae and adults on maple, August 31, C. W. Buckten, Mamaroneck. Same, young females, August 17, H. A. Unger, Clinton Heights. Same, young and females on maple, August 16, H. B. Wooster, Walden, through State Conservation Commission. Same, August 14, J. W. Small, North Tarrytown. Same, August 7, L. H. Crossman, New Rochelle. Same, July 20, A. J. Harcourt, Kingston. Same, male cocoons on maple, May 18, J. T. Lansing, Rensselaer. Same, young on maple, May 26, Benjamin Hammond, Fishkill

Pulvinaria vitis Linn., cottony maple scale, adults on maple, June 16, B. D. Van Buren, Mount Vernon, through State Department of Agriculture. Same, on maple, May 21, C. F. Nies, Salamanca. Same, adults and young on soft maple, July 21, C. C. Kekok, West Brighton

Lecanium scale, adults and young, June 20, Miss E. S. Blunt, New Russia

? Eulecanium magnoliarum Ckll., adults on maple, June 30, Miss A Humphrey, Warsaw

E. nigrofasciatum Perg., terrapin scale on soft maple, April 8, H. N. Babcock, Elmira. Same, on soft maple, April 29, M. DeForest Yates, Schenectady. Same, June 12, Miss S. A. Brown, Unadilla Forks

E. persicae Fabr., adult on mulberry, May 29, G. E. Ward, Ravena

? Saissetia oleae Bern., olive scale, adult on lemon, March 5, C. E. Olsen, Maspeth

Chionaspis pinifoliae Fitch, pine leaf scale, eggs on Scotch pine, September 27, S. G. Harris, Tarrytown

Diaspis carueli Targ., juniper scale, adults on Swedish juniper, September 27, A. E. Stene, Kingston, R. I.

Aulacaspis rosae Sandb., rose scale, egg on rose, November 18, Miss Rhoda Thompson, Ballston Spa. Same, April 26, E. J. Ritch, Kingston

Epidiaspis piricola Del Guer., pear scale, adult on French imported pear, January 16. Through the State Department of Agriculture

Aspidiotus ? ostreaeformis Curt., European oyster scale, adults on willow, May 12, Ellwanger & Barry, Rochester. Same, October 11, Arthur Gibson, Ottawa, Canada

A. perniciosus Comst., San José scale, young on apple, April 1, A. M. Lane, Schenectady. Same, May 18, Mrs E. A. Earl, Ballston Spa. Same, August 8, W. J. Akins, New Baltimore. Same, adults and young on apple, September 15, R. Schofield, Coeymans

Chrysomphalus smilacis Comst., smilax scale on ? Smilax, March 29, C. E. Olsen, Maspeth

Lepidosaphes ulmi Linn., oyster shell bark louse on French lilac, August 14, W. J. Akins, New Baltimore. Same, young on apple, May 18, Mrs E. A. Earl, Ballston Spa. Same, eggs on balm of Gilead, April 21, J. E. Field, New York City

L. beckii Newm., adult on lemon, March 5, C. E. Olsen, Maspeth

Parlatoria proteus Curt., orange chaff scale, adult on orange, March 5, C. E. Olsen, Maspeth

Lygus pratensis Linn., tarnished plant bug, adults on aster, October 8, G. H. Hudson, Plattsburg.

Poecilocapsus lineatus Fabr., four-lined leaf bug, work on currant, June 13, Albert Yeomans, Walworth

Orthoptera

Ischnoptera pennsylvanica DeG., June 19, M. R. Brown, Merrickville

Gryllotalpa borealis Burm., mole cricket, August 26, W. F. Moore, Mechanicville. Through Troy Press

Plecoptera

Pteronarcys biloba Newm., adult, May 26, W. G. Robinson, Greenfield Center

Ephemerida

Hexagenia variabilis ? Eaton, June 2, B. H. Lane, Coxsackie

Thysanura

Smynthurus arvalis Fitch, adults on raspberry, May 24, S. R. Taber, Milton

EXPLANATION OF PLATES

PLATE I

Codling moth

A Two small apples, one end and the other side wormy. The former is the most common method of injury by apple worms or larvae of the first brood, while the other is very characteristic of larvae of the second brood and is usually confined to points where fruits touch or where a leaf and apple adhere.

B Group of blossoms ready to spray and showing conditions just after the petals drop. Note that the green sepal lobes are widely expanded or drooping, and that conditions are therefore favorable for filling the calyx cup with poison.

C Three mature apples showing the work of the apple worm or codling moth larva about the core, at the blossom end and an irregular cavity at the side, a point where the full grown larvae frequently escape

D A piece of bark removed from the tree and showing on the under surface the numerous cocoons in which the insects hibernate and undergo their transformations from the caterpillar to the pupa and moth

1 Moth with wings expanded, natural size

2 Moth resting on young apple, side view

3 Moth resting on leaf, seen from above

4 A portion of a pinkish apple worm or larva in a wormy apple

5 Cocoon, as seen from the under side and showing the hole made by a woodpecker in search of the apple worm or larva

6 Cell on the under side of the bark containing a codling moth worm or larva. Note its nearly doubled position.

7 Upper surface of bark showing hole made by a woodpecker. The same condition as seen from the inner surface is represented at 5.

8 Empty cocoon

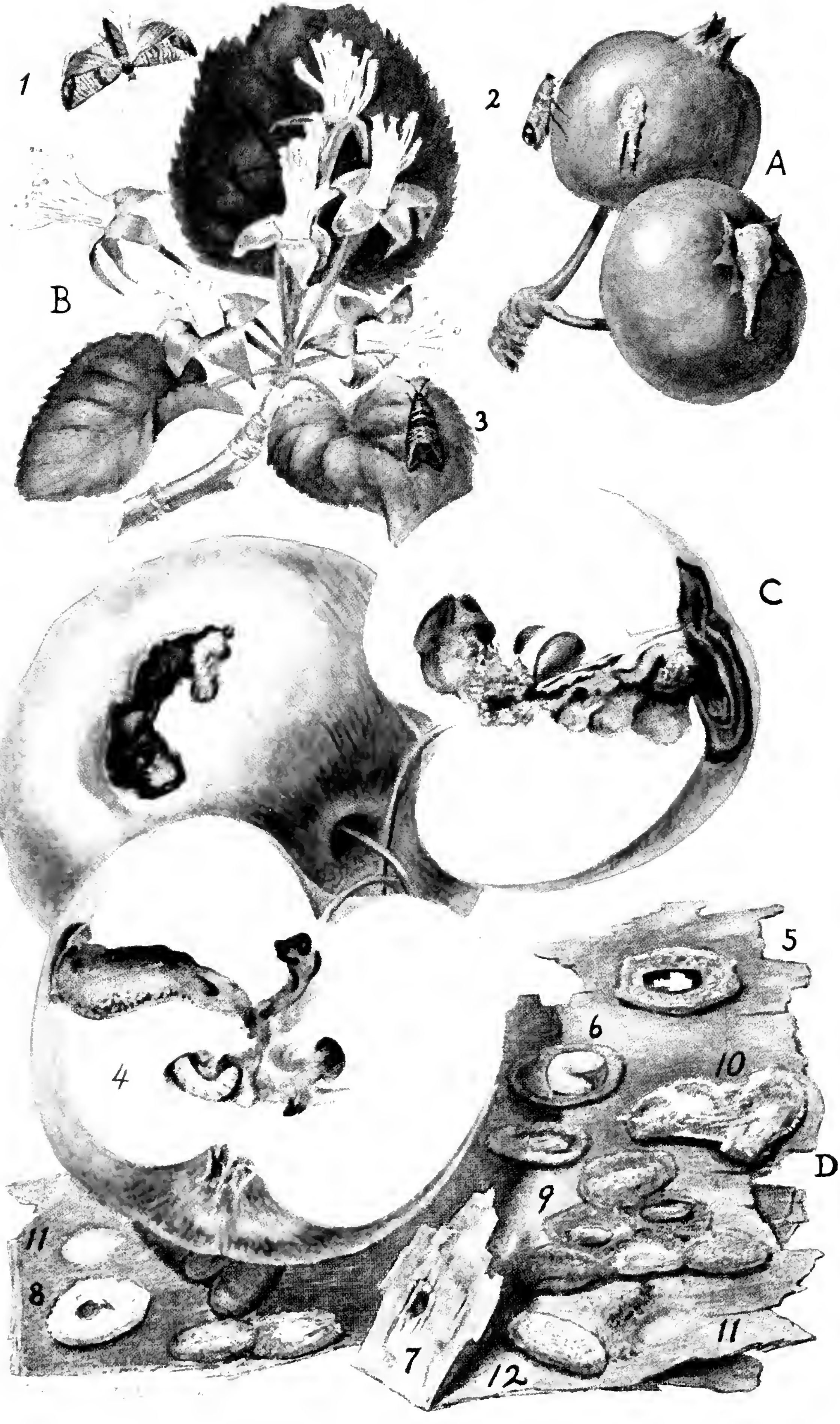
9 Group of old cocoons

10 Two cocoons in which apple worms or larvae have been destroyed by fungus

11 Oval excavation in the bark made by the apple worm or larva prior to spinning its cocoon

12 Newly made cocoon, the silken case being nearly obscured by particles of bark

Plate 1



Codling moth and its work

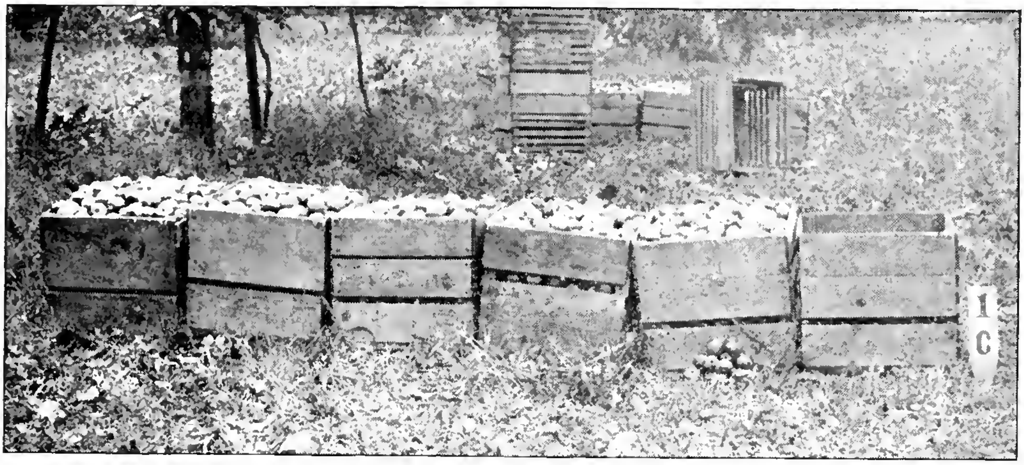
PLATE 2

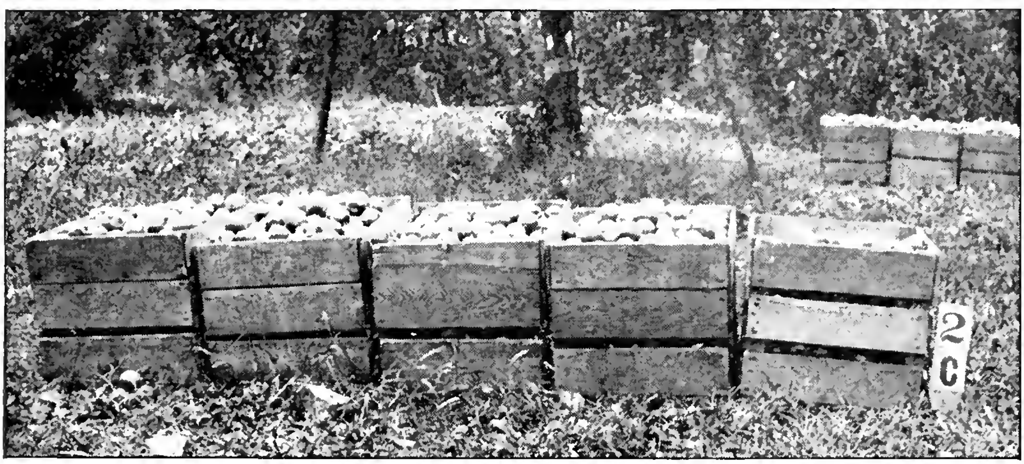
Codling moth work

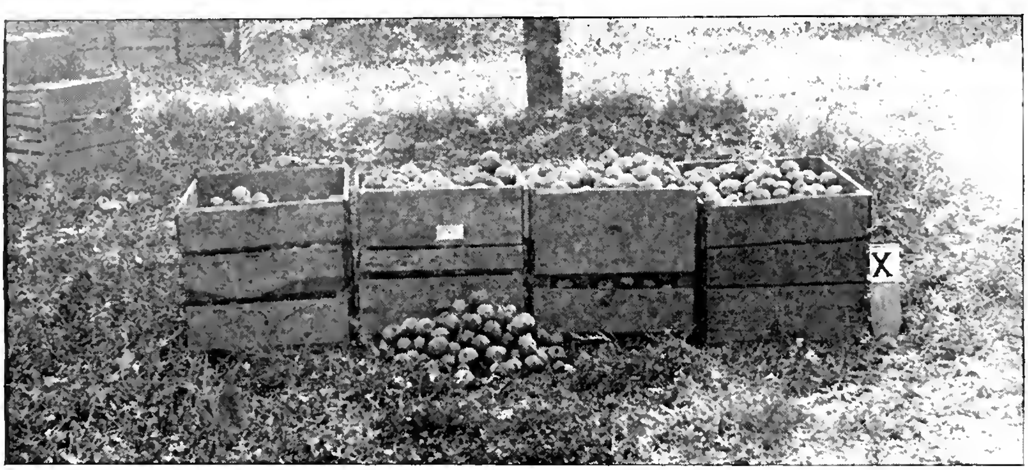
Series 1

1c Sprayed once, picked fruit: 3842 sound, 25 wormy apples
2c Sprayed twice, picked fruit: 3136 sound, 2 wormy apples
X Unsprayed, picked fruit: 2411 sound, 171 wormy apples

Plate 2







Codling moth work

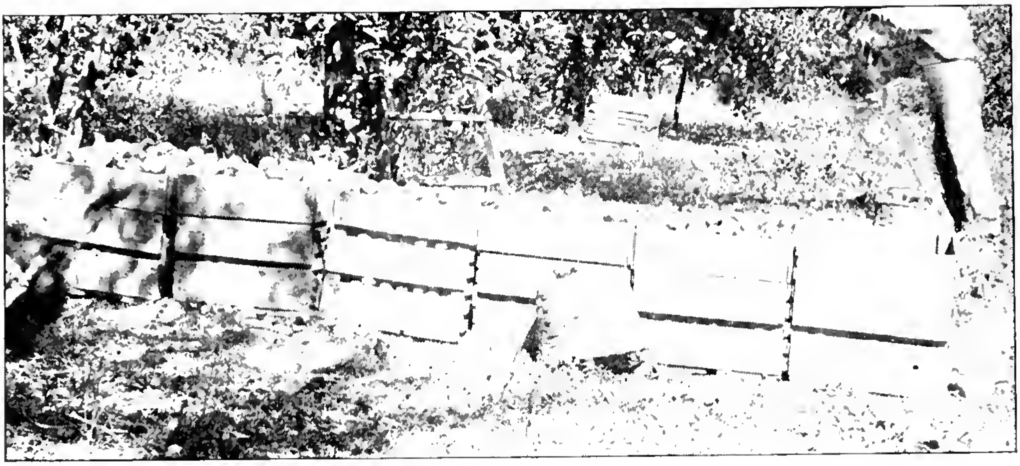
PLATE 3

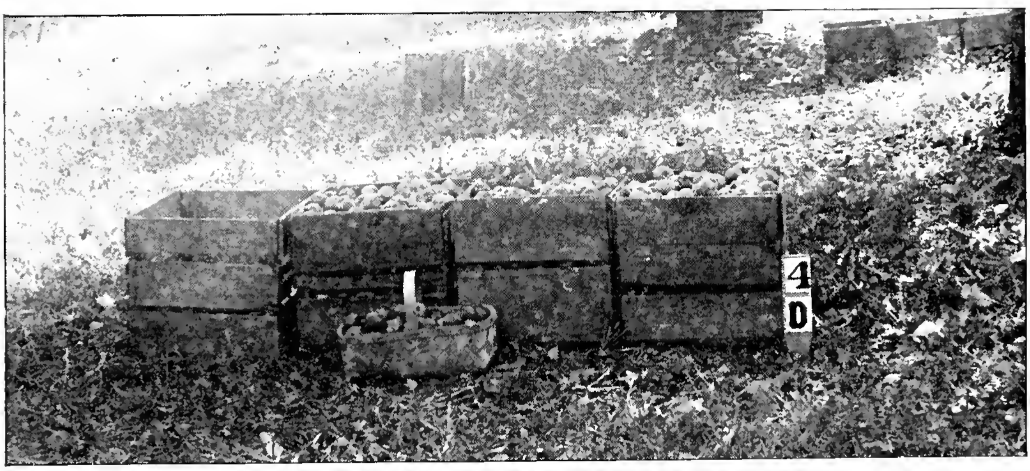
Codling moth work

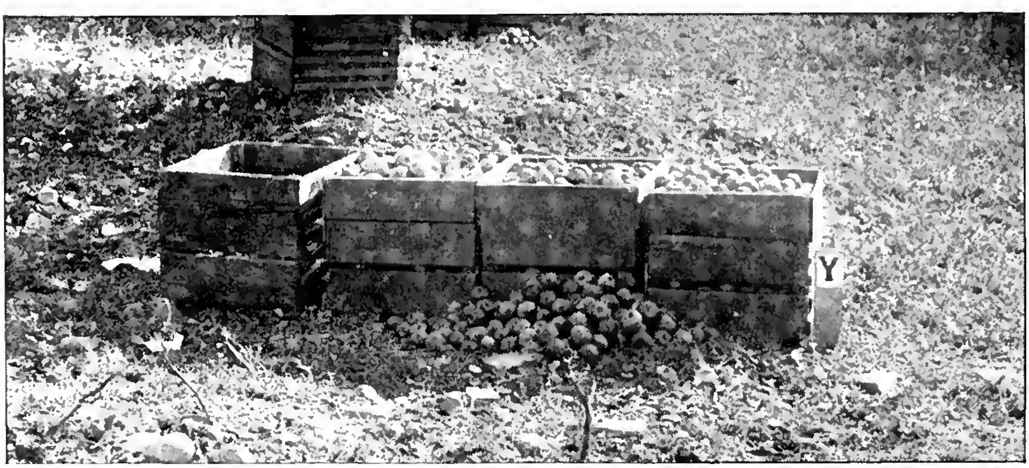
Series 1

3*a* Sprayed thrice, picked fruit: 3879 sound, 3 wormy apples
4*d* Sprayed once late, picked fruit: 1809 sound, 131 wormy apples.
Y Unsprayed, picked fruit: 1832 sound, 225 wormy apples

Plate 3







Codling moth work

PLATE 4

Codling moth work

Series 1

2c View showing loaded condition of tree
3a View showing loaded condition of tree

Plate 4

Trees in experimental orchard

PLATE 5

Codling moth work

Series 2

1a Sprayed once, picked fruit: 2868 sound, 45 wormy apples
2b Sprayed twice, picked fruit: 5724 sound, 77 wormy apples

Plate 5

Codling moth work

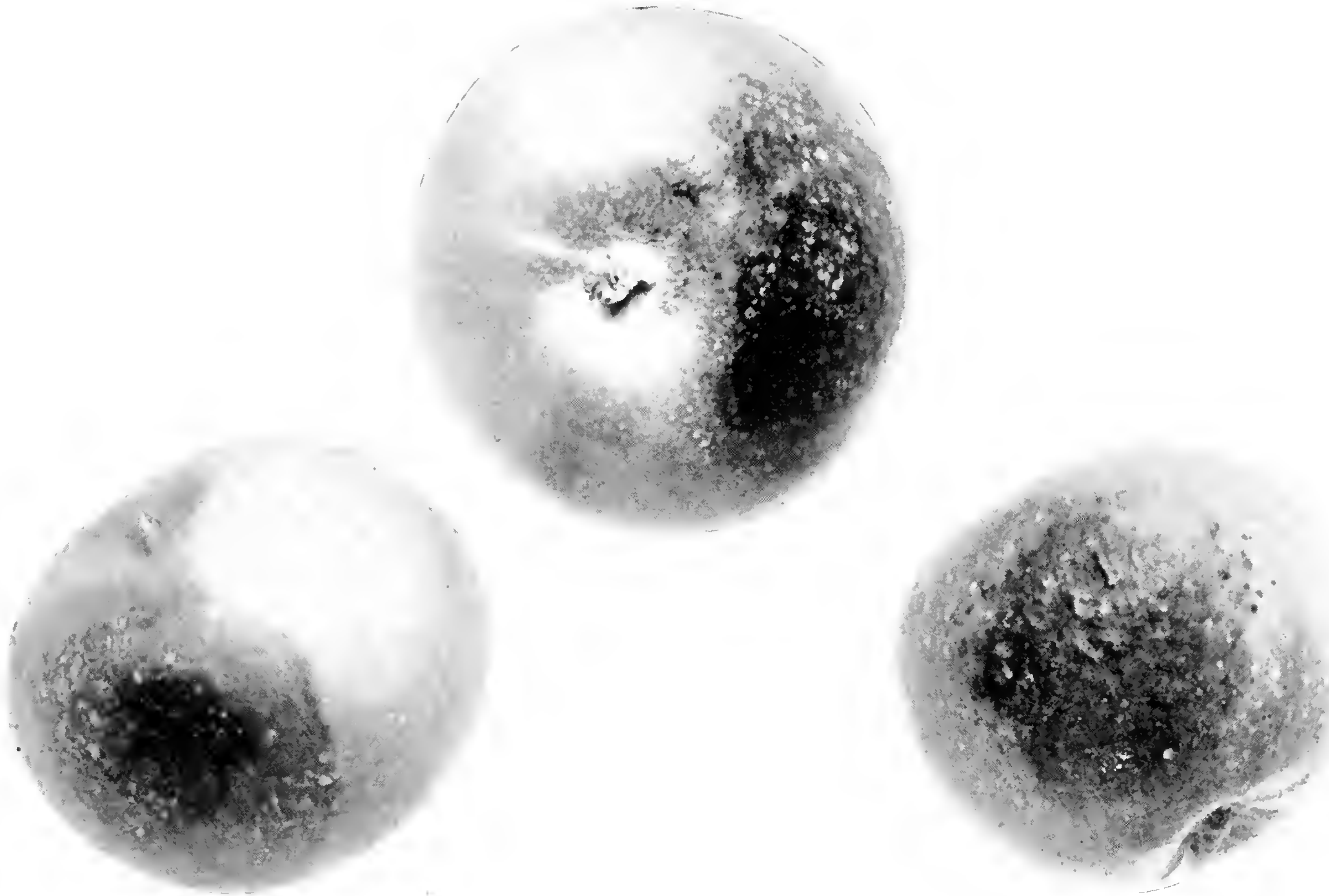
PLATE 6

Codling moth work

Series 1

Three apples showing sun scald, W. H. Hart orchard. September 1911

Plate 6



Apples affected by sun scald

PLATE 7

Codling moth work

Series 2

Two apples showing sun scald, followed by severe checking, from orchard of Edward Van Alstyne, October 1911

Plate 7

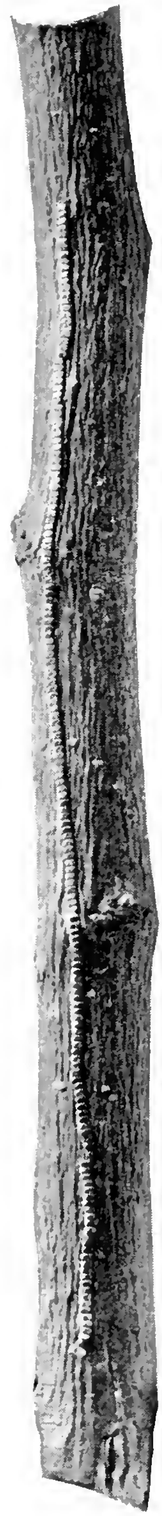
Checking following sun scald

PLATE 8

1 Notch wing, *Ennomos magnarius* Hübn., natural size
2 Eggs of notch wing, *Ennomos magnarius*, natural size
3 *Winthemia quadripustulata* Fabr., view showing deformed or asymmetrical abdominal segments
4 Apple showing work of a miner, probably a species of Marmara Clem.

Plate 8

1



2

3

4

Apple insects and a parasite

PLATE 9

1 Micropyle of definite marked tussock moth, *Hemerocampa definita* Pack. x 200

2 Micropyle of gipsy moth, *Porthetria dispar* Linn. x 200

3 Hairs from full-grown gipsy moth larva, *Porthetria dispar* Linn. x 50

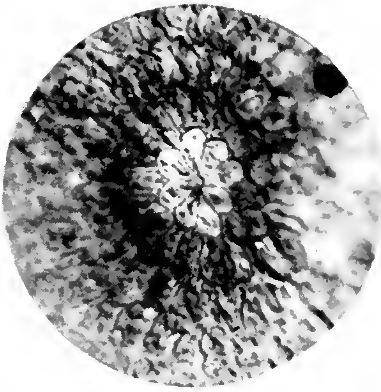
4 Hairs from egg mass of gipsy moth, *Porthetria dispar* Linn. x 200

5 Large hair from full-grown gipsy moth larva, *Porthetria dispar* Linn. x 200

6 An aerostatic hair from young larva of gipsy moth, *Porthetria dispar* Linn. x 225

7 Portion of pupal case of gipsy moth, *Porthetria dispar* Linn. x 33

Plate 9



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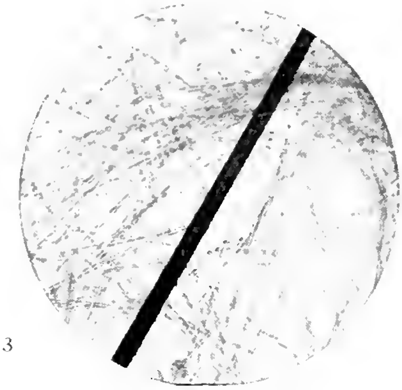

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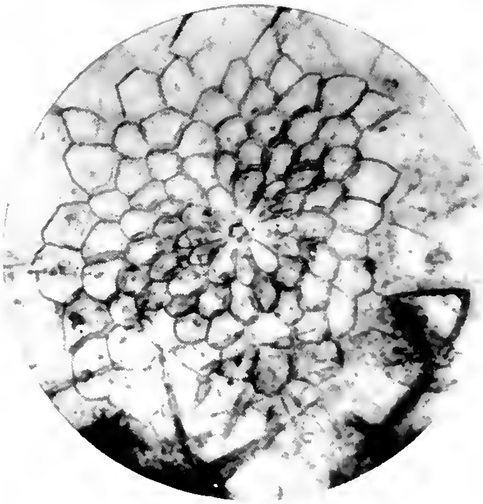

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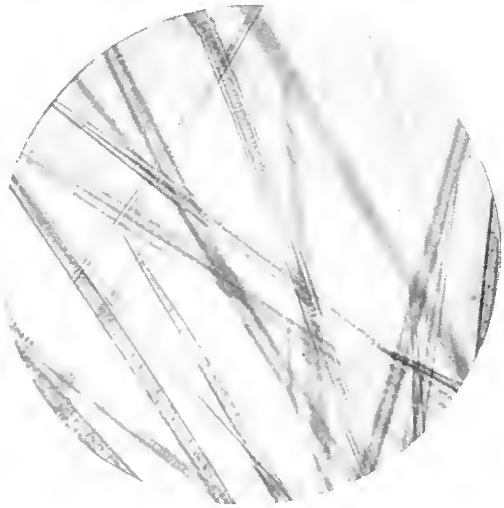

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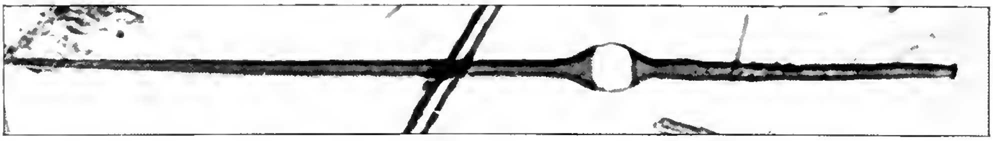
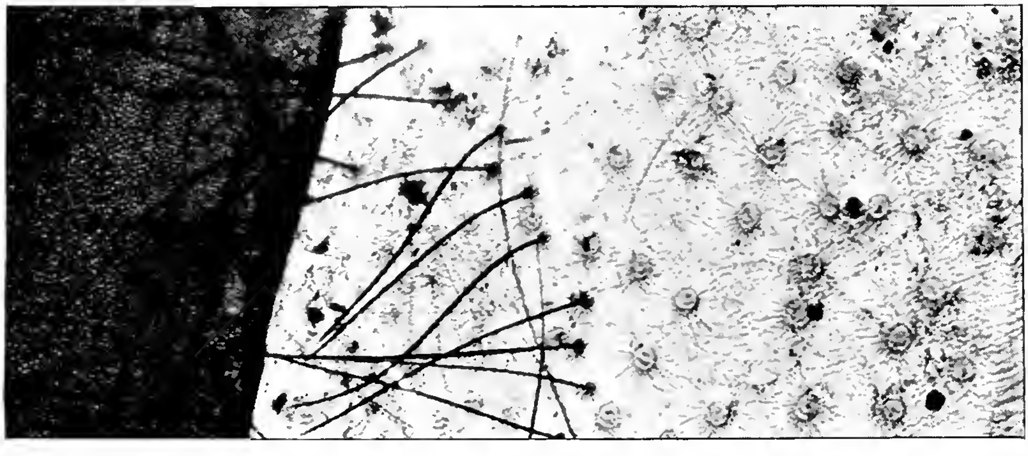




7

Gipsy moth structures

PLATE 10

Gipsy moth

Porthetria dispar Linn.

Defoliated apple orchard, Weston, Mass., June 29, 1911
Note the fruit and the vigorous untouched poison ivy foliage on the trunks of the trees

Plate 10

Gipsy moth work 1911

PLATE 11

Gipsy moth

Porthetria dispar Linn.

Red oak near Weston, Mass., June 29, 1911. Many acres were defoliated like this, though a strip some 200 feet wide on each side of the road had been well protected by poison.

Plate 11

Gipsy moth work 1911

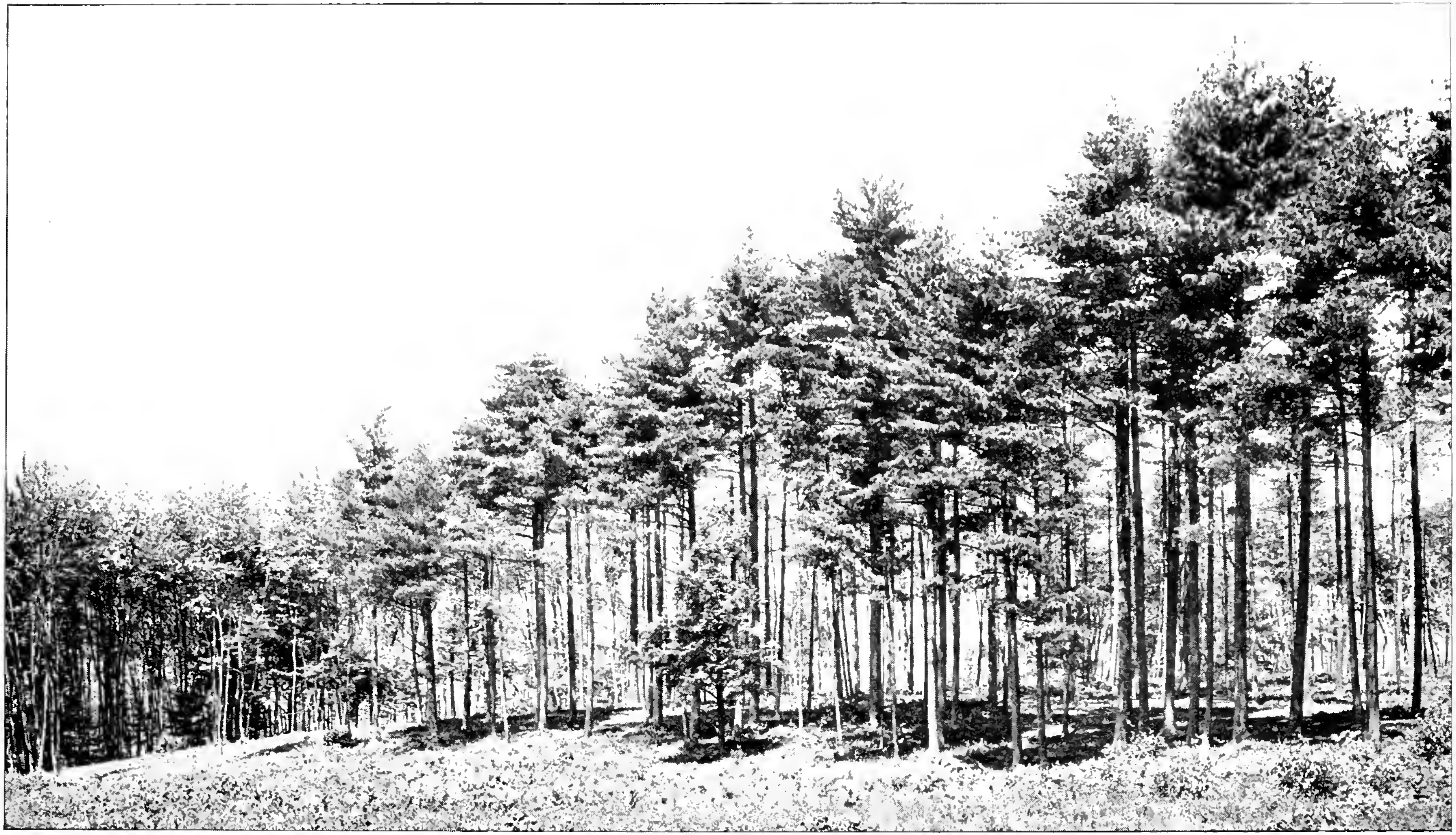
PLATE 12

Gipsy moth

Porthetria dispar Linn.

Practically clean stands of pine and maple near Metheun, Mass., June 30, 1911. These areas were protected simply by cutting out the favorite food plants and practically no injury resulted, as the young caterpillars were unable to develop upon either the pine or maple.

Plate 12



Clean stands of maple and pine uninjured by gipsy moth

PLATE 13

Brown-tail moth

Euproctis chrysorrhoea Linn.

Nests on young oaks near Salem, N. H. Photo June 30, 1911

Plate 13

Brown tail moth work 1911

PLATE 14

6

Green maple worm

Xylina antennata Walk.

Defoliated willows and maples, North Albany, N. Y., June 1911

Plate 14

Green maple worm work 1911

PLATE 15

Green maple worm

Xylina antennata Walk.

Defoliated soft maples at Amsterdam, N. Y., June 1911

Green maple worm work 1911

PLATE 16

Green maple worm

Xylina antennata Walk.

Soft maple sprouts badly ragged by caterpillars, Amsterdam, June 1911

Green maple worm work 1911

PLATE 17

1 Moth of green maple worm, Xylina antennata Walk. x 1
2 Green maple worm, Xylina antennata Walk. x 1
3 Iris borer, Macronoctua onusta Grote x 1
4 Pyrausta theseusalis Walk., showing anal tuft expanded x 1
5 Larval cases of maple leaf cutter, Paraclemensia acerifoliella Fitch, natural size

170

Plate 17

1

3

2

4

5

New York insects

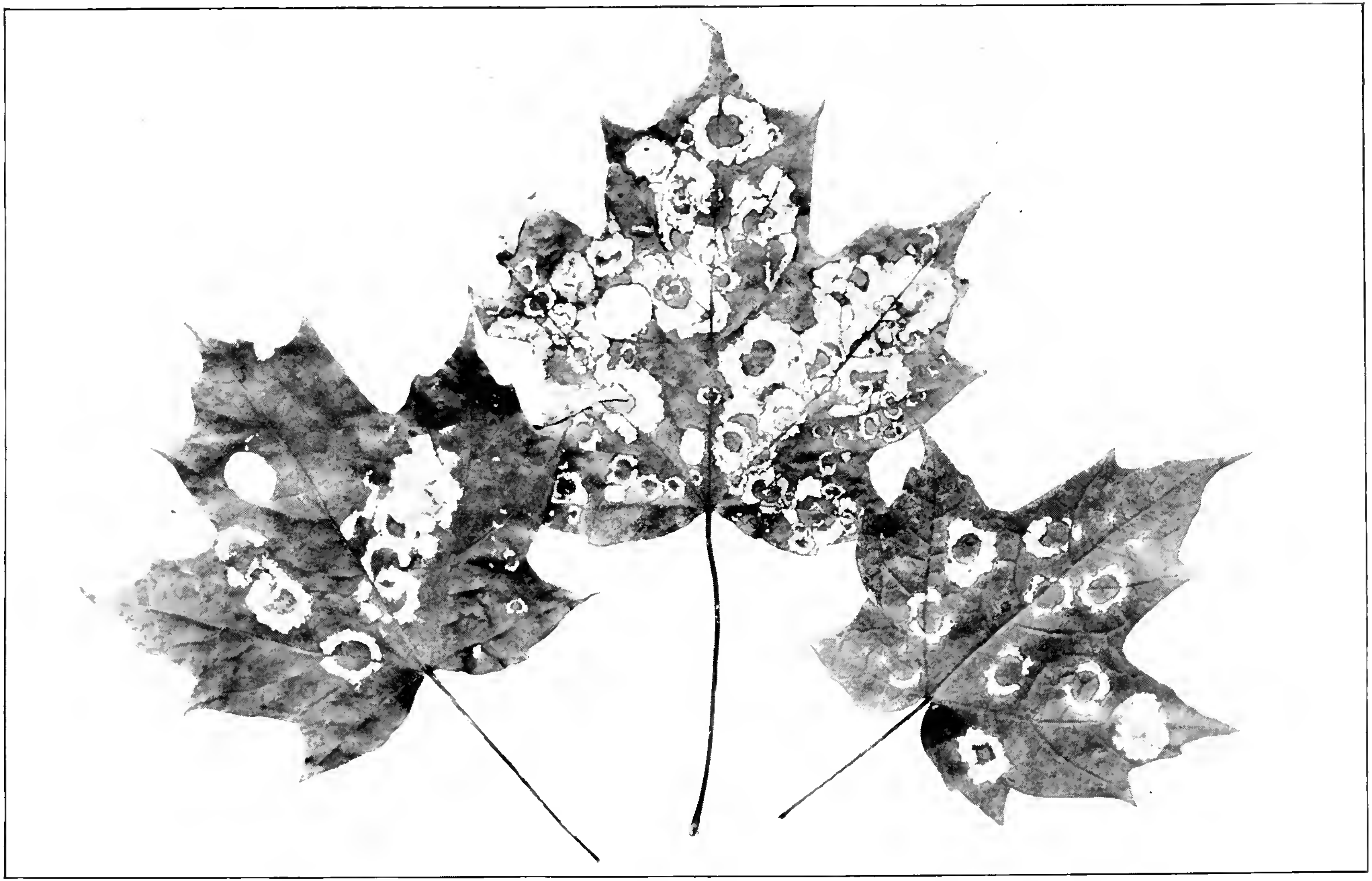
PLATE 18

Maple leaf cutter

Paraclemensia acerifoliella Fitch

Soft maple leaves showing characteristic eating and several cases

Plate 18



Work of maple leaf cutter 1911

PLATE 19

Periodical Cicada

Tibicen septendecim Linn.

1 Pupa as it comes from the soil
2 Pupal shell just cracking
3 Pupa five minutes later, 10:01
4 Pupa two minutes later, 10:03
5 Emerging insect five minutes later, 10:08
6 Emerging insect three minutes later, 10:11

Plate 19


1


2


3


4


5


6

Cicada transformations

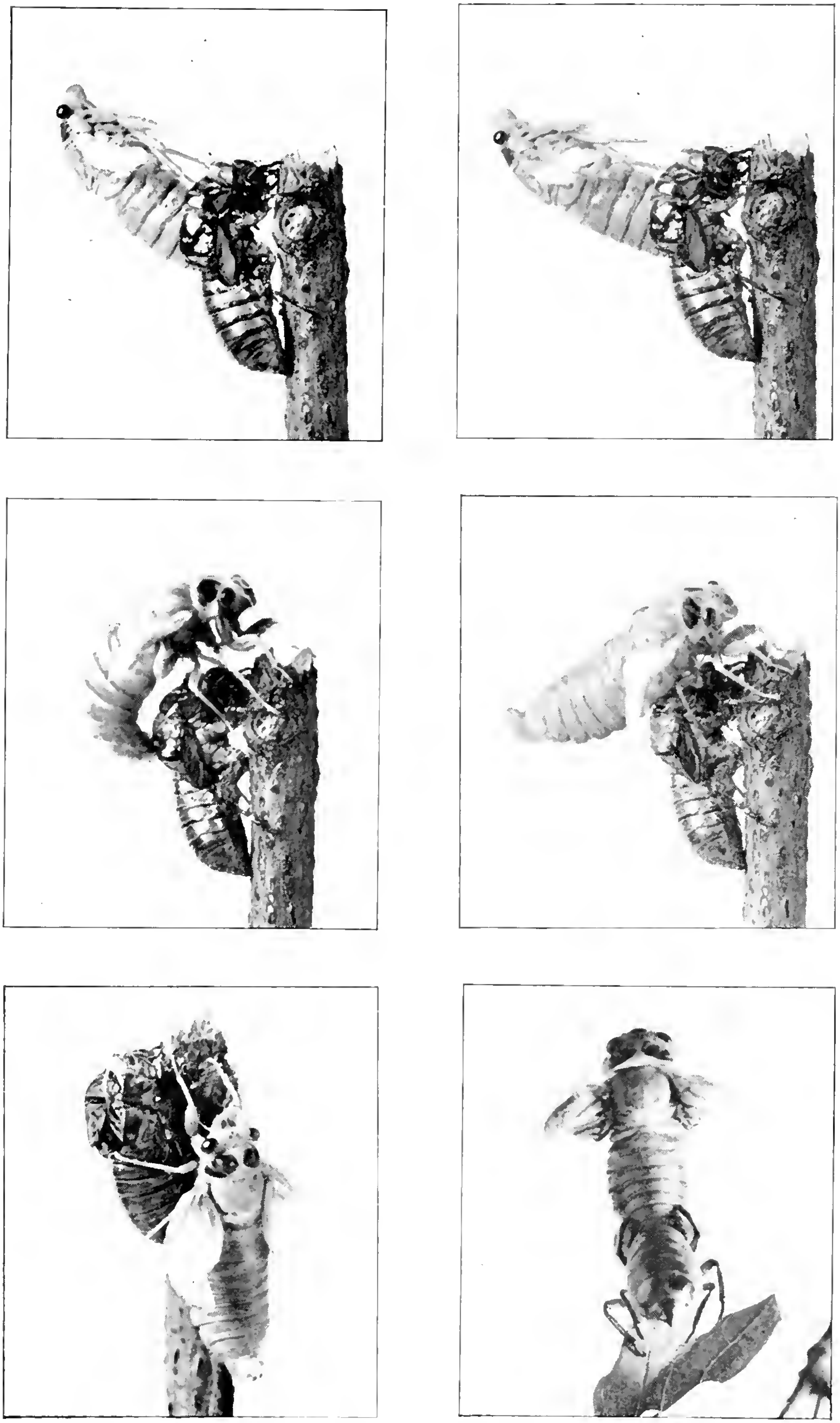
PLATE 20

Periodical Cicada

Tibicen septendecim Linn.

1 Emerging insect two minutes later than plate 18, fig. 6, 10:13
2 Emerging insect one minute later, 10:14
3 Insect crawling from the shell, 10:35
4 Insect resting on the empty shell, 10:36
5 Insect hanging beside the shell, 10:42
6 Insect hanging from the pupal shell. Note padlike wings, 9:45

Plate 20



1 2 3 4 5 6

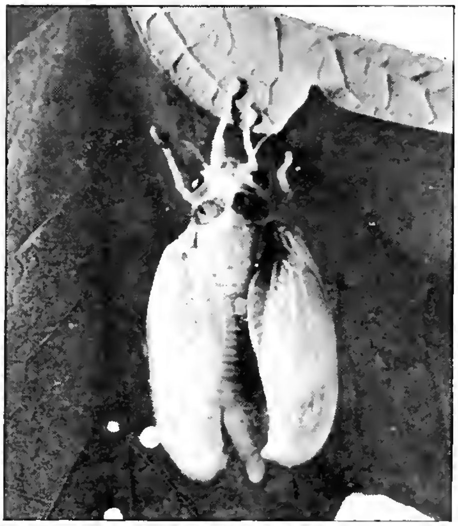
Cicada transformations

PLATE 21

Periodical Cicada

Tibicen septendecim Linn.

1 Insect six minutes later than in plate 20, fig. 6, 9:51
2 Insect one minute later, 9:52
3 Insect one minute later, 9:53
4 Wings fully developed and partly wrapped around the body
5 Cicada fully colored as it appeared the next morning
6 Cicada with ovipositor partly inserted in a twig



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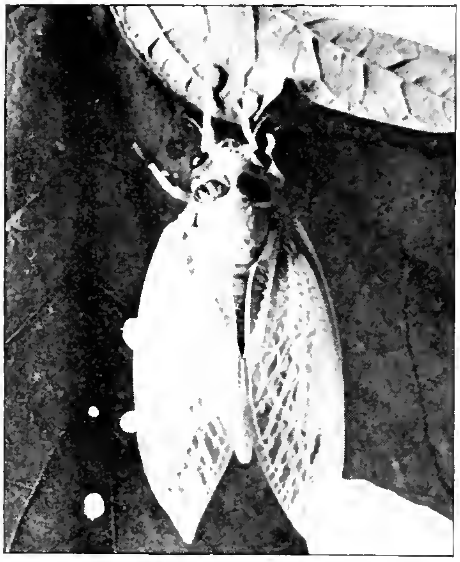

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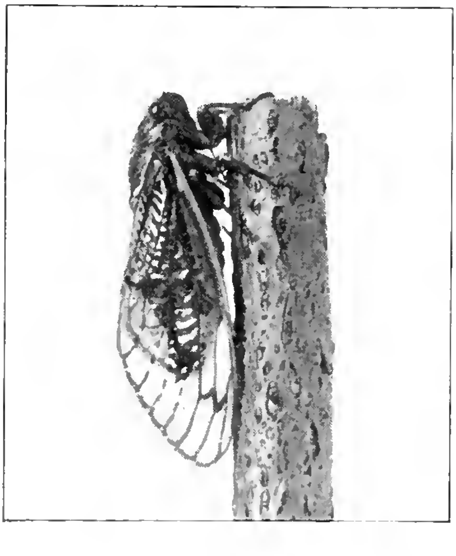

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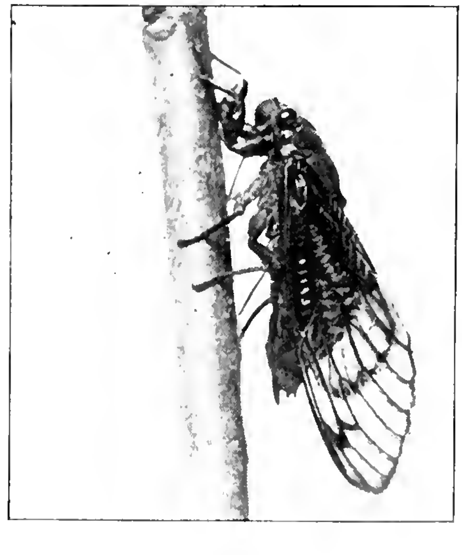

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Cicada transformations

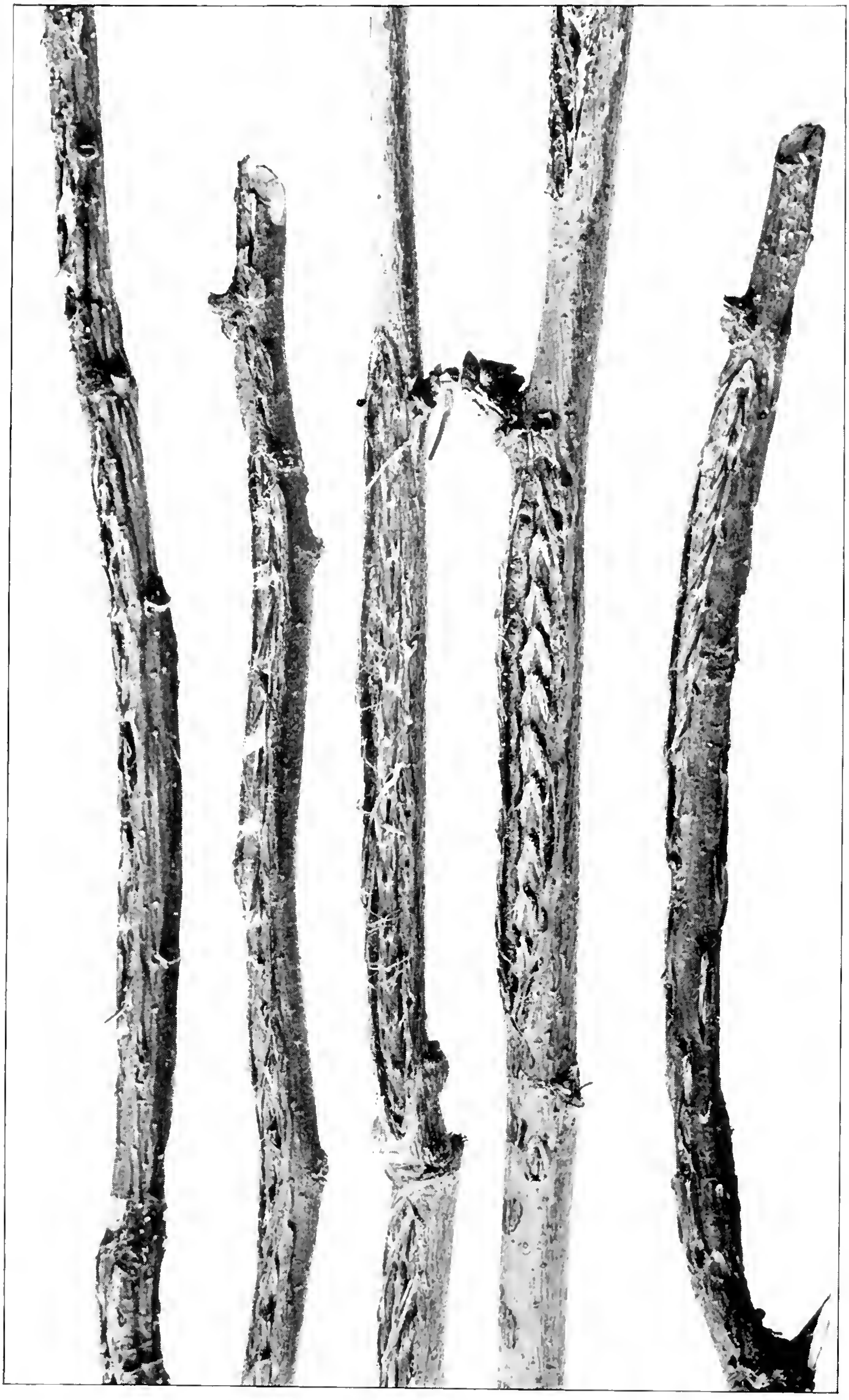
PLATE 22

Periodical Cicada

Tibicen septendecim Linn.

Twigs showing oviposition scars

Plate 22



Cicada oviposition

PLATE 23

Periodical Cicada

Tibicen septendecim Linn.

Cicada chambers at New Baltimore, N. Y., June 1911

Plate 23

Cicada chambers above ground

PLATE 24

Periodical Cicada

Tibicen septendecim Linn.

View showing young orchard protected with netting from Cicada injury, New Baltimore, N. Y., June 1911

Plate 24

Trees netted to protect them from Cicadas

PLATE 25

White marked tussock moth

Hemerocampa leucostigma Sm. & Abb.

Defoliated linden at the corner of Eagle and Hamilton streets, Albany, N. Y. Photo June 1911

Plate 25

White-marked tussock moth work

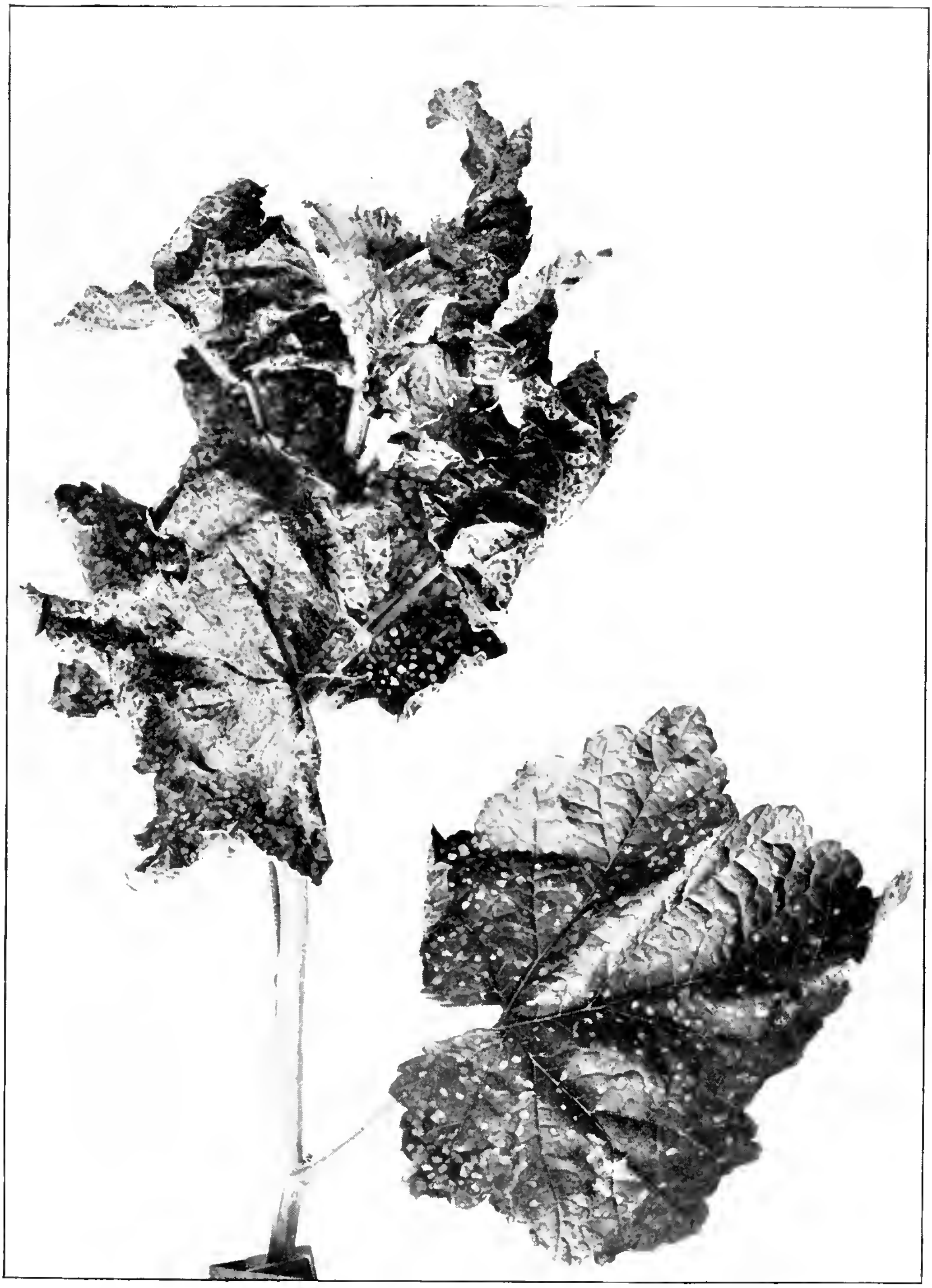
PLATE 26

Four-lined leaf bug

Poecilocapsus lineatus Fabr.

Wilder currant shoots showing the characteristic spotting caused by this pest

Plate 26



Four-lined leaf bug work

PLATE 27

1 Males of white marked tussock moth, *Hemerocampa leucostigma* Sm. & Abb. x 1

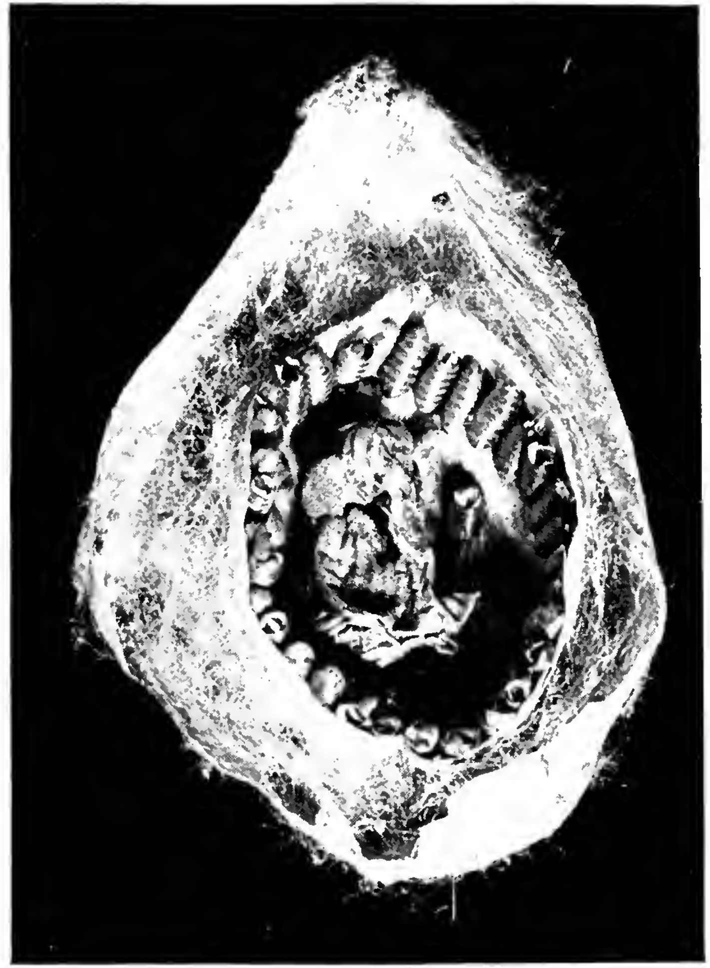
2 Female of white marked tussock moth, *Hemerocampa leucostigma* Sm. & Abb. depositing eggs on the filmy cocoon x 1

3 Cocoon of Cecropia moth, *Samia cecropia* Linn. containing numerous puparia of a parasitic fly, *Frontina frenchii* Will.

4 Pupa and larva of *Xylophagus lugens* Loew and larva (the larger one) of the allied *X abdominalis* Lw.

Plate 27

1



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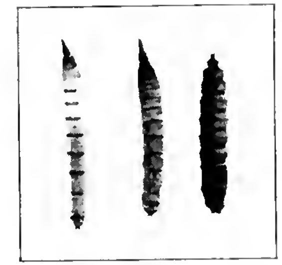

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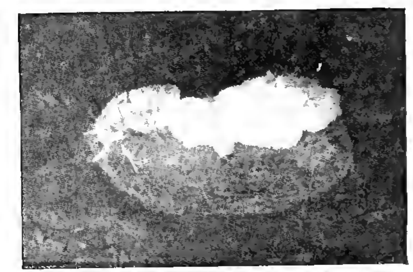

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Education Department Bulletin

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Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y., under the act of July 16, 1894

No. 511 ALBANY, N. Y. January 15, 1912

New York State Museum

John M. Clarke, Director

Ephraim Porter Felt, State Entomologist

Museum Bulletin 156

ELM LEAF BEETLE AND WHITE-MARKED TUSSOCK MOTH

BY

EPHRAIM PORTER FELT D.Sc.

New York State Education Department
Science Division, April 4, 1912

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to submit herewith a revision of our State Museum Bulletin 109 relating to the elm leaf beetle, the tussock moth and their depredations upon our shade trees. The demand for information on these insect pests is large and the last edition of the bulletin is now exhausted. I therefore recommend this manuscript for publication.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 9th day of April 1912

A. S. Draper

Commissioner of Education

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ELM LEAF BEETLE AND WHITE-MARKED TUSSOCK MOTH

BY

EPHRAIM PORTER FELT D. Sc.

The elm leaf beetle and the white-marked tussock moth must be ranked among the most important leaf feeders affecting the shade trees of cities and villages in New York State. They have been responsible for widespread injury to thousands of trees in recent years, while earlier experience shows that we must reckon with these species if we would preserve the beauty of our trees. Experience in the past has demonstrated beyond all question the practicability of checking both of these leaf feeders by spraying, an operation which is not very costly if modern apparatus be employed. We are forced to conclude therefore that extensive injury by either of these pests must be attributed to indifference or culpable neglect rather than inability, despite the fact that many appear very eager to take up the warfare at a time when the ravages are most apparent and unfortunately when repressive measures can be employed to very little advantage.

There is a tendency on the part of many private individuals to attribute their woes to the neglect of adjacent shade trees on public streets, and conversely municipal authorities are prone to state that injury to public trees is due to the pests swarming thereto from neglected private grounds. The facts of the case are that both of these insects are very local in habit. This is a necessity in the case of the tussock moth, because the female is wingless and as a consequence the species relies for dissemination on the very limited crawling powers of the caterpillar or upon being carried by other agencies. The elm leaf beetle, on the contrary, flies readily, but for some reason or other it is very local in its habits and not infrequently one may see magnificent trees infested with hordes of beetles and larvae, while within a block, sometimes within 50 feet, other elms may be practically free from the pest. These facts are of greatest importance to all interested in the welfare of shade trees, since they demonstrate beyond question the possibility of protecting the trees on our public streets, irrespective of what is done by private citizens, or conversely, the practicability of keeping the pest in check on private grounds, even though there is little or no repressive work upon those adjacent.

Elm leaf beetle

Galerucella luteola Müll

The ravages of this dangerous enemy to elms has been particularly severe in recent years. The damage has doubtless been accentuated in numerous instances by exceptionally dry weather and possibly by extremely low winter temperatures. These two factors afford no adequate explanation for the great increase in the number of injured trees, and particularly for the general destruction of the foliage so conspicuous in many communities in 1910 and 1911. It is very probable that the extension of electric car service and the more general use of automobiles have been of material service in disseminating a local and exceedingly prolific insect, since both of these vehicles usually traverse tree-lined streets and afford abundant opportunities for the collection and dissemination of the beetles and thus greatly increase the damage along favorite routes of travel.

This pest was so abundant and injurious from 1896 to 1899 in the cities of Albany and Troy as literally to compel some action or a very large proportion of the elms would have been destroyed. The insect made such headway in these cities that it ruined or killed about 3000 elms before the end of 1900, and it is more than probable that at least 1000 additional succumbed the following decade. The earlier spraying against this pest produced for the most part very satisfactory results, while the treatment in recent years has given indifferent returns in many instances. An examination of conditions in several communities in the summer of 1911 forced us to the conclusion that most of the poor results following spraying were due to careless or slovenly work. It was a rather common occurrence to find the lower limbs fairly well sprayed, while the upper branches were almost untouched by the poison and, as a consequence, severely injured by the beetle.

Dead foliage in midsummer, a weakened or dying condition of the trees, and the vacant spaces formerly occupied by elms, are in most instances the direct result of injury by this pernicious beetle, though all conversant with the situation must admit that leaking gas and electricity have killed some trees in many communities. The number destroyed by these latter two agencies is small compared to those succumbing to insect depredations. Old age has been advanced by some as a reason for the death of many elms. This is hardly an adequate explanation, since many trees which have perished were comparatively young. Authentic records show that the American elm may live from 150 to 200 years. Under favorable conditions it should thrive for at least a century and in many instances for a century and a half. It is lamentable that so many magnificent elms, representing the growth of several generations, and in many instances occupying commanding positions and adding greatly to the beauty and value of the adjacent property, should be destroyed within a few years by an insect which may be controlled at a comparatively small expense.

Results of attack. Elms losing two crops of leaves a season for three or four years are invariably seriously affected and some at least may die. The injury is almost as severe if the first crop of leaves is destroyed so late that very little new foliage develops the latter part of the season. This condition was rather general with American elms in 1911 and may have resulted in part from the weakened condition of the trees, an outcome of earlier injuries.

Food plants. This leaf feeder displays a marked preference for the more tender foliage of the English and Scotch elms, though after the beetle has become abundant, it is frequently exceedingly destructive to the American elm. Its operations on this latter tree have been especially severe in the city of Watervliet and in villages in the upper Hudson valley.

Distribution. This pest has now attained an extensive distribution in this country, ranging from north of Salem, Mass., to Charlotte, N. C., and westward into Ohio and Kentucky. It occurs in most of the cities and villages in the Hudson valley, having made its way north to Glens Falls and Ticonderoga and along the Mohawk valley at least to Amsterdam. It has become well established at Elmira and Ithaca and has been known for some years in Oswego, though it does not appear to have been particularly destructive in that city. There is no record known to us of this species occurring in Utica, Syracuse, Rochester or Buffalo, though it is rather surprising that it has not already become established in all of these cities.

Description. The skeletonized brown appearance of the foliage in midsummer is very characteristic of the work of this pest, particularly in the eastern cities and villages of the State. The irregular, oval holes about one-quarter of an inch in diameter, eaten by the beetles in early spring, are another indication of the work of this species.

The parent beetle may be recognized by reference to the colored illustration [pl. 1, fig. 5, 6]. It is about one-quarter of an inch long, with the head, thorax and margin of the wing covers a reddish yellow. The coal-black eyes and median spot of the same color on the head are prominent. The thorax is marked with a dorsal black spot of variable shape and with a pair of lateral ovoid ones. The median black line on the wing covers is widely separated from lateral stripes of the same color by greenish yellow. The wing covers are minutely and irregularly punctured, bear a fine pubescence and at the base of each there is an elongated, black spot in the middle of the greenish yellow stripe. These markings are fairly constant in the beetle, though the color is quite variable during life and changes more or less after death. Many of the insects emerging from winter quarters have the yellowish stripes of the wing covers nearly obliterated by black.

The orange-yellow eggs [pl. 1, fig. 1] are usually deposited in irregular rows side by side, forming clusters of from three to twenty-six or more on the underside of the leaf. Each egg is somewhat fusiform, attached vertically by its larger end and with the free extremity tapering to a paler rounded point.

The recently hatched grub [pl. 1, fig. 2] is about one-twentieth of an inch long with the head, thoracic shield, numerous tubercles, hairs and legs jet-black. The skin is dark yellow but the tubercles are so large and the hairs so prominent that the prevailing color of the grub at this stage is nearly black. An increase in size, following molts, is accompanied by the stiff hairs becoming less conspicuous and the yellow more prominent, till the grub becomes full grown [pl. 1, fig. 3]. It is then about one-half of an inch long, more flattened than in the earlier stages, with a broad, yellowish stripe down the middle of the back and with a narrower stripe of the same color on each side, these being separated by broad, dark bands thickly set with tubercles bearing short, dark colored hairs. The dorsal yellow stripe is broken on each side by a subdorsal row of black tubercles which decrease in size posteriorly. The lateral yellow stripe includes a row of prominent tubercles with dark tips bearing hairs of the same color. The under surface is yellowish.

The pupa [pl. 1, fig. 4] is a bright orange-yellow, about one-fifth of an inch long and with a very convex dorsal surface which bears transverse rows of stout, inconspicuous hairs.

Life history. The transformations of this insect are so rapid and so greatly influenced by local conditions that a man must know what to expect or he will accomplish very little in fighting the pest, because a substance effective against the beetles or grubs may not kill the pupae and, after the larvae have begun to descend, may be of no value. The beetles winter in attics, sheds, belfries and other shelters. They emerge with the advent of warm weather and may then be found on the walks during the sunny portion of the day or at the windows of houses, trying to escape. The last of April or early in May, with the appearance of the foliage, the beetles fly to the elms and eat irregular holes in the leaves. Some time is occupied in feeding before the deposition of eggs, the latter may continue four and possibly five or six weeks. The prolific beetles consume a large amount of foliage during this time, depositing clusters of from three to twenty-six or more eggs every day or two. Over half the total number of eggs may be laid at the height of the season within about twelve days; in 1898, from June 12th to 23d. A female may produce over six hundred eggs.

The young grubs appear early in June or about five or six days after the eggs have been deposited later in the season. They feed on the under surface of the leaf, producing the familiar skeletonization [pl. 1, fig. 7] which is caused by their eating the softer underpart, leaving the veins and the upper epidermis practically untouched. The results of their feeding are so marked that it is easy to detect the presence of the grubs by the semitransparent patches in the foliage. These latter soon dry and turn brown.

There are two and occasionally three generations of this destructive insect in the latitude of Albany, the number depending to a considerable extent upon the availability of suitable food. The grubs complete their growth in from fifteen to twenty days, descending limbs and trunk to a great extent in search of some shelter under which to pupate. Seven days are spent in this latter state in warm July weather, while in September it is extended to twelve and in October to twenty-four days. The grubs of the first brood usually forsake the trees in Albany by the last of June or early in July, and beetles belonging to the second generation may begin depositing eggs about the middle of July, and from then to late in autumn it is generally possible to find this insect in all stages in some part of Albany. The beetles of the second brood are naturally attracted to fresh foliage and consequently more eggs are usually deposited on trees which have been defoliated earlier in the season than upon others.

Badly infested trees are therefore very likely to lose two crops of leaves in a season and may possibly have their third seriously marred by this pest. The second brood of grubs completes its growth about the middle of August, beetles appearing the latter part of the month, and if there is an abundant supply of fresh leaves, a third generation may appear in considerable numbers. This last brood more frequently occurs in near-by trees which have not been severely injured earlier in the season.

Natural enemies. This leaf feeder is subject to attack by a number of natural enemies, most of which, however, are of comparatively little importance in keeping it in check. The common garden toad will devour many beetles, and the much despised English sparrow also feeds upon these insects to some extent. Several predaceous insects prey upon this pest to a certain degree.

Preventive measures. There are measures of considerable value in the prevention of insect depredations, and there is no reason why such should not be applied to the shade tree problem. It is a mistake to have half to three-fourths of all the shade trees in a city or village one species, especially if mostly on contiguous streets. This is true of many localities where the elm leaf beetle has caused very serious injury during the last few years. The American elm and sugar maple, both deservedly favorites for shade and park trees, may well give way in part at least to other desirable species, such as the Norway maple, an excellent tree in many ways and practically free from the insect pests so injurious to the sugar and the white or silver maple. The last named has been extensively used in many localities, and though brittle and liable to injury by wind and ice, usually keeps in excellent condition for a number of years. The red maple is also a valuable tree. The American basswood or linden, the horsechestnut, the European plane tree or buttonwood, the American ash and oaks, especially the pin oak, red oak and scarlet oak should be set more freely. The Ailanthus (pistillate trees) and the Carolina poplar, though possessing serious drawbacks, are desirable under certain conditions. This diversified planting would admit the use of one species on a street, and if adjacent streets were set with different varieties, such an arrangement would go far toward reducing the possibility of extended outbreaks by injurious insects or fungous diseases.

The proper care of trees, including judicious selection so as to secure the best adaptation to local conditions, is an important factor in forestalling insect ravages. Trees in full vigor are better able to sustain injury and are usually less troubled by insects than those in a debilitated condition. Certain progressive communities have already recognized this need and have met it in a more or less satisfactory manner. The city of Newark, N. J., with a population of 347,469, expends for tree work (which latter is separate from park work) about $27,000 a year, $6000 of this being for pruning, $6000 for spraying and $15,000 for setting out new trees, maintenance etc. East Orange, N. J., with a population of only 34,371, expended in 1909 over $10,000 through its shade tree commission, $1200 of this being a special appropriation for spraying elms. The city of Buffalo has recently placed the care of its trees in the hands of a forester and there is no reason why other communities should not adopt equally comprehensive measures. Spraying alone is not sufficient. There should be wise planting, judicious pruning and liberal fertilization whenever necessary.

Remedial measures. The secret in controlling this insect lies in understanding thoroughly its life history and appreciating the vulnerable points. A thorough spraying with a poison early in the spring, when the leaves are half out or larger, is most effective in preventing breeding, as the beetles are destroyed before they can deposit many eggs. Arsenate of lead is by far the best poison and should be used at the rate of four pounds (15 per cent arsenic oxid) to fifty gallons of water. Fortunately the beetles are rather local in habit and as a consequence individual trees or groups of trees may be protected to a very large extent even if there are neglected ones in the near vicinity. The local spread of this pest is slow and this should be taken advantage of to the greatest possible extent by keeping the insect in control wherever it occurs, even though the infestation be a small one and the present injury of comparatively little importance. It is a mistake on the part of local authorities to wait till this enemy of the elms has become well established and destructive before repressive measures are undertaken.

The grubs feed almost exclusively on the under surface of the leaf, rarely occurring upon its upper side. The first injury is usually on the upper more tender leaves, hence there is great need of spraying the tops of the trees, and in order to kill the destructive grubs it is essential that the poison be thrown on the underside of the foliage. Spraying with an arsenical poison for the destruction of grubs is satisfactory only when the application is early, as it is hardly advisable to spray for this insect when the grubs are nearly full grown, since they are liable to desert the tree even when slightly underfed and complete their transformations, rather than to eat distasteful foliage.

The ideal spray for this pest is a fine mist applied to the under side of all the leaves. It is impossible to throw such a spray any distance, and owing to the great height of most elms, such treatment is impractical. A moderately coarse spray which can be thrown 25 to 40 feet has been usually employed in connection with ladders or the use of a high tower. The latter is practical only where the streets are fairly level. The recent development in the use of a solid stream and pressures of between 200 and 300 pounds for gipsy moth work has greatly reduced the cost of applications in woodlands, and the system is now being applied to shade trees with a corresponding saving in time and expense. This method necessitates the use of more poison, there is increased dripping and the throwing of the spray upon the foliage is not so readily controlled. These are grave though not insurmountable objections, and for the present we are inclined to favor a moderately coarse spray with the use of ladders or a tower as the most practical method of spraying shade trees.

Communities usually fail to realize that in the elm leaf beetle we are dealing with an insect extremely sensitive to poison and one which will feed upon sprayed leaves only when no others are available. Its senses are so keen that it can detect poison hardly visible with a powerful hand lens. Under such conditions one may readily see how easy it is to secure indifferent results. Spraying trees is a disagreeable, hazardous occupation, and in order to secure the best returns, it is necessary to make the compensation such as to result in a keen competition for the position of nozzleman. The application of business principles would justify larger municipalities placing this work in the hands of one who understood at least the rudiments involved (a skilled landscape gardener or forester would be even better) and giving him authority to insist upon any reasonable standards in methods and operation. Such a person could reasonably be expected, if provided with sufficient funds, to keep the foliage of elms practically intact throughout the season, even in sections where the elm leaf beetle was excessively abundant or upon trees adjacent to those badly injured by the pest. Many trees were badly injured last year because there was so much difficulty in securing men who would do thorough work, a prime essential in an undertaking of this kind.

The effective spraying season extends from early to middle May till nearly the latter part of June, a total of approximately six weeks. Making allowances for interruptions by rain, we can hardly expect more than thirty full working days during this period. A power spraying outfit of the usual type and provided with two lines of hose can spray thoroughly, perhaps fifty trees a day or a maximum of 1500 during the season as restricted above, much depending upon the size and location of the trees as well as the efficiency of the men in charge.

The cost of thorough spraying is not excessive. It may be estimated at about 50 cents a tree or only 10–20 cents a tree if all the work be done from the ground with a high power outfit, in each case making no allowance for the cost of apparatus. A power spraying outfit adapted to shade tree work can hardly be obtained for less than $275 to $500, and in case of the high pressure outfits, may easily amount to more than double the latter sum. There should be plenty of power, an abundance of hose and good ladders unless it is planned to do all the work from the ground. This work can be done with a powerful hand pump at a greater cost for operation though the initial expense

($30—$50) is much less. It is extremely desirable, where conditions permit, for a community to provide not only for the spraying of the street trees, but also to arrange for the care of those on private grounds at a nominal cost.

The full-grown larvae crawl down the trunks in great numbers and the golden yellow pupae may be found in abundance in crevices in the bark and on the ground about the tree. A good proportion of the insects can be forced to take refuge on the ground by scraping off the rough bark, thus depriving them of shelters upon the tree. Large numbers can then be killed when assembled about the base of the tree by spraying them with a contact insecticide such as kerosene emulsion, whale oil soap solution or even by pouring boiling water on them. The grubs should be destroyed in the manner indicated every five days so long as the pests are seen in numbers, in order to secure the best results. This method of fighting the pest is advisable only when it is impossible to employ the more satisfactory arsenical sprays. Bands of tar, sticky fly paper, cotton batting, etc., while they do no harm, can not be considered of much value in keeping the elm leaf beetle under control. The relatively few grubs caught on a sticky band are but a drop in the bucket compared with the masses which complete their transformations either above or below. It is worse than useless to attempt to control this or any other insect by boring a hole in the trunk of a tree and inserting therein compounds of any nature. The tree is weakened and unless the chemical be powerful enough to kill it, the insects are not affected.

White-marked tussock moth.

Hemerocampa leucostigma Abb. & Sm.

This insect, preeminently a pest on city and village trees, occasionally proves a veritable scourge over considerable areas. Some cities appear to be more afflicted in this way than others. The summer of 1906 was marked by extensive depredations in a number of cities and villages throughout the State, thus duplicating the experience of 1898. It will therefore be seen that serious injuries by this caterpillar are more or less periodic. This is to be explained by the fact that the species has a number of natural enemies which assist materially in keeping it under control. The destructive outbreaks are examples of what might occur annually were there no parasites to check the work of this voracious leaf feeder. The cause of this native species thriving so greatly in cities and villages during recent years is explained by the abundance of the English sparrow. This bird will not eat the caterpillars and drives away many of the native forms which, in earlier days, were of great service in devouring these hairy pests.

Description. The full-grown caterpillar is really a beautiful object. It has a coral-red head, a pair of long, black plumes just over it, a single one at the opposite extremity of the body, four delicate yellowish or white, brushlike tufts on its back and just behind them, separated only by a segment, two small retractile red elevations. There is a broad, black band broken only by tubercles and tufts along the back and bordered by yellowish stripes. Each side is dark gray except for the yellowish tubercles. The breathing tubes or spiracles are in a lateral black line and below this the caterpillar is yellow, the legs usually being paler [pl. 2, fig. 4]. The very young caterpillar is pale yellowish or whitish with long, irregular hairs. It increases in size, casts its skin from time to time and assumes one after another the characteristics of the full-grown larva.

The thin cocoons spun in the crevices of the bark [pl. 2, fig. 6] have the long hairs of the caterpillar interwoven and within this shelter the larva transforms to a yellowish white pupa more or less shaded with dark brown or black [pl. 2, fig. 7].

The sexes differ strikingly as is shown on plate 2, figures 1 and 2. The male is a beautiful moth with large feathery antennae, tufted legs, and with the wings and body delicately marked with several shades of gray or grayish white. The female, on the other hand, is a nearly uniform gray with simple antennae and but rudimentary wings.

The eggs, usually over three hundred, are deposited on the empty cocoon, under a conspicuous white mass of frothy matter about one-half of an inch in diameter [pl. 2, fig. 3]. This soon hardens and forms a very effective protection. The egg masses [pl. 7, 8] are easily removed and a tree thoroughly cleared thereof can become infested again only by caterpillars crawling from adjacent trees or being carried thereto. The individual egg is nearly spheric, about one-twenty-fifth of an inch in diameter, white or yellowish white and with a light brown spot surrounded by a ring of the same color.

Life history and habits. This insect winters in the conspicuous egg masses described above, the young appearing about the latter part of May in this latitude. They feed at first on the more tender lower epidermis of the leaf and soon devour all but the principal veins. The small caterpillars frequently hang by a silken thread and continued jarring may cause many to drop to the ground. Feeding and growth occupy a month or more, pupation occurring the latter part of June or early in July. There is some deviation from this, as a few individuals spin up early and some caterpillars linger till numerous egg clusters indicate that most of the insects have completed the round of life. The pupal stage occupies from ten to fifteen days. The wingless female appears at the end of this period, crawls on her cocoon and shortly deposits eggs as described. There is normally but one generation annually in Albany and other inland cities, while in New York City and vicinity and in Boston, Mass., there are two broods and at Washington, D. C., there are three generations each year as stated by Doctor Howard.

The young caterpillars drop from the tree readily, suspend themselves by silken threads and then may be blown or carried considerable distances. The full-grown caterpillars desert the trees and wander considerably. This is particularly true of the larger ones which almost invariably produce female moths. The cocoons are spun very generally on the trunks or on the underside of the larger branches.

Food plants. This leaf feeder exhibits a marked preference in cities for the linden and horse-chestnut, while it feeds readily on elms and maples. It has also been recorded on a number of other trees.

Natural enemies. This species has a number of natural enemies. Its comparative rarity in the country shows that our native birds must be very efficient natural checks upon this insect. Mr E. H. Forbush states that forty-seven species of native birds feed on hairy caterpillars, most of which would probably take this leaf feeder. The robin, Baltimore oriole and cuckoo are among the more valuable in this respect.

Parasitic insects are also very efficient checks. This species is subject to attack by some twenty-one primary parasites and these in turn may become the prey of fourteen hyperparasites.

Remedies. A simple and very satisfactory method of controlling this insect is the gathering and destroying of egg masses. Several cities and villages in New York State have employed children in this work by offering a small bounty and a system of prizes. The result has been that a large number of egg masses were secured and destroyed at a comparatively slight cost. The defect in this method is that it is more or less irregular in operation and is usually resorted to only after serious injury to the trees has aroused public opinion. There is no doubt as to the effectiveness of collecting egg masses and in not a few instances it may prove the cheapest method of keeping this pest in check. It would seem better for the welfare of the trees to make some provision for the systematic collection of egg masses from year to year from all the trees, even though the cost be somewhat greater.

The collection of egg masses should be supplemented, if uncleaned trees are in the vicinity, by banding the trunks at the time the caterpillars begin to crawl, with some material which will prevent the ascent of straggling larvae. A very simple method is to take a band of cotton batting some six or eight inches wide, wrap it around the tree, tie a string about its middle and then turn the upper edge down over the string. Tree tanglefoot, a preparation made by the same company that manufactures tanglefoot fly paper, has been used very extensively on trees about Boston. It is very adhesive, remains sticky for a considerable time and does not injure the bark of older trees at least.

The tussock moth caterpillar succumbs readily to arsenical poisons and where the trees are infested or are likely to be attacked by more than one leaf feeder, as is true in the Hudson valley, spraying is perhaps the best method of protecting the trees. One of the best poisons for this purpose, particularly in sections infested by the elm leaf beetle, is arsenate of lead, (15 per cent arsenic oxid), used at the rate of four pounds to fifty gallons of water.

EXPLANATION OF PLATES

Plate 1

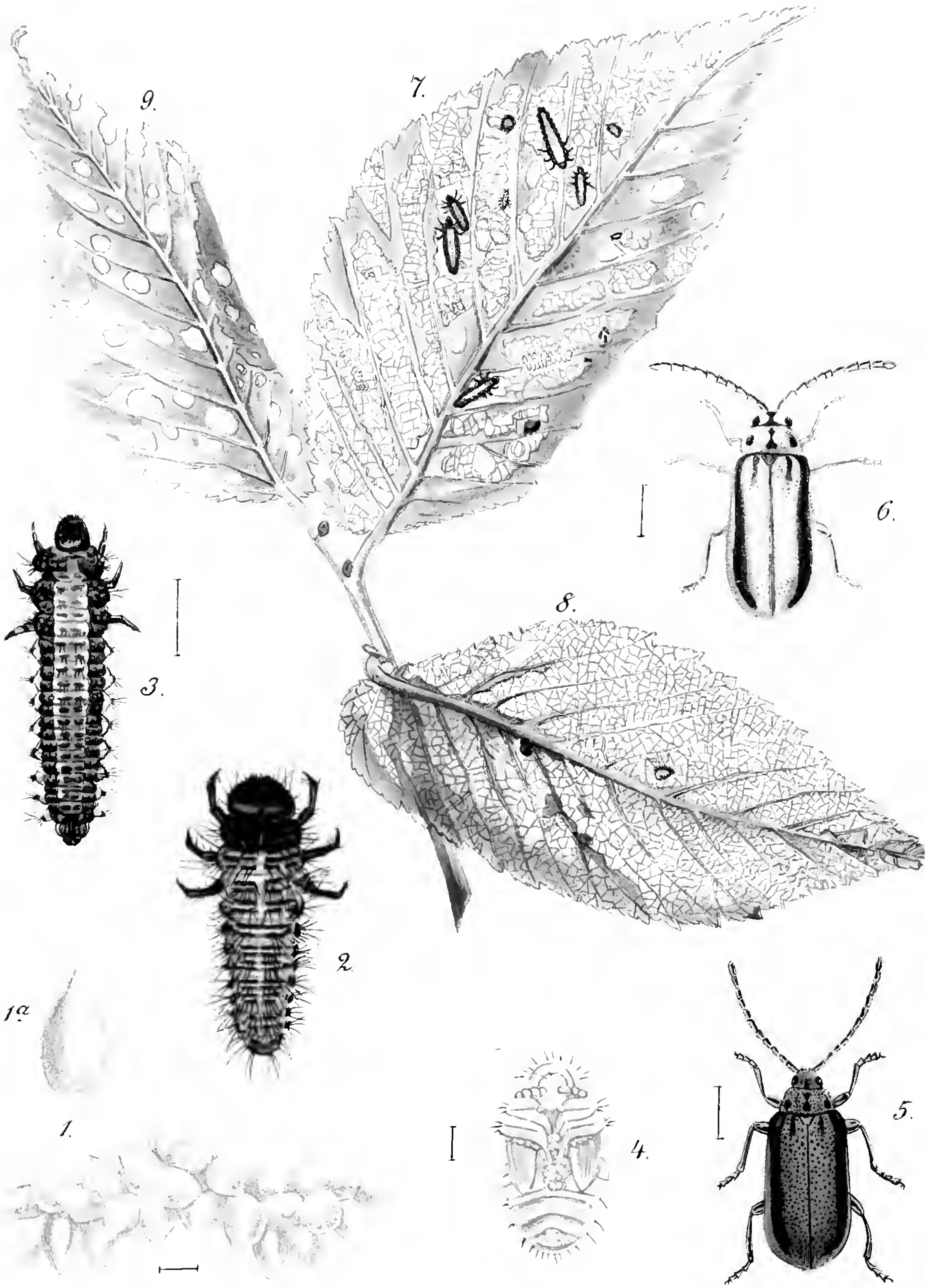
Executed from nature, under the author's direction, by L. H. Joutel of New York City, and reproduced from the 5th report of the Commissioners of Fisheries, Game and Forests through the courtesy of the commissioners

Elm leaf beetle

Galerucella luteola Müll.

1 Cluster of eggs, much enlarged
1*a* Side view of single egg, still more enlarged
2 Recently hatched larva or grub, much enlarged
3 Full-grown larva or grub, much enlarged
4 Pupa, much enlarged
5 Overwintered beetle, much enlarged
6 Fresh, brightly colored beetle much enlarged
7 Leaf showing eating of larvae or grubs and a few holes eaten by beetles, eggs in clusters, cast larval skins and full-grown larvae, natural size
8 Leaf skeletonized by grubs
9 Leaf eaten by beetles

PLATE 1



L. F. Joutel, 1900.

ELM LEAF BEETLE

(Reprint from 5th report of commissioners of fisheries, game and forests)

Plate 2

Executed from nature by L. H. Joutel

White-marked tussock moth

Hemerocampa leucostigma Abb. & Sm.

1 Male moth at rest on trunk
2 Female laying eggs upon her cocoon
3 Egg masses on cocoons
4 A full-grown caterpillar resting on a twig
5 Cast skins of caterpillars
6 Cocoons massed on trunk
7 Pupa of female within cocoon
8 Twigs girdled by caterpillars
8a Twig broken off at point of girdling

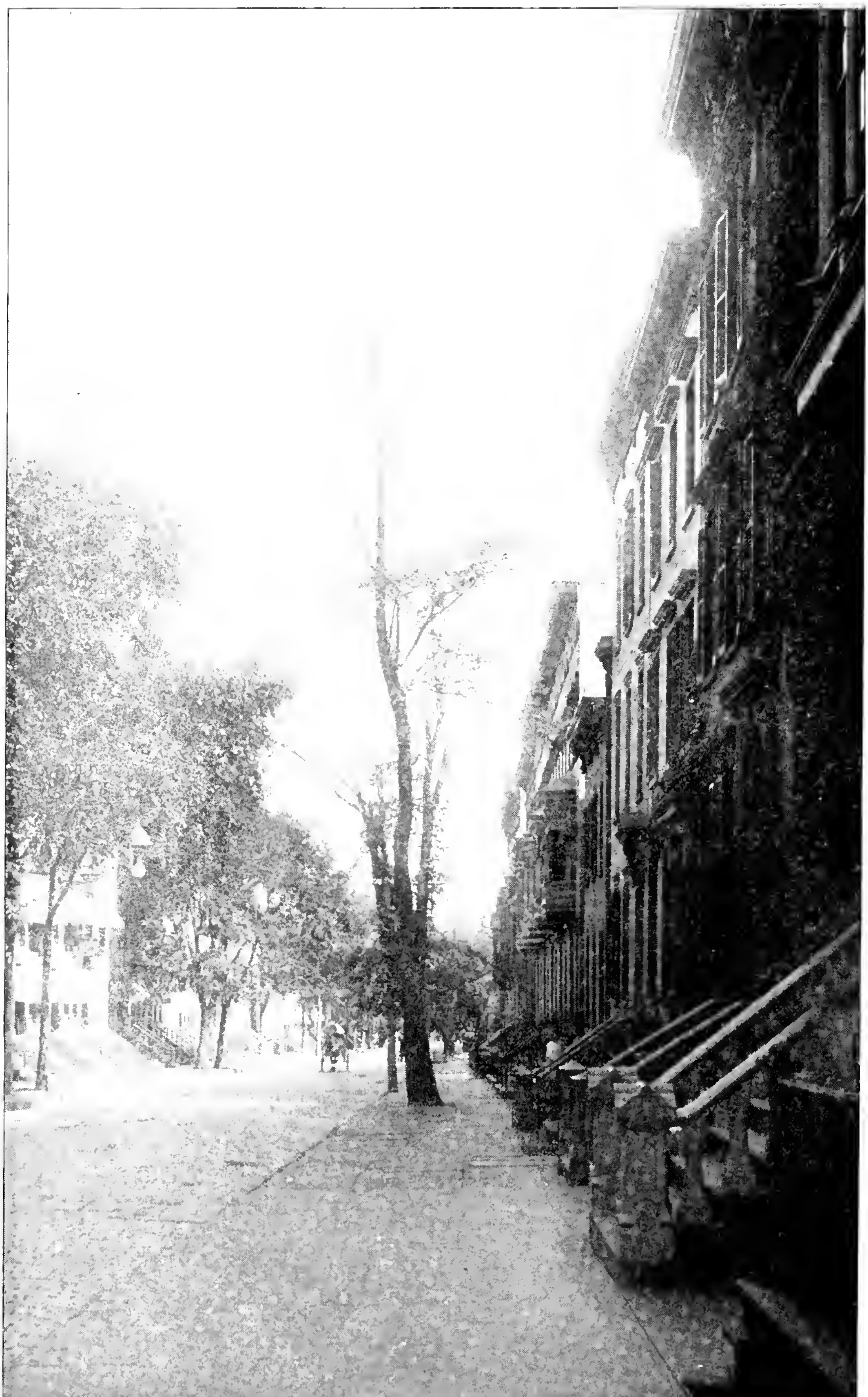
The foliage shows the effects of this caterpillar's work

L. H. Joutel, 1906.

WHITE MARKED TUSSOCK MOTH

Plate 3

A magnificent English elm nearly defoliated by the elm leaf beetle, G a l e r u c e l l a l u t e o l a Müll. Lancaster street, Albany. Photo August 1906.



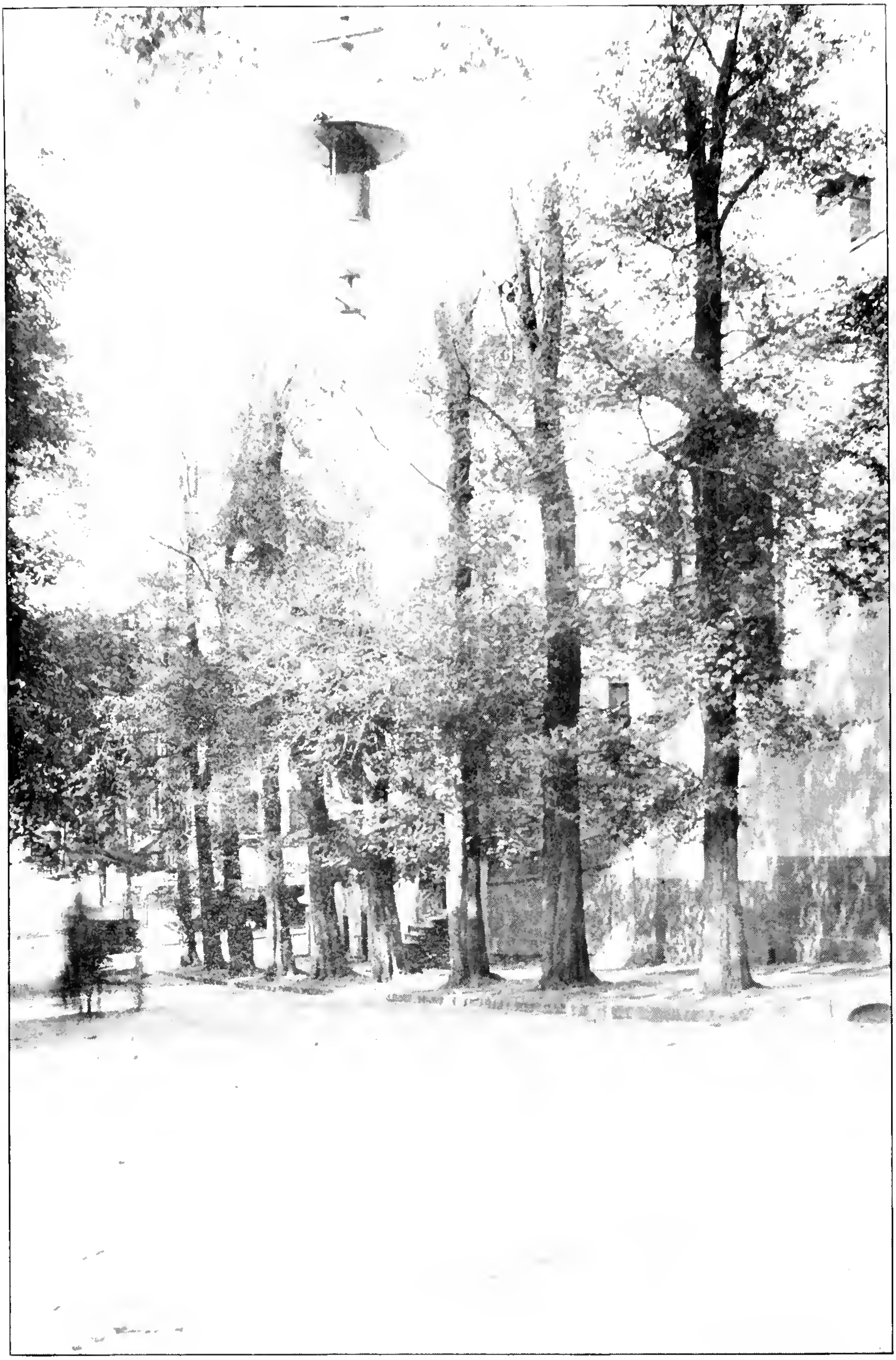
Albany, Aug. 1906

Work of elm leaf beetle on Lancaster street

Plate 4

Row of English elms on South Hawk street, Albany, nearly ruined by the work of the elm leaf beetle, G a l e r u c e l l a l u t e o l a Müll. Photo August 1906. These nine trees were, in 1898, in about the same condition as the one illustrated on plate 3.

Plate 4

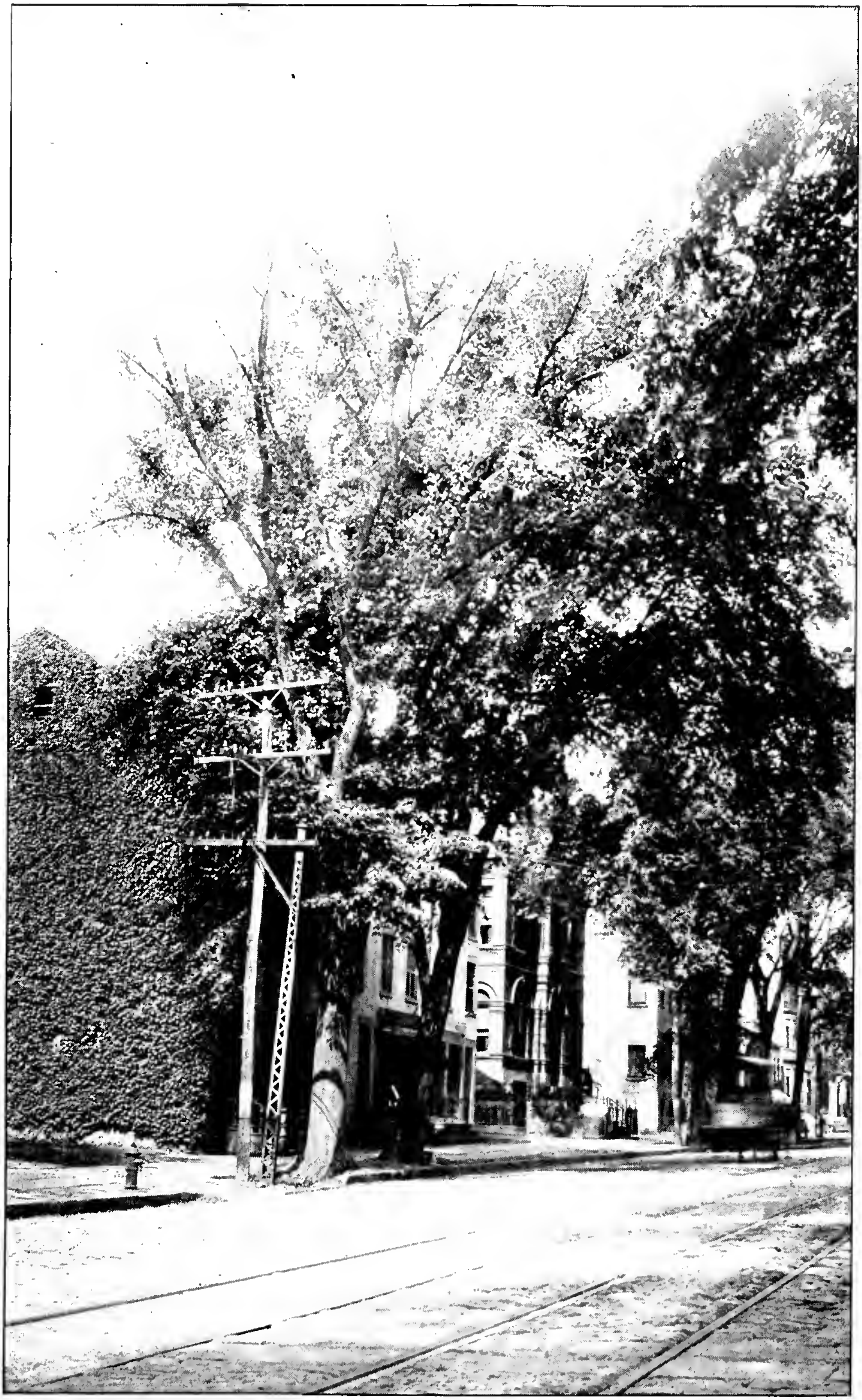


Albany, Aug. 1906

Work of elm leaf beetle on South Hawk street

Plate 5

American elm on Washington avenue near Fort Orange Club, Albany, seriously injured by the elm leaf beetle, Galerucella luteola Müll. Photo August 1906. Note the numerous dead limbs. This tree died about two years later.



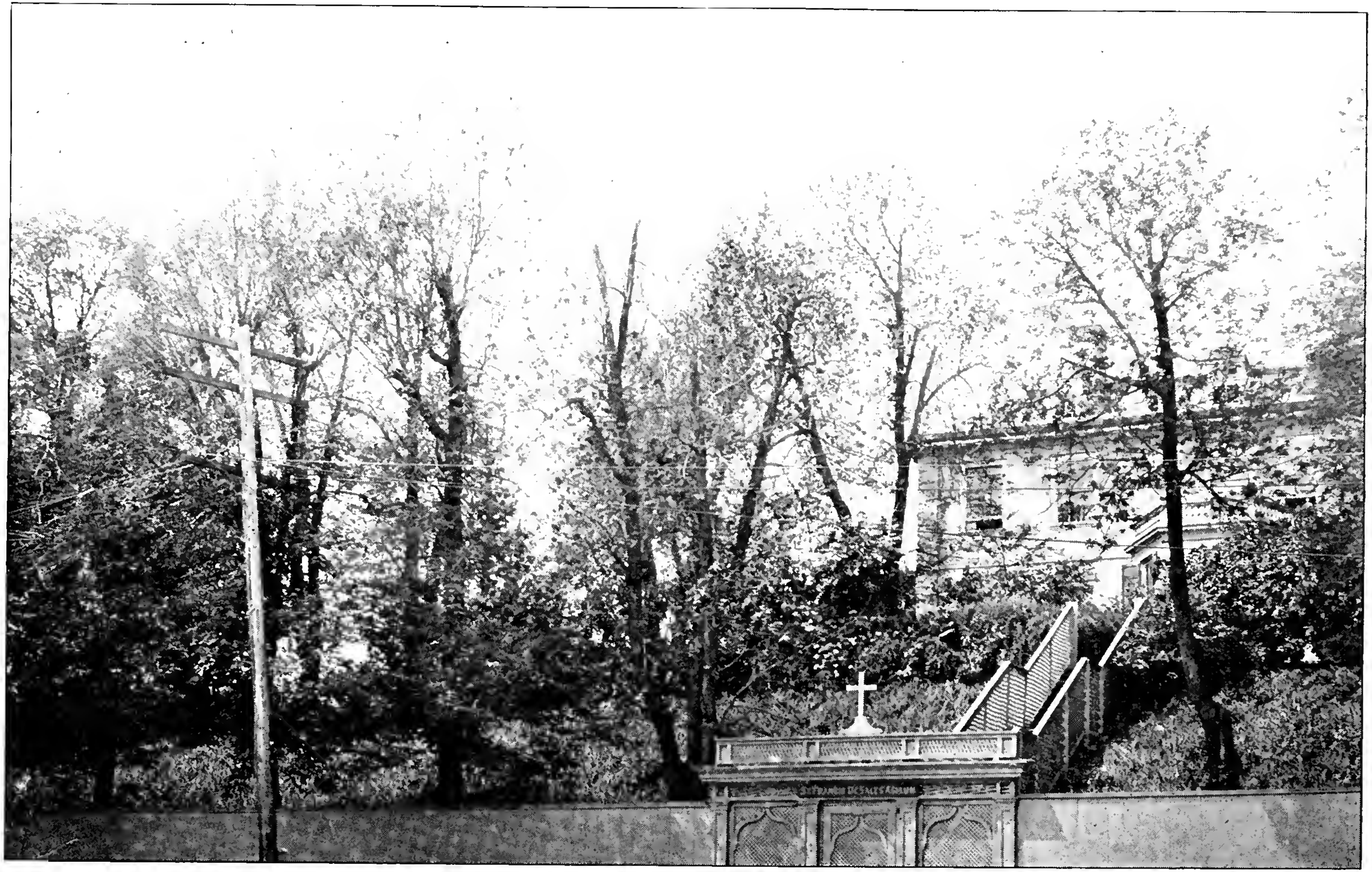
Albany, Aug. 1906

Work of elm leaf beetle on Washington avenue

Plate 6

Work of white-marked tussock moth, *Hemerocampa leucostigma* Abb. & Sm., on clump of horse-chestnuts standing on the grounds of St Francis de Sales Asylum, Albany. Photo August 1906.

Plate 6



Albany, Aug. 1906

Work of white-marked tussock moth on horse chestnut

Plate 7

Egg masses of white-marked tussock moth *Hemerocampa leucostigma* Abb. & Sm., on American elm. Congress street, Albany. Photo August 1906. Note that the egg masses are conspicuous, attached to slight cocoons and therefore easily removed.

Plate 7

Albany, Aug. 1906

White-marked tussock moth eggs on Spring street

Plate 8

Egg masses of white-marked tussock moth, Hemerocampa leucostigma Abb. & Sm., on English elm. Capitol park, Albany. Photo August 1906. Note that the egg masses are conspicuous, attached to slight cocoons and therefore easily removed.

Plate 8

Capitol Park, Albany, 1906

White-marked tussock moth eggs

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Appendix 4

Botany

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157 Report of the State Botanist 1911

Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y. under the act of July 16, 1894

No. 514 ALBANY, N. Y. MARCH 1, 1912

New York State Museum

JOHN M. CLARKE, Director

CHARLES H. PECK, State Botanist

Museum Bulletin 157

REPORT OF THE STATE BOTANIST 1911

New York State Education Department
Science Division, February 28, 1912

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I beg to transmit herewith for publication as a bulletin of the State Museum, the annual report of the State Botanist for the fiscal year ending September 30, 1911.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 29th day of February, 1912

A. S. Draper

Commissioner of Education

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Published fortnightly by the University of the State of New York

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New York State Museum

John M. Clarke, Director.
Charles H. Peck, State Botanist

Museum Bulletin 157

REPORT OF STATE BOTANIST 1911

Dr John M. Clarke, Director of the State Museum:

I have the honor of submitting the following report of work done in the botanical section of the State Museum during the past year.

Specimens of plants for the State herbarium have been collected in the counties of Albany, Essex, Lewis, Oneida, Otsego, Rensselaer, Saratoga, Steuben and Warren.

Specimens have been contributed by correspondents and others that were collected in the counties of Albany, Cattaraugus, Columbia, Cortland, Franklin, Fulton, Greene, Herkimer, Jefferson, Monroe, New York, Oneida, Onondaga, Ontario, Orange, Orleans, Queens, Rensselaer, Richmond, Schenectady, Suffolk, Tompkins, Warren, Washington and Westchester.

Extralimital specimens have been contributed that were collected in Alaska, California, Canada, Colorado, Connecticut, Cuba, Delaware, District of Columbia, Europe, Florida, Indiana, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, Ohio, Oregon, Utah, Vermont and Washington.

The number of species of which specimens have been added to the herbarium is 283 of which 100 were not before represented in it. Of these, 28 are new or hitherto undescribed species. All of these are fungi.

A list of the names of the added specimens is marked "Plants added to the Herbarium."

The number of those who have contributed specimens is 74. This includes those who sent specimens merely for identification, if the specimens were collected in our State and were in such condition and of such character as to make them desirable additions to the herbarium. The number of persons for whom identifications have been made is 162. The number of identifications made is 1915.

A list of the names of contributors and of their respective contributions is marked "Contributors and their contributions."

The names of species new to our flora with their localities, time of collecting and remarks concerning them will be found in a chapter marked "Species not before reported." This includes species which may have been reported before as varieties of other species but which now are regarded as distinct species. Also descriptions of those regarded as new species.

New localities of rare plants, new varieties and any facts of interest that may have been observed are given under the title "Remarks and observations."

Many specimens of fungi collected outside of our State have been received for determination. When no description could be found to correspond to their characters they have been considered new species and names given to them and descriptions of them written. These will be found under the heading "New species and varieties of extralimital fungi."

Eight species and varieties of mushrooms have been tested for their edible qualities and approved. These added to those already known make the number of New York edible species and varieties of mushrooms now known, 213.

One species previously reported as edible was found by Mr F. C. Stewart to have a bitter taste. It is the rooted collybia, Collybia radicata (Relh.) Fr. In my trials of this species for its edibility no such flavor was observed. At my request Mr Stewart sent me specimens of this mushroom gathered in the locality from which the bitter ones came. These were cooked in the same manner as in my former trials. Their bitter flavor was verified: but no evil consequences resulted. It has been learned in this case that some mushrooms, as well as apples and other fruits, may vary in flavor. When the bitter taste is mild it is not a serious objection to their edibility provided it is not distasteful to the eater and no evil consequences follow. Dandelions cooked as a pot-herb often have a decidedly bitter flavor which to some persons is not at all objectionable and may even be considered as valuable because indicating tonic properties.

Two trips have been made in my efforts to locate and investigate the chestnut bark disease. Having learned by report that this disease was supposed to have attacked the chestnut trees about Cooperstown, that locality was visited and under the guidance of one familiar with the locality and interested in the woodland supposed to be affected, a careful search for it was made. No evidences of the presence of the fungus that causes the chestnut bark disease were found either in the standing trees or in the branches, stumps and young shoots of trees that had been cut because they were supposed to have been attacked by it. The real cause of the trouble was not satisfactorily ascertained, but it seemed probable that the severe drouths of three preceding seasons may have contributed to the trouble.

Having heard that the disease was advancing northward from New York City through the counties along the east bank of the Hudson river, and had already reached Columbia county, a visit was made to the town of Sand Lake in Rensselaer county. Chestnut trees are common in the woods of that region but my efforts to find there any evidences of the fungus that causes the chestnut bark disease were wholly unsuccessful. Subsequent investigations by others have indicated its presence in both the southern and northern part of the county. In this case as in others a new attack appears to have been made in places widely separated from any others. In this respect the disease is specially dangerous, the germs or spores being evidently carried by insects, birds or some other agent than winds. It is therefore of the utmost importance that a close watch be kept for the appearance of the disease wherever chestnut trees abound and that trees found affected by it should be cut and their bark burned as soon as possible. The spread of the disease has been so rapid and its work so virulent during the two years past that constant watchfulness and prompt action whenever it appears are essential to its suppression. It is probable that this destructive outbreak of this remarkable disease is sporadic and brought about by an unusual combination of favoring circumstances and will not long continue to be so destructive. Nature generally finds some way to check such extraordinary action and restore the equilibrium of her forces, but sometimes the proper conditions are not restored till after great damage has been done. It will not do therefore to sit quietly down and wait for such a consummation. We may by prompt and judicious action aid the natural processes and thereby diminish and shorten the ravages of the evil.

In continuance of my investigation of the marsh flora of the Adirondacks, Peacock marsh in the town of North Elba was visited. It is located about three miles south of Lake Placid and nearly east from Averyville. The visit was made in June and owing to the early time in the season it is probable that some plants which occur later were not seen. A list of those seen will be found in the chapter designated " Remarks and observations."

It is interesting to note the seasonal influences on plants and their similar results on our cultivated plants and wild mushrooms. In the eastern part of the State the prevailing low temperature in the spring retarded the development of vegetation and kept back the blossoming of the early varieties of fruit trees. Then a somewhat abrupt change to warmer weather caused these and later varieties to blossom more nearly simultaneously than usual. The early Richmond cherry and the Montmorency commonly have an interval of about ten days between their times of flowering. This year that interval was only two or three days. Pear trees, plum trees and cherry trees were in blossom nearly at the same time and apple trees quickly succeeded them. The resulting fruit crop was abundant and matured early. In midseason a long period of dry hot weather kept back the development of those species of mushrooms that commonly appear at this time of the year. It was a rare thing to find one. They were extremely scarce even in swamps and wet places. Several correspondents wrote that they never before knew mushrooms to be so scarce. One correspondent says, " On account of the drouth this has been the poorest season for fungi I have known in twenty-five years. Not a single morel could I find." This condition continued longer in some places than in others. Where plenteous rains came toward the end of the season mushrooms began to appear. In the vicinity of New York City rain fell abundantly during a whole week. This effectually broke the drouth and soon a crop of mushrooms began to appear. Summer and autumn species came up together and by their great variety and united numbers made such a crop as is rarely seen. In some places the ground appeared as if it was almost covered with them.

One correspondent says, " the Long Island woods are full of mushrooms. It seems that almost every step reveals some different species." Others represent their abundance as so great that they could be gathered by the bushel. One says that a friend who had been out collecting mushrooms brought in half a bushel of Tricholoma personatum Fr. This abundance has extended to other states than our own and has induced people to gather them for food more freely and in greater quantity than usual. As a consequence more accidents and deaths from eating poisonous mushrooms have been reported than usual. In New York City and vicinity it is reported that more than thirty deaths from this cause have taken place. It is affirmed however that nearly all these were among foreign born people who have doubtless mistaken poisonous species for the European species they were accustomed to eat in their own country. Native American people generally have a proper sense of the danger of rashly eating mushrooms whose edible qualities are unknown to them and are prudent enough to avoid doing it. In European countries the ignorant are to some extent protected from such danger by an inspector of the markets who permits to be sold only those mushrooms known to be edible.

It is possible that poverty combined with the high cost of living may have been a source of danger in some cases of mushroom poisoning. An instance was reported to me of a poor family in which the mother and two children were poisoned. The mother recovered but the children died. An enthusiastic mycologist living in the vicinity of the place where this accident occurred began an investigation of the case in an attempt to learn what mushroom caused the sickness. Enough was learned from the mother to indicate that the mushroom chiefly eaten was one known by the name autumn pholiota, Pholiota autumnalis Pk. This was not known to mycologists to be an unwholesome species, but apparently impelled by hunger the family had collected a considerable quantity of it, cooked and ate it. The mother ate about a pint, the boy about the same quantity and the girl somewhat less. All were made sick and after several hours delay a physician was called. The result was as above stated. The flavor of the mushroom is not specially enticing and I can see no reason why they should have eaten so much of it unless they were impelled by hunger. An excessive quantity of a good mushroom may be harmful, but of a bad one it would be still worse. The mycologist who investigated the case learned by subsequent experiment that this is a noxious species and though it may not always be fatal it should be rigidly avoided. It is at least unwholesome.

Besides the abundance of the crop caused by the concentration of summer and autumn species the appearance at such a time of species not before recorded as growing out of season is remarkable. Morels are among the most constant spring and early summer growers. I have not before known them to appear at any other time. One correspondent writing after the morel season had passed says, "I have not been able to find a single morel this season." My own experience was similar to his. Evidently the cold spring time immediately followed by dry weather suppressed the crop of morels. The moderately warm and moist fall weather, however, gave opportunity for a crop of morels in a limited station near Boston, Mass. Specimens were collected and some of them sent to me by Mrs U. C. Sherman with the inquiry if it was not unusual for morels to appear in autumn. An examination of them showed a very close relationship to the conic morel. They differed in a few minor characters from the conic morel, Morchella conica Pers., but most of all in their time of appearance. This is probably due to the peculiar weather conditions of this season, nevertheless it seemed best in view of the minor differences and the very unusual time of its appearance to designate it by the varietal name which will be found in its proper place in this report.

Some seasons seem to be specially favorable to the development of the species of certain genera. In one season species of Hygrophorus will be abundant, in another many species of Lepiota will be seen and in another, species of Lactarius will appear to be unusually common. This year specimens of more species of Tricholoma have been received by me from correspondents during September, October and November than in any other previous year. This indicates to me that the latter part of the season has been unusually favorable to the development of species of Tricholoma.

The custom of issuing generic monographs of New York species has been continued. Revised descriptions of New York species of the genera Clitocybe, Laccaria and Psilocybe have been prepared and arranged as far as practicable according to the Friesian system as given in Sylloge.

To meet the requirements of the rules of the International Botanical Congress of 1905 Latin descriptions of the new species and varieties herein reported have been written.

My assistant, Mr S. H. Burnham, has performed his clerical duties with noteworthy faithfulness, doing all the typewriting of the office, attending to the arrangement, mounting and labeling of specimens, aiding in the identification of specimens sent for that purpose, and in conducting the correspondence. In addition to this he has improved his opportunities during holiday and vacation periods in collecting specimens and in making many valuable additions to the herbarium.

Respectfully submitted

CHARLES H. PECK

State Botanist

Albany, December 28, 1911

PLANTS ADDED TO THE HERBARIUM

New to the herbarium

Acer carolinianum *Walt.*
Aecidium atriplicis *Shear*
Anthyllis vulneraria *L.*
Armillaria pinetorum *Gill.*
Artemisia frigida *Willd.*
A. gnaphalodes *Nutt.*
Ascochyta imperfecta *Pk.*
A. rhei *E. & E.*
Boletus ballouii *Pk.*
Camarosporium maclurae *Pk.*
Centaurea maculosa *Lam.*
Cercospora medicaginis *E. & E.*
Cercosporella terminalis *Pk.*
Clavaria subtilis *Pers.*
Clitocybe fumosa brevipes *Pk.*
C. hirneola *Fr.*
C. sinopicoides *Pk.*
C. splendens *(Pers.) Fr.*
C. tuba *Fr.*
C. tumulosa *Kalchb.*
Coniothecium chomatosporium *Cd.*
Coprinus domesticus *(Pers.) Fr.*
Coronospora angustata *Fckl.*
Cortinarius albidipes *Pk.*
C. phyllophilus *Pk.*
C. purpurascens *Fr.*
Coryneum disciforme *K. & S.*
Cytospora rhoina *Fr.*
C. salicis *(Cd.) Rabenh.*
Dasyscypha sulphuricolor *Pk.*
Deutzia scabra *Thunb.*
Diplodia spiraeina *Sacc.*
Diplodina medicaginis *Oud.*
Flammula sulphurea *Pk.*
Fusarium pirinum *(Fr.) Sacc.*
Ganoderma sessile *Murr.*
Gloeosporium valsoideum *Sacc.*
Gutierrezia sarothra *(Pursh) B. & R.*
Gymnolomia multiflora *(Nutt.) B. & H.*
Haplosporella ribis *Sacc.*
Hebeloma sinapizans *Fr.*
Helvella capucinoides *Pk.*
Hendersonia grossulariae *Oud.*
Hydnellum peckii *Banker*
Hygrophorus recurvatus *Pk.*
Hygrophorus sordidus *Pk.*
Leptosphaeria distributa *(C. & E.)*
Marasmius epiphyllus *Fr.*
Melanconis alni *Tul.*
Mycena atroumbonata *Pk.*
Mycena metata *Fr.*
Naucoria arenaria *Pk.*
Oenothera muricata *L.*
Omphalia offuciata *Fr.*
Ophiotheca vermicularis *(Schw.)*
Peniophora tenuissima *Pk.*
Periconia pycnospora *Fres.*
Peronospora trifoliorum *DeBy.*
Pestalozzia adusta *E. & E.*
P. funerea *Desm.*
P. longiseta *Speg.*
Phacidium lignicola *Pk.*
Pholiota rigidipes *Pk.*
Phoma amorphae *Pk.*
P. bacteriophila *Pk.*
P. leprosa *Pk.*
P. smilacis *B. & J.*
Physcia granulifera *(Ach.) Tuck.*
Polyporus melanopus *Fr.*
Polysaccum pisocarpium *Fr.*
Psilocybe fuscofolia *Pk.*
P. polycephala *(Paul.)*
Poria pulchella *Schw.*
Ramularia karstenii *Sacc.*
Rubus glandicaulis *Blanch.*
Sagedia cestrensis *Tuck.*
Septoria aquilegiae *P. & S.*
S. dianthi *Desm.*
S. malvicola *E. & M.*
S. mirabilissima *Pk.*
Sphaeronema minutulum *D. Sacc.*
Sphaeropsis amorphae *E. & B.*
S. maclurae *Cke.*
Spongipellis occidentalis *Murr.*
Stagonospora carpathica *Baeuml.*
Steccherinum peckii *Banker*
Steganosporium fenestratum *(E. & E.)*
Stigmina populi *(E. & E.) Pk.*
Teichospora trimorpha *Atk.*
Thyridium pallidum *E. & E.*

Tricholoma boreale *Fr.*
T. planiceps *Pk.*
T. subsaponaceum *Pk.*
T. subsejunctum *Pk.*
Trimmatostroma salicis *Cd.*
Uromyces spartinae *Farl.*
Ustilago hypodytes (*Schl.*) *Fr.*
Verbena stricta *Vent.*
Vermicularia hysteriiformis *Pk.*
Volutella buxi (*Cd.*) *Berk.*

Not new to the herbarium

Acalypha virginica *L.*
Agaricus abruptibulbus *Pk.*
A. placomyces *Pk.*
A. subrufescens *Pk.*
Amaranthus crispus (*L. & T.*) *A. Br.*
Amelanchier oligocarpa (*Mx.*)
Andromeda glaucophylla *Link*
Andropogon furcatus *Muhl.*
Anthostoma gastrina (*Fr.*) *Sacc.*
Anychia dichotoma *Mx.*
Arctium minus (*Hill.*) *Bernh.*
Arabis drummondii *Gray*
Belonidium aurelia (*Pers.*) *DeNot.*
Bidens cernua *L.*
Boletus albidipes *Pk.*
B. speciosus *Frost*
Botrychium obliquum *Muhl.*
B. simplex *E. Hitchc.*
Calocera viscosa (*Pers.*) *Fr.*
Calvatia gigantea (*Batsch*)
Cantharellus aurantiacus *Fr.*
Centaurea nigra radiata *DC.*
Cichorium intybus *L.*
Claudopus nidulans (*Pers.*) *Pk.*
Clavaria crassipes *Pk.*
Clitocybe candicans *Pers.*
C. clavipes (*Pers.*) *Fr.*
C. nebularis (*Batsch*) *Fr.*
C. sudorifica *Pk.*
Coccomyces juniperi *Karst.*
Collema pulposum (*Bernh.*) *Ach.*
Collybia albipilata *Pk.*
C. butyracea *Bull.*
C. familia *Pk.*
C. radicata (*Relh.*) *Fr.*
C. tuberosa *Bull.*
Coniophora puteana (*Schum.*) *Fr.*
Convolvulus arvensis *L.*
Corallorrhiza trifida *Chat.*
Corticium martianum *B. & C.*
Coryneum pustulatum *Pk.*
Crataegus helderbergensis *S.*
Cryptogramma stelleri (*Gmel.*)
Cynosurus cristatus *L.*
Cytospora microspora (*Cd.*) *Rabenh.*
Datura stramonium *L.*
Dendrophoma tiliae *Pk.*
Dentaria diphylla *Mx.*
Dicentra canadensis (*Goldie*)
Didymium squamulosum (*A. & S.*)
Drosera rotundifolia *L.*
Durella corrugata (*C. & P.*) *Sacc.*
Entoloma grayanum *Pk.*
Epilobium molle *Torr.*
Epipactis tesselata (*Lodd.*)
Eragrostis frankii (*F. Mey. & L.*)
Euphorbia corollata *L.*
Flammula alnicola *Fr.*
F. pulchrifolia *Pk.*
Fomes conchatus (*Pers.*) *Fr.*
F. fomentarius (*L.*) *Fr.*
F. pinicola (*Sw.*) *Fr.*
F. roseus (*A. & S.*) *Fr.*
Fraxinus pennsylvanica *Marsh.*
Fuligo septica (*Link*) *Gmel.*
Galera reticulata *Pk.*
Galium trifidum *L.*
Geopyxis hesperidea *C. & P.*
Gloniopsis australis (*Duby*) *Sacc.*
Grindelia squarrosa (*Pursh*)
G. squar. nuda (*Wood*)
Habenaria ciliaris (*L.*) *R. Br.*
Helvella macropus (*Pers.*) *Karst.*
Hibiscus trionum *L.*
Hirneola auricula-judae (*L.*)
Hydnum caput-ursi *Fr.*
H. coralloides *Scop.*
H. erinaceus *Bull.*
H. subfuscum *Pk.*
Hygrophorus min. subluteus *Pk.*
Hymenochaete tabacina (*Sow.*) *Lev.*
Hypholoma boughtoni *Pk.*
H. rigidipes *Pk.*
H. subl. squamosum *Cke.*

Hypoxylon serpens (*Pers.*) *Fr.*
Irpex lacteus *Fr.*
Juncus brevicaudatus (*Engelm.*)
Laccaria striatula (*Pk.*)
Lachnea hemisphaerica pusilla *Pk.*
Lactarius cinereus *Pk.*
L. minusculus *Burl.*
L. rimosellus *Pk.*
Lentinus lepideus *Fr.*
Lenzites sepiaria *Fr.*
Lespedeza procumbens *Mx.*
Linnaea bor. americana (*Forbes*)
Lonicera tatarica *L.*
L. xylosteum *L.*
Lycoperdon pusillum *Batsch*
Lyonia ligustrina (*L.*) *DC.*
Lysimachia punctata *L.*
L. thyrsiflora *L.*
Macrosporium tomato *Cke.*
Marasmius spongiosus *B. & C.*
Mentha gentilis *L.*
Merulius fugax *Fr.*
M. tremellosus *Schrad.*
M. ulmi *Pk.*
Monilia peckiana *S. & V.*
Mollisia melaleuca (*Fr.*) *Sacc.*
Mutinus caninus (*Huds.*) *Fr.*
Mycena clavicularis *Fr.*
M. pseudopura *Cke.*
M. pura *Pers.*
M. sanguinolenta *A. & S.*
M. vulgaris (*Pers.*) *Fr.*
Mycosyrinx osmundae *Pk.*
M. osm. cinnamomeae *Pk.*
Naucoria vernalis *Pk.*
Osmunda cin. bipinnatifida *Clute*
Panaeolus retirugis *Fr.*
Penicillium glaucum *Link*
Phlebia pileata *Pk.*
Pholiota adiposa *Fr.*
P. autumnalis *Pk.*
P. comosa *Fr.*
P. discolor *Pk.*
P. praecox *Pers.*
P. vermiflua *Pk.*
Physcia hypoleuca (*Muhl.*) *Tuck.*
Pleurotus porrigens *Pers.*
Poa compressa *L.*
Polygonum hydropiper *L.*
Polyporus admirabilis *Pk.*
Polyporus albellus *Pk.*
P. benzoinus (*Wahl.*) *Fr.*
P. brumalis (*Pers.*) *Fr.*
P. delectans *Pk.*
P. fragrans *Pk.*
P. frondosus *Fr.*
P. giganteus (*Pers.*) *Fr.*
P. umbellatus *Fr.*
Polystictus parvulus *Kl.*
Propolis faginea (*Schrad.*) *Karst.*
Quercus prinoides *Willd.*
Rhytisma acerinum (*Pers.*) *Fr.*
R. vitis *Schw.*
Roestelia aurantiaca *Pk.*
Rosellinia mutans (*C. & P.*) *Sacc.*
Rubus canadensis *L.*
R. sativus (*Bail.*) *Brainerd*
Russula purpurina *Q. & S.*
Rynchospora fusca (*L.*) *Ait. f.*
R. glomerata (*L.*) *Vahl*
Scirpus cyp. condensatus *Fern.*
Scleroderma geaster *Fr.*
Smilacina trifolia (*L.*) *Desf.*
Solenia ochracea *Hoffm.*
Solidago juncea ramosa *P. & B.*
Sphaeropsis biformis *Pk.*
S. persicae *E. & B.*
Stenophyllus capillaris (*L.*) *Britt.*
Stereum acerinum nivosum *Rav.*
S. radiatum reflexum *Pk.*
S. spadiceum *Fr.*
Streptothrix fusca *Cd.*
Stropharia aeruginosa (*Curt.*) *Fr.*
Symplocarpus foetidus (*L.*) *Nutt.*
Taraxacum officinale *Weber*
Tipularia discolor (*Pursh*) *Nutt.*
Tricholoma album (*Schaeff.*) *Fr.*
T. eques. albipes *Pk.*
T. personatum *Fr.*
T. resplendens *Fr.*
Trichothecium roseum (*Pers.*) *Link*
Trichostema dichotomum *L.*
Valsa linderae *Pk.*
V. rhoöphila *C. & E.*
Vernonia altissima *Nutt.*
Viola blanda *Willd.*
V. cucullata *Ait.*
V. pallens (*Banks*) *Brainerd*
Xyris caroliniana *Walt.*

CONTRIBUTORS AND THEIR CONTRIBUTIONS

Miss L. C. Allen, Newtonville, Mass.
Lepiota farinosa *Pk.*

Mrs C. Beach, Catskill
Cryptogramma stelleri *(Gmel.) Prantl*

Miss F. Beckwith, Rochester
Anthyllus vulneraria *L.*
Artemisia frigida *Willd.*
A. gnaphalodes *Nutt.*
Grindelia squarrosa nuda *(Wood)*
Gutierrezia sarothra *(Pursh) B. & R.*
Gymnolomia multiflora *(Nutt.) B.&H.*
Veronica virginica *L.*

Mrs E. B. Blackford, Boston, Mass.
Collybia atrata *Fr.*

Mrs R. C. Burnham, Hudson Falls
Agaricus subrufescens *Pk.*

Miss M. C. Burns, Middleville
Vernonia altissima *Nutt.*

Miss J. F. Conant, Melrose, Mass.
Hydnum laevigatum *Sw.*
Morchella conica serotina *Pk.*

Mrs G. E. Duryee, Schenectady
Agaricus campester majusculus *Pk.*

Mrs E. P. Gardner, Canandaigua
Arabis drummondii *Gray*
Oenothera muricata *L.*
Oenothera muricata canescens *(T. & G.)*
O. oakesiana *Robbins*

Mrs L. L. Goodrich, Syracuse
Centaurea nigra radiata *DC.*

Miss C. C. Haynes, New York
Astrella tenella *(L.) Bv.*
Cololejeunea jooriana *(Aust.)*
Reboulia hemisphaerica *(L.)*
Riccia americana *M. A. Howe*
Riccia arvensis *Aust.*
Ricciocarpus natans terrestris *Lindb.*
Scapania uliginosa *Lindb.*
Targonia hypophylla *L.*

Miss A. Hibbard, West Roxbury, Mass.
Tricholoma piperatum *Pk.*

Mrs M. A. Knickerbocker, San Francisco, Cal.
Astragalus watsonianus *(Ktze.)*
Ephedra nevadensis *Wats.*
Lewisia rediviva *Pursh*

Mrs M. Miller, Boonville
Rhytisma acerinum *(Pers.) Fr.*

Misses M. L. Overacker and I. S. Lawrence, Syracuse
Claudopus nidulans *(Pers.) Pk.*

Mrs F. W. Patterson, Washington, D. C.
Hygrophorus sordidus *Pk.*

Mrs J. H. Poor, New York
Volutella buxi *(Cd.) Berk.*

Mrs U. C. Sherman, Roslindale, Mass.
Morchella conica serotina *Pk.*

Miss E. H. Smith, Berkeley, Cal.
Septoria populi *Desm.*

Miss E. C. Webster, Canandaigua

Clitocybe fumosa brevipes *Pk.*
C. sudorifica *Pk.*
Cortinarius purpurascens *Fr.*
Cynosurus cristatus *L.*
Flammula sulphurea *Pk.*
Hebeloma sinapizans *Fr.*
Helvella crispa *(Scop.) Fr.*
Hieracium murorum *L.*
Hygrophorus recurvatus *Pk.*
Hypholoma perplexum *Pk.*
Lysimachia thyrsiflora *L.*
Mycena metata *Fr.*
Pholiota squarrosa *Muell.*

F. H. Ames, Brooklyn
Boletus vermiculosus spraguei *(Frost) Pk.*

J. C. Arthur, Lafayette, Ind.
Aecidium kellermanni *DeToni*

G. F. Atkinson, Ithaca
Teichospora trimorpha *Atk.*

G. G. Atwood, Albany

Irpex tulipiferae *Schw.*
Peridermium pyriforme *Pk.*

W. H. Ballou, New York

Boletus auriflammeus *B. & C.*
B. ballouii *Pk.*
Clitocybe fumosa brevipes *Pk.*
C. illudens *Schw.*
Entoloma batschianum *Fr.*
Fistulina hepatica *Fr.*
Fomes pinicola *(Sw.) Fr.*
Ganoderma sessile *Murr.*
Gloeoporus conchoides *Mont.*
Lactarius rimosellus *Pk.*
Lentinus spretus *Pk.*
Peridermium cerebrum *Pk.*
Polyporus albellus *Pk.*
P. flavovirens *B. & R.*
P. frondosus *Fr.*
P. umbellatus *Fr.*
Polystictus parvulus *Kl.*
Psilocybe fuscofolia *Pk.*
Steccherinum ballouii *Banker*
Stropharia coronilla *Bull.*

H. J. Banker, Greencastle, Ind.
Acalypha virginica *L.*

E. Bartholomew, Stockton, Kan.

Alternaria brassicae phaseoli *Brun.*
Amanitopsis vaginata alba *Stev.*
Camarosporium berkeleyanum *Lev.*
Camptoum cuspidatum *Cke. & Hark.*
Cercospora circumscissa *Sacc.*
C. eustomae *Pk.*
C. henningsii *Allesch*
C. pastinaceae *(Sacc.) Pk.*
Cercosporella mirabilis *Pk.*
Cladosporium aromaticum *E. & E.*
C. gloeosporoides *Atk.*
Coryneum sorbi *Pk.*
Cytospora foliicola *Libert*
Dermatea mori *Pk.*
Diaporthe inornata *Pk.*
Diplodia polygonicola *Pk.*
Exobasidium vaccinii *(Fckl.) Woron.*
Gloeosporium psoraleae *Pk.*
Graphyllum chloes junci *Pk.*
Haplosporella ailanthi *E. & E.*
Helotium citrinum *(Hedw.) Fr.*
Hendersonia rosae *Kickx.*
Henningsinia caespitosa *Pk.*
Hysterium cubense *Pk.*
Leptostromella scirpina *Pk.*
Macrophoma burserae *Pk.*
M. numerosa *Pk.*
Melanconium betulinum *S. & K.*
Ovularia avicularis *Pk.*
Phoma roystoneae *Pk.*
Pyrenophora depressa *Pk.*
Ramularia macrospora asteris *Sacc.*
Rhytidhysterium guaraniticum *Speg.*
Rosellinia bigeloviae roystoneae *Pk.*
Septonema spilomeum *Berk.*
Septoria apii *Chester*
S. ficarioides *Pk.*
S. magnospora *Pk.*
S. purpurascens *E. & M.*
S. solanina *Speg.*
Sphaeropsis smilacis *E. & E.*
Thelephora sullivantii *Mont.*
Uromyces pictus *Thuem.*
Valsa ceratophora *Tul.*

J. M. Bates, Red Cloud, Neb.

Cercospora gymnocladii *E. & K.*
Puccinia silphii *Schw.*
Ramularia pruinosa *Speg.*
Septoria gramineum *Desm.*

M. S. Baxter, Rochester

Antennaria neglecta *Greene*
Antennaria neodioica *Greene*
Antennaria plantaginifolia *(L.) Richards.*

F. S. Boughton, Pittsford

Cantharellus aurantiacus *Fr.*
Clavaria stricta *Pers.*
C. tsugina *Pk.*
Flammula sulphurea *Pk.*
Galera reticulata *Pk.*
Hypholoma rigidipes *Pk.*
Omphalia oculus *Pk.*
Pholiota confragosa *Fr.*
Polyporus ovinus *(Schaeff.) Fr.*
Stropharia aeruginosa *(Curt.)*

F. J. Braendle, Washington, D. C.

Bovistella ohiensis *E. & M.*
Hygrophorus sordidus *Pk.*
Polyporus volvatus *Pk.*
Tricholoma columbetta *Fr.*
Tricholoma melaleucum *(Pers.) Fr.*

C. E. Brand, Norwich, Conn.

Lepiota farinosa *Pk.*

S. H. Burnham, Hudson Falls

Agaricus subrufescens *Pk.*
Amaranthus crispus *(L. & T.) A. Br.*
Anthostoma gastrina *(Fr.) Sacc.*
Anychia dichotoma *Mx.*
Arctium minus *(Hill.) Bernh.*
Boletus speciosus *Frost*

Cephalozia lunulaefolia *Dum.*
Clavaria crassipes *Pk.*
Clitocybe candicans *Pers.*
C. clavipes (*Pers.*) *Fr.*
C. nebularis (*Batsch*) *Fr.*
C. sudorifica *Pk.*
Convolvulus arvensis *L.*
Coryneum disciforme *K. & S.*
Cytospora microspora (*Cd.*) *Rabenh.*
C. rhoina *Fr.*
Datura stramonium *L.*
Deutzia scabra *Thunb.*
Diplodia spiraeina *Sacc.*
Eragrostis frankii (*F. Mey. & L.*)
Euphorbia corollata *L.*
Flammula alnicola *Fr.*
F. pulchrifolia *Pk.*
Fomes fomentarius (*L.*) *Fr.*
F. roseus (*A. & S.*) *Fr.*
Ganoderma sessile *Murr.*
Hibiscus trionum *L.*
Hirneola auricula-judae (*L.*) *Berk.*
Laccaria striatula (*Pk.*)
Lentinus lepideus *Fr.*
Lespedeza procumbens *Mx.*
Lonicera xylosteum *L.*
Mentha gentilis *L.*
Mycena vulgaris (*Pers.*) *Fr.*
Mycosyrinx osmundae *Pk.*
M. osm. cinnamomeae *Pk.*
Osmunda cinn. bipinnatifida *Clute*
Phlebia pileata *Pk.*
Pholiota autumnalis *Pk.*
Phoma amorphae *Sacc.*
Physcia granulifera (*Ach.*) *Tuck.*
Plagiothecium deplanatum (*Schimp.*)
Polyporus admirabilis *Pk.*
P. delectans *Pk.*
P. fragrans *Pk.*
P. melanopus *Fr.*
P. picipes *Fr.*
P. underwoodii *Murr.*
Poria pulchella *Schw.*
Quercus prinoides *Willd.*
Sphaeropsis amorphae *E. & B.*
S. biformis *Pk.*
S. maclurae *Cke.*
Spongipellis occidentalis *Murr.*
Stereum radiatum reflexum *Pk.*
S. spadiceum *Fr.*
Thyridium pallidum *E. & E.*
Tricholoma album (*Schaeff.*) *Fr.*
T. boreale *Fr.*
T. resplendens *Fr.*

H. W. Clute, Gloversville
Corallorrhiza maculata flavida *Pk.*

M. T. Cook, New Brunswick, N. J.
Trichoderma koningi *Oud.*

S. W. Cowles, Marietta
Silene dichotoma *Ehrh.*

J. A. Crabtree, Montgomery
Grindelia squarrosa (*Pursh*) *Dunal*

S. Davis, Brookline, Mass.

Clavaria peckii *Sacc.*
Entoloma flavifolium *Pk.*
E. grayanum *Pk.*
E. subtruncatum *Pk.*
Leptoglossum luteum (*Pk.*) *Sacc.*
Leptonia davisiana *Pk.*
Pilosace eximia *Pk.*
Tricholoma terraeolens majus *Pk.*

J. Dearness, London, Can.

Creonectria verrucosa (*Schw.*) *Seaver*
Dothiorella quercina (*C. & E.*) *Sacc.*
Entyloma polysporum (*Pk.*) *Farl.*
Mazzantia sepium *S. & P.*
Ophiobolus cesatianus (*Mont.*) *Sacc.*
Peronospora hydrophylli *Waite*

Peronospora parasitica *DeBy.*
Pestalozzia funerea *Desm.*
Phyllachora graminis (*Pers.*) *Fckl.*
Puccinia glaucis *Arth.*
Puccinia minutissima *Arth.*
Pyrenopeziza artemisiae (*Lasch*)
Septoria noctiflorae *E. & K.*
Urophlyctis pulposa (*Wallr.*)
Xylaria filiformis caulincola *Rehm*

F. Dobbin, Shushan

Bryum capillare *L.*
Collema pulposum (*Bernh.*) *Ach.*

C. E. Fairman, Lyndonville

Septoria polygonorum *Desm.*
Sphaeronema minutulum *D. Sacc.*
Ustilago hypodytes (*Schl.*) *Fr.*

W. G. Farlow, Cambridge, Mass.

Tolyposporella (?) nolinae *Clint.*
Uromyces spartinae *Farl.*
Ustilago muhlenbergiae *Clint.*

O. E. Fischer, Detroit, Mich.

Clitocybe piceina *Pk.*
Lepiota fischeri *Kauffm. ined.*

M. J. French, Utica

Pholiota comosa *Fr.*
Volvaria bombycina (*Pers.*) *Fr.*

G. S. Graves, Newport

Collection of 24 abnormal ferns, leaves and flowers.

C. Guillet, Westfield, Mass.

Solidago juncea ramosa *P. & B.*

J. F. v. Hafften, Winfield

Cedrus libani *Barr.*
Ginkgo biloba *L.*

C. C. Hanmer, East Hartford, Conn.

Lepiota farinosa *Pk.*
Marasmius peronatus *Fr.*

B. B. Higgins, Ithaca

Trimmatostroma salicis *Cd.*

A. P. Hitchcock, New Lebanon

Xylaria polymorpha (*Pers.*) *Grev.*

G. T. Howell, Rockville, Ind.

Pluteus alveolatus eccentricus *Pk.*
Tricholoma subsaponaceum *Pk.*

M. E. Jones, Salt Lake City, Utah

Puccinia aberrans *Pk.*
Thecopsora pyrolae (*Gmel.*) *Karst.*
Uredinopsis copelandii *Syd.*
Uromyces erythronii (*DC.*) *Pers.*

G. L. Kirk, Rutland, Vt.

Dichelyma pallescens *B. & S.*

R. Latham, Orient Point

Aecidium atriplicis *Shear*
Ascochyta rhei *E. & E.*
Belonidium aurelia (*Pers.*) *DeNot.*
Boletus ballouii *Pk.*

Camarosporium maclurae *Pk.*
Clitocybe pithyophila *Fr.*
Coccomyces juniperi *Karst.*
Collybia tuberosa *Bull.*
Coronophora angustata *Fckl.*
Coryneum pustulatum *Pk.*
Cytospora salicis (*Cd.*) *Rabenh.*
Dendrophoma tiliae *Pk.*
Durella corrugata (*C. & P.*) *Sacc.*
Geopyxis hesperidea *C. & P.*
Gloniopsis australis (*Duby*) *Sacc.*
Haplosporella ribis *Sacc.*
Hendersonia grossulariae *Oud.*
Hydnum subfuscum *Pk.*
Hygrophorus laetus (*Pers.*) *Fr.*
H. miniatus subluteus *Pk.*
H. sordidus *Pk.*
Hymenochaete rubiginosa (*Schrad.*)
Hypoxylon serpens (*Pers.*) *Fr.*
Marasmius epiphyllus *Fr.*
M. spongiosus *B. & C.*
Merulius ulmi *Pk.*
Mollisia melaleuca (*Fr.*) *Sacc.*
Monilia peckiana *S. & V.*
Mycena sanguinolenta *A. & S.*
Pestalozzia adusta *E. & E.*
P. funerea *Desm.*
P. longiseta *Speg.*
Phoma smilacis *Roy. & Jacq.*
Physcia hypoleuca (*Muhl.*) *Tuck.*
Poa compressa L.
Polyporus giganteus (*Pers.*) *Fr.*
Polysaccum pisocarpium *Fr.*
Propolis faginea (*Schrad.*) *Karst.*
Rhytisma vitis *Schw.*
Rosellinia mutans (*C. & P.*) *Sacc.*
Russula purpurina *Q. & S.*
Sagedia cestrensis *Tuck.*
Scleroderma geaster *Fr.*
Septoria dianthi *Desm.*
Solenia ochracea *Hoffm.*
Sphaeropsis persicae *E. & B.*
Steganosporium fenestratum (*E.& E.*)
Stereum acerinum nivosum *Rav.*
Streptothrix fusca *Cd.*
Tipularia discolor (*Pursh*) *Nutt.*
Trichostema dichotomum *L.*
Valsa linderae *Pk.*
Valsa rhoöphila *C. & E.*

W. B. Limberger, Randolph

Lysimachia punctata *L.*
Viola cardaminefolia *Greene*
Viola minuscula *Greene*

C. A. Mabie, Holley

Hydnum erinaceus *Bull.*
Lepiota naucinoides *Pk.*
Lepiota rhacodes *Vitt.*

G. E. Morris, Waltham, Mass.

Amanita crenulata *Pk.*
A. morrisii *Pk.*
Armillaria nardosmia *Ellis*
Boletus cyanescens *Bull.*
B. luteus *L.*
B. parasiticus *Bull.*
Cortinarius cinnabarinus *Fr.*
C. morrisii *Pk.*
C. vibratilis *Fr.*
Geaster morgani *Lloyd*
Merulius rubellus *Pk.*
Panaeolus subbalteatus *B. & Br.*
Paxillus microsporus *Pk.*
Pholiota duroides *Pk.*
Scleroderma tenerum *B. & C.*
S. verrucosum (*Bull.*)
Sparassis crispa (*Wulf.*) *Fr.*
Tricholoma saponaceum *Fr.*
Tricholoma sejunctum (*Sow.*) *Fr.*

F. T. Pember, Granville

Centaurea maculosa *Lam.*
Verbena stricta *Vent.*

L. H. Pennington, Syracuse

Coprinus domesticus (*Pers.*) *Fr.*
Hymenogaster anomalus *Pk.*

C. R. Pettis, Albany

Chilonectria cucurbitula *(Curr.)* Phoma bacteriophila *Pk.*
Septoria mirabillissima *Pk.*

D. Reddick, Ithaca

Monilia peckiana *S. & V.*

W. H. Ropes, Salem, Mass.

Calvatia rubroflava *Cragin* Lysurus borealis serotinus *Pk.*

F. L. Schrader, New York

Hygrophorus sordidus *Pk.*

F. J. Seaver, New York

Herpotrichia nigra *Hartig*

E. B. Sterling, Trenton, N. J.

Fomes igniarius *(L.) Fr.* Hebeloma subcollariatum *B. & Br.*

F. C. Stewart, Geneva

Ascochyta imperfecta *Pk.*
Cercospora circumscissa *Sacc.*
C. medicaginis *E. & E.*
Collybia radicata *(Relh.) Fr.*
Diplodina medicaginis *Oud.*
Flammula sulphurea *Pk.*
Gloeosporium nervisequum *(Fckl.)*
G. valsoideum *Sacc.*
Hypholoma boughtoni *Pk.*
Lentinus spretus *Pk.*
Peronospora trifoliorum *DeBy.*
Pseudopeziza medicaginis *(Lib.)*

W. G. Stover, Stillwater, Okla.

Bolbitius fragilis *Fr.*
Marasmius bellipes *Morg.*
Marasmius delectans *Morg.*
M. opacus *B. & C.*

J. M. Van Hook, Bloomington, Ind.

Hypoxylon atropurpureum *Fr.*
H. effusum *Nits.*
H. petersii *B. & C.*
Hypoxylon rubiginosum *(Pers.)*
H. sassafras *(Schw.)*
H. turbinulatum *(Schw.)*
Nummularia microplaca *B. & C.*

W. G. Van Name, Albany

Roestelia aurantiaca *Pk.*

H. L. Wells, New Haven, Conn.

Boletus edulis clavipes *Pk.*

T. E. Wilcox, Washington, D. C.

Boletus affinis *Pk.* Boletus subtomentosus *L.*
Sparassis herbstii *Pk.*

C. L. Williams, Glens Falls

Coniothecium chomatosporium *Cd.*

D. B. Young, Albany

Calyptospora goeppertiana *Kuehn* Chaetomium streptothrix *Quel.*

SPECIES NOT BEFORE REPORTED

Acer carolinianum Walt.

Troupsburg, Steuben co. May. This species is readily distinguished from Acer rubrum L., the red maple, when in fruit. The wings are nearly parallel or convergent, but in the red maple they are divergent. They are also nearly or quite fully developed when the leaves are yet partly expanded. The leaves are usually only three lobed and are more hairy, specially beneath, than in the red maple. On account of the three lobed leaves it was named Acer rubrum var. tridens in Wood's Class Book of Botany It has generally been neglected by botanists but it certainly seems worthy of recognition. The station here reported is the only one in our State known to me and is north of its previously recorded range.

Aecidium atriplicis Shear

On living leaves of young plants of the halberd leaved orach, Atriplex patula hastata (L.) Gray. Orient Point, Suffolk co. May. R. Latham.

Anthyllis vulneraria L.

Introduced. Cobbs Hill reservoir. Rochester. September. Miss Florence Beckwith. Determined by P. A. Rydberg.

Armillaria pinetorum Gill.

Decaying wood. North Elba, Essex co. September. This species of Armillaria is easily distinguished by its small size, scaly cap and stem and very small spores. It differs from the European plant in growing on wood.

Artemisia frigida Willd.

Cobbs Hill reservoir. Rochester. August. Miss F. Beckwith. Introduced from the West but well established.

Artemisia gnaphalodes Nutt.

Cobbs Hill reservoir. Rochester. August. Miss F. Beckwith. Introduced from the West. This and the preceding one were determined by P. A. Rydberg.

Ascochyta imperfecta n. sp.

Spots variable, 4–12 mm in diameter, amphigenous, orbicular, semicircular or subtriangular, the larger ones usually terminal or marginal, pale brown or smoky brown, not sharply defined;

perithecia amphigenous, few, depressed, .3–.6 mm broad, brown or blackish brown; spores variable, continuous or pseudouniseptate, oblong or subcylindric, obtuse, hyaline, 6–15 x 2.5–4 μ.

Living or languishing leaves of alfalfa, Medicago sativa L. Geneva. May and June. F. C. Stewart.

It may be separated from Ascochyta medicaginis Bres. by its habitat and smaller perithecia and spores.

Ascochyta rhei E. & E.

Living leaves of pie plant, Rheum rhaponticum L. Orient Point. R. Latham. This was originally described as Phyllosticta rhei E. & E.

Boletus albidipes n. sp.

For description of this species see article on Edible Fungi in another chapter of this report.

Boletus ballouii n. sp.

Plate VIII, figures 1–5

Pileus fleshy, firm, often irregular, convex becoming nearly plane or slightly depressed in the center, dry, unpolished or minutely tomentose, occasionally rimosely squamose, at first bright orange or orange tinged with brown, becoming wood brown or subcinnamon with age or in drying, flesh white tinged with yellow beneath the cuticle, taste mild or sometimes slightly disagreeable; tubes at first white or whitish becoming smoky brown where cut or bruised and brown or brownish in drying, usually slightly depressed around the stem and adnexed or subdecurrent; stem variable, solid, mealy or minutely scurfy, striate or subreticulate at the top, single or cespitose, white or pallid above, yellow or orange below, similar to the pileus in color when dry, its flesh when cut while fresh assuming a brownish tint, mycelium white, radiating at the base; spores pale yellow inclining to orange, 8–10 x 4–5 μ, cystidia rare, fusiform, granular within.

Pileus 5–12 cm broad; stem 2.5–12 cm long, 7–15 mm thick.

Orient Point. October. R. Latham. Specimens have also been received with copious notes from W. H. Ballou for whom the species is named. They were collected in groves at or near Deal Beach, N. J. It is said to be common in Monmouth co., N. J. This is a beautiful species apparently related to Boletus subsanguineus Pk. from which it differs in its dry pileus with its orange color changing to brown, in its whitish tubes and in its stem approaching the pileus in color.

Camarosporium maclurae n. sp.

Perithecia gregarious, about .3 mm broad, nestling in the bark, erumpent, conic or subglobose, scarcely papillate, black; spores at first simple and hyaline, then colored and 3–5-septate and muriform, sometimes slightly curved, 15–20 x 8–10 μ.

Dead branches of osage orange, Maclura pomifera (Raf.) Schneid. Orient Point. April. R. Latham.

The apertures in the epidermis through which the fungus breaks are either orbicular or subelliptic.

Centaurea maculosa Lam.

Granville, Washington co. September. F. T. Pember. An introduced species.

Cercospora medicaginis E. & E.

Living leaves of alfalfa, Medicago sativa L. Geneva. June. F. C. Stewart.

Cercosporella terminalis n. sp.

Spots narrowly oblong, 1–3 cm long, 3–5 mm broad, often confluent, specially at the apical end of the leaf which is commonly entirely discolored, brown or blackish brown, often sterile; tufts mostly effused, forming linear flocculent white patches; spores variable, curved or flexuous, subcylindric or gradually tapering toward the apex, continuous or 1–3-septate, often nucleate, 50–150 x 3–5 μ, supported on short simple or obscure hyphae.

Leaves of Indian poke, Veratrum viride Ait. Edwards, St Lawrence co. May.

This species is closely related to Cercosporella veratri Pk. from which it is easily distinguished by its earlier appearance and by the different character of the spots. Their habit of becoming confluent and discoloring the whole apex of the leaf has suggested the specific name. Notwithstanding the obscure character of the hyphae, a careful search even in young and slightly discolored spots failed to detect any acervuli.

Clavaria subtilis Pers.

Among fallen leaves of spruce trees. North Elba. September. In some of the specimens the tips of the ultimate branchlets have retained their pure white color.

Clitocybe fumosa brevipes n. var.

This variety differs from the typical form in its constantly short stem which is 1.2–2 cm long. Its thickness is nearly equal to its length. It is so short that the pileus appears to rest on the ground.

Canandaigua. October. Miss E. C. Webster. Near New York City. W. H. Ballou.

Clitocybe hirneola Fr.

North Elba. September.

Clitocybe sinopicoides n. sp.

Low wet places. North Elba. June. For the description of this species see chapter on New York species of Clitocybe.

Clitocybe splendens (Pers.) Fr.

Mossy ground under balsam fir trees. North Elba. June. This species is allied to Clitocybe gilva (Pers.) Fr. from which it may be separated by its whiter flesh, its thinner pileus and its less crowded lamellae. The spores in both are subglobose and 4–5 μ broad.

Clitocybe sudorifica n. sp.

Gregarious. Grassy ground. Saratoga Springs, F. G. Howland. Albany, S. H. Burnham. Canandaigua, Miss E. C. Webster. September to November. For description see chapter on New York species of Clitocybe.

Clitocybe tuba Fr.

Woods. North River. September.

Clitocybe tumulosa Kalchb.

Woods. North Elba. September.

Coniothecium chomatosporium Cd.

Branches of apple tree. Glens Falls. April. C. L. Williams.

Coprinus domesticus (Pers.) Fr.

Syracuse. June. L. H. Pennington. A very rare species.

Coronophora angustata Fckl.

Dead trunks of bayberry, Myrica carolinensis Mill. Orient Point. April. R. Latham.

Cortinarius albidipes n. sp.

The description of this species will be found in the chapter on Edible Fungi in this report.

Cortinarius phyllophilus n. sp.

Pileus fleshy, thick, compact, convex or nearly plane, viscid, somewhat shining and slightly innately fibrillose when dry, pale tawny ochraceous, flesh white, taste mild; lamellae thin, close, eroded on the edge, yellow becoming brownish cinnamon; stem short, stout, firm, abruptly bulbous, silky fibrillose, whitish with ferruginous stains at the base; spores somewhat pointed at the ends, 10–12 x 5–6 μ.

Pileus 7–12 cm broad; stem 3–5 cm long, 1–1.5 cm thick.

Among fallen leaves in woods. Humphreys gorge, Lewis co. September.

The species belongs to section Phlegmacium, group Scauri. The color of the spore print is dark cinnamon. Young lamellae yellow.

Cortinarius purpurascens Fr.

Canandaigua. September. Miss E. C. Webster.

Coryneum disciforme K. & S.

Dead branches of basswood, Tilia americana L. Vaughns, Washington co. June. S. H. Burnham.

Cytospora rhoina Fr.

Dead branches of smooth sumac, Rhus glabra L. Rensselaer. February. S. H. Burnham.

Cytospora salicis (Cd.) Rabenh.

Dead branches of willows. Orient Point. May. R. Latham.

Dasyscypha sulphuricolor n. sp.

Cups sulfur color, gregarious or subcespitose, subsessile, 1–3 mm broad, minutely villose, hymenium plane or convex, margined by the incurved edge of the cup; asci subcylindrical, 70–80 x 3–4 μ; spores oblong or subfusiform, 10–12 x 2–3 μ, paraphyses filiform.

Decaying wood of black ash, Fraxinus nigra Marsh. Remsen, Oneida co. August. The species is apparently related to Dasyscypha pulverulenta (Lib.) Sacc. but it differs from it in its larger size, longer asci and spores and in its habitat.

Deutzia scabra Thunb.

The rough leaved deutzia is plentiful along the stream at Copake Iron Works, Columbia co. July. S. H. Burnham. It has evidently escaped from cultivation but is apparently well established. Occasionally double flowered specimens are seen, which indicates that such plants grew from branchlets of Deutzia scabra var. plena Maxim. which had taken root and developed into shrubs.

Diplodia spiraeina Sacc.

Dead branches of nine bark, Physocarpus opulifolius (L.) Maxim. Near Rensselaer lake, Albany co. May. S. H. Burnham.

Diplodina medicaginis Oud.

Dead stems of alfalfa, Medicago sativa L. Geneva. April. F. C. Stewart.

Flammula sulphurea n. sp.

Plate VII, figures 7–11

Pileus fleshy, subconic or convex becoming broadly convex, glabrous, viscid, hygrophanous, watery yellow when moist, sulfur yellow after the escape of the moisture, sometimes with whitish silky fibrillose scales on the margin, flesh white when dry, odor and taste disagreeable; lamellae thin, close, arcuate, adnate, crenulate on the margin, whitish becoming dark ferruginous; stem equal, flexuous, fibrillose or squamulose below, stuffed or hollow, pale yellow and naked at the top, ferruginous toward the base; spores dark ferruginous, 8–11 x 5–6 μ.

Pileus 2–6 cm broad; stem 3–6 cm long, 4–8 mm thick.

Cespitose or densely gregarious. Grassy ground under apple trees or in orchards. October. Menands, Albany co. Canandaigua. Miss E. C. Webster. Geneva. F. C. Stewart. Pittsford, Monroe co. F. S. Boughton.

This species is related to Flammula spumosa Fr. with which it has probably been confused but from which it is easily distinguished by its place of growth, its more cespitose mode of growth, the uniform pale yellow color, fibrillose margin of the pileus, white flesh and larger spores. Its color is suggestive of F. alnicola Fr., but it is readily separated from that by its place of growth, white flesh and viscid hygrophanous pileus. It is worthy of remark that this species has appeared for the first time this season in four distinct localities and in each one under or near apple trees.

Fusarium pirinum (Fr.) Sacc.

On decaying pears. Menands. August.

Ganoderma sessile Murr.

Dead wood of oak and elm. Peebles island, Waterford, Saratoga co. September. S. H. Burnham. New York. W. H. Ballou. It is colored like Ganoderma tsugae Murr. but is a smaller species with the pileus sessile and dimidiate.

Gloeosporium valsoideum Sacc.

Small twigs of sycamore, Platanus occidentalis L. Geneva. F. C. Stewart. It is easily distinguished from Gloeosporium nervisequum (Fckl.) Sacc. by its habitat and larger and more conspicuous pustules.

Gutierrezia sarothra (Pursh) B. & R.

Cobbs Hill reservoir. Rochester. August. Miss F. Beckwith. Introduced but apparently well established.

Gymnolomia multiflora (Nutt.) B. & H.

Cobbs Hill reservoir. Rochester. August. Miss F. Beckwith. Introduced but apparently well established. This and the preceding one were determined by P. A. Rydberg.

Haplosporella ribis Sacc.

Dead stems of some species of cultivated Ribes. Orient Point. May. R. Latham.

Hebeloma sinapizans Fr.

Canandaigua. September. Miss E. C. Webster.

Helvella capucinoides n. sp.

Pileus thin, submembranaceous, saddle-shaped, usually with one lobe deflexed, the other erect, the naked free margins of both curved inward, the lower enfolding the top of the stem, the hymenium smoky ochraceous, becoming brown or ochraceous brown with age or in drying, the lower or inner surface of the pileus white, rugulose; stem slender, firm, equal, stuffed or hollow, the surface wavy or uneven, minutely and pubescently pruinose, snowy white; asci cylindric, 240–280 x 18–20 μ; spores oblong ellipsoid, uniseriate, uninucleate, hyaline, 20–28 x 12–16 μ, paraphyses filiform, clavate at the tips.

Pileus .5–2.5 cm broad; stem 2.5–7 cm long, 2–4 mm thick.

Gregarious. In groves of arbor vitae trees, Thuja occidentalis L. North River. September.

This species agrees in some of its characters with the description of Helvella capucina Quel. but it differs in the shape and color of the pileus, in its naked margin and its even surface. The large nucleus of the spores in our plant is hyaline, not greenish as in the European.

Hendersonia grossulariae Oud.

Dead or dying stems of cultivated gooseberry, Ribes grossularia L. Orient Point. May. R. Latham.

Hydnellum peckii Banker ined.

Growing on the ground. North Elba. September. The plants are single or cespitose and have the pilei sometimes confluent. The pileus is whitish becoming brownish or subviolaceous with age.

Hygrophorus recurvatus n. sp.

Pileus fleshy in the center, thin toward the margin, convex becoming plane or concave by the margin curving upward, often lacerated on the margin, grayish brown and obscurely striatulate on the margin when moist, subalutaceous and even when dry, glabrous, the center often more highly colored than the margin, flesh white; lamellae subventricose, distant, venosely connected, decurrent, whitish; stem fragile, equal, stuffed or hollow, fibrous, easily splitting, subpruinose, white or whitish; spores broadly ellipsoid or subglobose, 6–8 x 4–6 μ or 6–7 μ in diameter.

Pileus 1.2–2.4 cm broad; stem 2–4 cm long, 2–4 mm thick.

Growing on lawns. Canandaigua. October. Miss E. C. Webster. The plants sometimes grow in arcs of circles. The relationship appears to be with Hygrophorus colemannianus Blox. from which it may be distinguished by its smaller size, paler color, more fragile character and its upcurved margin of the pileus in mature plants.

Hygrophorus sordidus Pk.

Among fallen leaves along the banks of Bronx river, New York. October. F. L. Schrader. Orient Point. R. Latham.

Leptosphaeria distributa (C. & E.) Sacc.

Dead stems of some species of Asclepias. Edwards. May These specimens differ from the typical form in not blackening the cuticle which at first covers the perithecia.

Marasmius epiphyllus Fr.

Fallen leaves. Orient Point. August. R. Latham. Port Jefferson, Suffolk co. Closely allied to Marasmius insititius Fr. from which the more velvety stem will separate it.

Melanconis alni Tul.

Dead branches of hoary alder, Alnus incana (L.) Moench. Rossie, St Lawrence co. May. The specimens are young.

Mycena atroumbonata n. sp.

Pileus submembranaceous, convex becoming broadly convex or nearly plane, umbonate, striate plicate from the margin half way to the umbo, glabrous, dark watery brown and shining when moist, grayish brown with a black umbo when dry; lamellae thin, moderately close, widely sinuate at the inner extremity, decurrent with a tooth, white when young, whitish or livid white when mature; stem slender, rather long, glabrous, hollow, radicating, colored like the pileus, with a white villosity at the base; spores oblong or ellipsoid, granular within, often 2-nucleate, 6–9 x 5–6 μ.

Pileus 1.2–3.2 cm broad; stem 5–8 cm long, 1–2 mm thick.

Gregarious. Mossy prostrate decaying trunks of hemlock, Tsuga canadensis (L.) Carr. North River. September.

This species is closely related to Mycena galericulata Scop. with which it probably has hitherto been confused. It differs in its gregarious mode of growth, its habitat, its black umbo, its widely plicate striate margin of the pileus, its pure white young lamellae and its more expanded mature pileus.

Mycena metata Fr.

Ground. Canandaigua. September. Miss E. C. Webster.

Naucoria arenaria n. sp.

Pileus thin, convex or nearly plane, glabrous, pale yellow or reddish yellow with paler margin; lamellae broad, distant, unequal, sinuate, brownish ferruginous; stem slender, rigid, glabrous, stuffed with a white pith, colored like the pileus, pseudobulbous; spores brownish ferruginous 15–20 x 10–12 μ.

Pileus .75–2 cm broad; stem 2–3 cm long, 1–2 mm thick.

Sandy soil. Karner, Albany co. August.

A small species closely related to Naucoria platysperma Pk. but much smaller with more distant lamellae and a more rigid stem enlarged at the base by a globe of sand bound together by the mycelium and firmly attached to the stem.

Oenothera muricata L.

Canandaigua. August. Mrs E. P. Gardner, who also sends specimens of Oenothera muricata canescens (T. & G.) Robins.

Omphalia offuciata Fr.

Under or near pine trees. Luzerne, Warren co. June. In our specimens the spores are broadly ellipsoid or nearly globose, 6–8 x 5–6 μ or 5–6 μ in diameter. I have seen no description of the European plant that gives the spore dimensions.

Ophiotheca vermicularis (Schw.) Macbr.

Dead stems of herbs. Edwards. May. Determined by T. H. Macbride.

Peniophora tenuissima n. sp.

Widely effused, very thin, indeterminate, adnate, not at all or but slightly rimose when dry, whitish, subpruinose; spores ellipsoid, 8 x 4 μ; cystidia subcylindric or elongated conic, obtuse, 50–80 x 15–20 μ.

Bark of yellow birch, Betula lutea Mx. North Elba. June.

Periconia pycnospora Fres.

Dead stem of paeony, Paeonia officinalis L. Menands. April. Rare.

Peronospora trifoliorum DeBy.

Living leaves of alfalfa, Medicago sativa L. Geneva, Potsdam, Fayetteville, Canandaigua and Earlville. June. F. C. Stewart. Oospores were found in October.

Pestalozzia adusta E. & E.

Living leaves of wild black cherry, Prunus serotina Ehrh. Orient Point. July. R. Latham.

Pestalozzia funerea Desm.

Twigs of white cedar, Thuja occidentalis L. Orient Point. May. R. Latham.

Pestalozzia longiseta Speg.

Living leaves of cultivated raspberry. Orient Point. August. R. Latham.

Phacidium lignicola n. sp.

Perithecia superficial or nearly so, about 1 mm broad, orbicular or broadly ellipsoid, prominent, rugose, black, laciniately opening, the margin with 3–5 triangular teeth; hymenium blackish or greenish black; asci clavate, 60–80 x 12 μ broad in the widest part; spores crowded or subdistichous, continuous, straight or slightly curved, oblong or sometimes slightly narrowed toward one end, hyaline, 12–15 x 3.5–4 μ.

Dry hard decorticated wood of American aspen, Populus tremuloides Mx. Thompsons Lake, Albany co. May.

Pholiota rigidipes n. sp.

Pileus fleshy, rather thin, broadly convex, sometimes slightly and broadly umbonate, obscurely squamulose with appressed hairy brownish scales more conspicuous in the center, pale yellow or buff, flesh white, tinged with yellow next the gills, taste mild; lamellae thin, rather broad, close, adnexed, brownish ferruginous when mature; stem equal, slender, stuffed or hollow, more or less flexuous, rigid, floccose squamulose below the slight sometimes evanescent annulus, white and pruinose at the top, pallid below the annulus; spores ellipsoid, 8–10 x 5–6 μ.

Pileus 5–8 cm broad; stem 5–7 cm long, 4–6 mm thick.

Among fallen leaves in woods. Constableville, Lewis co. September.

This species is related to Pholiota terrigena Fr. from which I have separated it because of its more slender habit, white flesh, adnexed lamellae and more slender rigid stem. The margin of the pileus in the dried specimen is obscurely striate.

Phoma amorphae Sacc.

Dead stems of false indigo, Amorpha fruticosa L. Near Kenwood, Albany co. May. S. H. Burnham.

Phoma bacteriophila n. sp.

Perithecia minute, .2–.3 mm broad, at first covered by the epidermis, then erumpent, scattered or densely gregarious, sometimes crowded and covering the whole branchlet, black; spores obovate or ellipsoid, hyaline, 6–8 x 4–5 μ.

Canker spots on young stems of white pine, Pinus strobus L. and on dead branchlets which it completely covers. White Pine plantation, Saranac Lake, Franklin co. April. C. R. Pettis.

The young trees are killed by a bacterial disease and the dead spots of the trunk and dead branchlets are attacked by this and other fungi.

Phoma leprosa n. sp.

Perithecia .3–.5 mm broad, depressed or subglobose, perforated, covered with a whitish incrustation; spores straight, cylindric, hyaline, 10–15 x 3–4 μ.

Old fruit of the punctate fruited thorn tree, Crataegus punctata Jacq. Rossie. May.

The sporophores are short or obsolete. The fungus is conspicuous by reason of the white crustlike scales that cover the perithecia This character is suggestive of the specific name.

Phoma smilacis B. & J.

Dead stems of some species of Smilax. Orient Point. April. R. Latham.

Physcia granulifera (Ach.) Tuck.

Lyndonville, Orleans co. C. E. Fairman. On stems of button bush, Cephalanthus occidentalis L. Karner. January. S. H. Burnham.

Polyporus melanopus Fr.

Woods. Vaughns, Washington co. October. S. H. Burnham. Determined by C. G. Lloyd. A rare species both in this country and in Europe. It bears some resemblance to Polyporus radicatus Schw. from which it is separated by its cespitose mode of growth and its smaller spores. It is more closely allied to P. varius Fr.

Polysaccum pisocarpium Fr.

Sandy soil in cedar woods. Orient Point. October. R. Latham.

Poria pulchella Schw.

Bark of black willow, Salix nigra Marsh. Loudonville, Albany co. March. S. H. Burnham.

Psilocybe fuscofolia n. sp.

Solitary, gregarious or cespitose. Vicinity of New York. October. W. H. Ballou. For description of this species see chapter on New York species of Psilocybe.

Psilocybe polycephala (Paul.)

Ground in woods. Constableville. September. Description given in chapter on Edible Fungi.

Ramularia karstenii Sacc.

Leaves of Epilobium adenocaulon Haussk. North Elba. June. It most frequently occupies the apical part of the leaves and discolors and kills them. The basal half of the leaf is usually reddish.

Rubus glandicaulis Blanch.

Roadsides and pastures. North Elba. June.

Sagedia cestrensis Tuck.

Bark of basswood, Tilia americana L. Orient Point. March. R. Latham.

Septoria aquilegiae Penz. & Sacc.

Living leaves of wild columbine, Aquilegia canadensis L. Rossie. May. Septoria aquilegiae E. & E. appears to be the same species.

Septoria dianthi Desm.

Living or languishing leaves of sweet william, Dianthus barbatus L. Orient Point. June. R. Latham. In these specimens the spots are surrounded by a purple border.

Septoria malvicola E. & M.

Leaves of the common or round leaved mallow, Malva rotundifolia L. Rossie. May.

Septoria mirabilissima n. sp.

Perithecia scattered, very minute, .1–.2 mm broad, superficial, black; spores filiform, flexuous or curved, continuous, hyaline, 40–150 x 1.5–2 μ, supported on slender sporophores, 20 x 1 μ.

Slightly discolored bark of white pine, Pinus strobus L. Four year old seedlings. White pine plantation, Saranac Lake. April. C. R. Pettis.

A remarkable species because of its peculiar habitat and its minute size. It is scarcely visible to the naked eye. The spores are unusually long and when moist the perithecia are easily scraped from the bark. The bark tissues had assumed a dark rusty red color, probably from some bacterial invasion and the trees were in a dying condition.

Sphaeronema minutulum D. Sacc.

Dead stems of showy sedum, Sedum spectabile Bor. Lyndonville. October. C. E. Fairman.

Sphaeropsis amorphae E. & B.

Dead stems of false indigo, Amorpha fruticosa L. Menands. March. S. H. Burnham.

Sphaeropsis maclurae Cke.

Dead branches of osage orange, Maclura pomifera (Raf.) Schneid. Kenwood. May. S. H. Burnham. The perithecia are densely gregarious and cover the branches on all sides. Occasionally two are crowded together thereby indicating an approach to the genus Haplosporella.

Spongipellis occidentalis Murr.

Prostrate trunk of American elm, Ulmus americana L. Vaughns. October. S. H. Burnham.

Stagonospora carpathica Baeuml.

Living leaves of alfalfa, Medicago sativa L. Geneva. June. F. C. Stewart. The typical form of the species occurs on leaves of sweet clover, Melilotus alba Desv. but the form on alfalfa leaves does not differ essentially from it.

Steccherinum peckii Banker ined.

Dead wood of sugar maple, Acer saccharum Marsh. Griffin Corners, Delaware co. September. The species is related to Steccherinum ochraceum (Pers.) S. F. Gray from which it differs in having a distinct stemlike base and in being glabrous and more distinctly zonate. The pilei are often laterally confluent as in Stereum fasciatum Schw.

Steganosporium fenestratum (E. & E.) Sacc.

Twigs and branches of sweet pepperbush, Clethra alnifolia L. Orient Point. May. R. Latham.

Stigmina populi (E. & E.) Pk.

Living leaves of American aspen, Populus tremuloides Mx. North Elba. June. This is a parasitic fungus which causes dead spots on the leaves. These spots increase in size and often become confluent and kill the leaves. The spores develop on both sides of the leaf and form dark olive green patches on the dead spots. The species was placed in the genus Clasterosporium by Ellis and Everhart, but its phyllogenous and biophilous characters evidently indicate a closer relationship to the genus Stigmina.

Teichospora trimorpha n. sp. Atk.

Perithecia scattered or gregarious, rounded, orbicular or oblong, rarely two or three conjoined, plane or shortly papillate, black, sunk in the bark; asci dimorphic, 30–125 x 12–15 μ, cylindric or tapering very gradually into a short pedicel, some collapsing, 4–6- or 8-spored; spores uniseriate, 20–30 x 7–10 μ, constricted in the middle, 5–8-septate, blackish brown, frequently inequilateral, paraphyses filiform, numerous.

Bark of dead branches of poplar. Fall creek above the dam. Near Ithaca. March 1894. G. F. Atkinson.

This species differs from Teichospora disseminata B. & C. in its much larger perithecia.

Thyridium pallidum E. & E.

Dead branches of staghorn sumac, Rhus typhina L. Vaughns. June. S. H. Burnham.

Tricholoma boreale Fr.

Lawns near Dudley observatory grounds under or near Austrian pine trees. Albany. November. S. H. Burnham.

Tricholoma planiceps n. sp.

Pileus fleshy but very thin, broadly convex or plane, glabrous, grayish brown or yellowish brown with the thin acute margin sometimes whitened by a very thin flocculent tomentum, flesh white; lamellae thin, narrow, close, slightly sinuate, white or whitish; stem slender, straight, stuffed or hollow, colored like but a little paler than the pileus; spores broadly ellipsoid, 7–8 x 5–6 μ.

Pileus 2–5 cm broad; stem 4–6 cm long, 4–6 mm thick.

In arbor vitae groves. North River. September.

Allied to Tricholoma melaleucum (Pers.) Fr. from which it differs in its very regular plane orbicular pileus, its more crowded narrow lamellae, its strict stem and broader spores. Its habitat is peculiar having been found only under white cedar trees, Thuja occidentalis L., and in but one locality. In this station it has been found two years in succession.

Tricholoma subsaponaceum n. sp.

Pileus fleshy, compact, flexible, convex or nearly plane, glabrous, whitish creamy white or pallid on the margin, smoky brown or alutaceous in the center, sometimes marked by a row of pallid or watery spots near the margin, assuming yellow or saffron hues where cut or bruised, flesh white, changing color like the pileus where cut or wounded, odor pleasant like anise, taste farinaceous; lamellae broad, close, adnexed or nearly free, whitish; stem variable, equal or enlarged at the top or at the base, sometimes compressed, often abruptly narrowed at the base and radicating, silky fibrillose, solid becoming hollow with age, whitish, changing color like the pileus where cut or bruised; spores broadly ellipsoid or subglobose, 5–6 x 4–5 μ.

Pileus 6–14 cm broad; stem 4–5 cm long, 1.5–3 cm thick.

Among fallen leaves in woods. October. Brooklyn. F. H. Ames. Also near Rockville, Indiana. G. T. Howell.

The Indiana specimens are taken as the type. The species is related to Tricholoma saponaceum Fr. but differs from it in the color assumed by wounded places, in its odor and taste and in its spores.

Tricholoma subsejunctum n. sp.

The description of this species will be found in the chapter on Edible Fungi in this report.

Trimmatostroma salicis Cd.

Dead branches of willows. Ithaca. November. B. B. Higgins.

Uromyces spartinae Farl.

Leaves of smooth marsh grass, Spartina glabra alterniflora (Loisel.) Merr. Shelter Island, Suffolk co. October. W. G. Farlow.

Ustilago hypodytes (Schl.) Fr.

On dead stems of quack grass, Agropyron repens (L.) Bv. Lyndonville. June. C. E. Fairman.

Verbena stricta Vent.

Pastures. Granville. August. F. T. Pember. Introduced from the western part of the country.

Vermicularia hysteriiformis n. sp.

Perithecia elliptic or oblong, .3–.6 mm long, at first covered by the epidermis, then erumpent, setose, black, the setae continuous, erect or divergent, 50–120 x 4–5 μ, black, tapering upward, pale at the apex; spores oblong or subfusiform, straight or slightly curved, acute at the ends, continuous, hyaline, 20–25 x 3–4 μ.

Dead stems of blue cohosh, Caulophyllum thalictroides (L.) Mx. Troupsburg. May.

Volutella buxi (Cd.) Berk.

Living and languishing stems and leaves of box, Buxus sempervirens L. East Hampton, Suffolk co. October. Mrs J. H. Poor.

REMARKS AND OBSERVATIONS

Agaricus arvensis Schaeff.

This fine large mushroom was found by F. H. Ames growing in the arc of a circle about 15 feet in diameter. Long Island. September. Several species occasionally grow in this manner. The fairy ring mushroom frequently does.

Agaricus subrufescens Pk.

This rare species in our State was found by Mrs R. C. Burnham near Vaughns in August. Its pileus was more distinctly squamose than usual. The scales were larger and more conspicuous and the young lamellae were whitish and those of the mature plants were brown. No intervening pink colored lamellae were seen.

Andropogon furcatus Muhl.

A glaucous form of this grass occurs in sandy soil near Karner. August.

Calvatia gigantea (Batsch)

The giant puff ball is the largest species known. It is not unusual for it to attain a diameter of 12–14 inches. It is also one of the very best of our esculent species. It has long been known to be edible so long as its flesh is pure white and it has never been known to prove, so far as I am informed, injurious to anyone eating it in reasonable quantity and at reasonable times. The unfortunate thing about it is that it is not common nor of long continuance. It occurs mostly in the month of September only and in limited stations widely separated from each other and generally in limited number in any station. On the farm of one of our correspondents, Mr A. P. Hitchcock, New Lebanon, is a station in which a few specimens have appeared annually for several years.

On the first day of September three or four young plants had made their appearance. These were in close proximity to each other. On September 6th two more had appeared. Two were selected for observation and numbered respectively 1 and 2. The following is the record of the development of these two as made by Mr Hitchcock.

Sept.		No. 1			No. 2	
1	circum.	10 in.	estimated	circum.	6 in.	estimated
6	"	32.75	measured	"	16	measured
8	"	38	"	"	34	"
10	"	42.5	"	"	43.5	"
11	"	43.75	"	"	45.75	"
12	"	42	"	"	46	"
15	decay commenced			"	46	"

On the 15th, the observations ceased.

It will be seen that No. 1 continued to increase in size for ten days or to the 11th when its circumference was 43.75 inches. The total increments amount to 33.75 inches. This gives an average daily increase of 3.37 inches. Number 2 continued to increase eleven days when its circumference was 46 inches and the total increments amount to 40 inches. This gives an average daily increase of 3.63 inches. It remained stationary three days and then began to decay. Number 1 being larger at the commencement of the observations, it is fair to conclude that it started about one day before No. 2. This gives them both at least eleven days in which to make their full development. We may therefore conclude that the average time of the development of these puff balls is about eleven days and that their average daily rate of increase in circumference is about 3.5 inches or a little more than one inch in diameter. The average time of growth appears to be eleven or twelve days or possibly twelve to fourteen days according to the length of time these two had been above ground before they were first seen.

Centaurea nigra radiata DC.

Homer, Cortland co. August. C. M. Crouse and Mrs L. L. Goodrich. An introduced plant.

Cichorium intybus L.

A white flowered form sometimes occurs. Menands. August.

Convolvulus arvensis L.

Washington park, Albany. July. S. H. Burnham. A form growing on lawns with leaves oblong and only 1–2 lines broad, the lobes at the base very narrow and divergent.

Corallorrhiza trifida Chatelain

North Elba. June. This delicate little coral root is becoming very rare in our State. Its early blooming time, May and June, at once distinguishes it from our other small species.

Cryptogramma stelleri (Gmel.) Prantl

Head of Plattekill cove, Ulster co. September. Mrs Charles Beach. This little fern was found growing in the crevices of sandstone rocks. It usually grows on limestone rocks and this is the first instance known to us in which it has been found growing on sandstone in our State. It occurs on sandstone cliffs in a few places in the middle western states.

Drosera rotundifolia L.

This common sundew and its variety comosa Fernald occur along the sandy shores of White lake, Oneida co. Specimens are sometimes found with the scape forked near the top, each branch bearing flowers and fruit. One thrifty plant had two forked scapes and two simple ones. There were six racemes borne on four scapes, which was a saving of two scapes. In the variety a similar economy is practised by shortening the rhacis of the raceme and crowding the flowers and fruit together.

Euphorbia corollata L.

Sand hills near Albany rural cemetery. September. S. H. Burnham. This is a rare species in our State. In the locality here given it is probably an introduction from the western states.

Galera reticulata Pk.

This rare species of mushroom was collected near Pittsford in October by F. S. Boughton. This is the second locality now known for it in our State.

Grindelia squarrosa (Pursh) Dunal

Overrunning a pasture at Montgomery, Orange co. September. J. A. Crabtree. In New York State Museum Bulletin 150, page 31, this plant was reported from Granville where it is recorded as growing in dry pastures on hillsides and in some places constituting nearly all the vegetation. Its abundance and aggressiveness in both these instances indicate that it is likely to become a noxious weed in our pastures. It would therefore be well to destroy it promptly in these places and in every locality where it may appear. A little labor of this kind promptly done may save much labor in the future and much loss of pasturage.

Grindelia squarrosa nuda (Wood) Gray

Cobbs Hill reservoir. Rochester. November. Miss F. Beckwith. This variety differs from the typical form in its flower heads having no ray flowers.

Habenaria ciliaris (L.) R. Br.

Fruiting specimens of this pretty orchidaceous plant were collected in August in a low but not wet piece of ground near Karner. Scarcely more than a dozen plants of it have been seen here any season since its discovery several years ago. The past season there were eleven. The vicinity has been deprived of most of its larger trees in comparatively recent years, yet the yellow fringed orchis is perpetuating itself well in spite of its changed environment. It probably could be cultivated if given a soil similar to that which it now occupies.

Hypholoma rigidipes Pk.

This mushroom was discovered two years ago at North River. Mr F. S. Boughton has added a second station for it by finding it near Pittsford in October.

Lachnea hemisphaerica pusilla n. var.

Cups small, 1.5–4 mm broad; spores uninucleate. In other respects like the typical form. Exsiccated water holes. Remsen. August.

Lactarius minusculus Burl.

Damp ground under or near pine trees. North River. September. In these specimens the milk was sparse or entirely absent, the pileus was viscid and the taste acrid. The color of the pileus is orange brown, sometimes darker in the center than on the margin.

Lepiota rhacodes Vitt.

This lepiota is very rarely seen in our State. Fine specimens were found near Holley, Orleans co. in October by C. A. Mabie.

Lobelia cardinalis L.

A white flowered form of the showy cardinal flower was found at Gull bay, Lake George in August by Mrs H. H. Murdock.

Lonicera tatarica L.

Pastures. Hornell. May. Two forms occur. One has young flowers pink, the other white, but the flowers of both become yellowish with age or in drying.

Lonicera xylosteum L.

Well established in the woods south of Kenwood. May. S. H. Burnham.

Lysimachia punctata L.

Roadsides near Randolph, Cattaraugus co. August. W. B. Limberger. Plants with whorled flowers only.

Lysimachia thyrsiflora L.

A peculiar form of this plant was collected near Canandaigua in July by Miss E. C. Webster. It has a terminal raceme which gives the plant the general appearance of Lysimachia terrestris (L.) BSP. The flowers are more closely placed, the pedicels are shorter and the petals and sepals are marked by dots instead of lines or dashes as in that species. There are also two short opposite thyrselike racemes just below the terminal one, and two longer and looser clusters among the leaves beneath. These are distant from each other with two leafy branches between them. The single contributed specimen suggests the possibility of its being a hybrid between L. thyrsiflora L. and L. terrestris (L.) BSP.

Mentha gentilis L.

Introduced and occurring specially in waste places in gardens and in dooryards. Kingsbury, Washington co. August. S. H. Burnham. It is recognizable at a glance by its variegated leaves, these having whitish or pale yellowish stripes along the principal veins.

Merulius ulmi Pk.

The type specimens of this species were found on dead branches of elm. It has been found at Orient Point growing on bayberry, Myrica carolinensis Mill. The former specimens are sterile and have the hymenium brighter colored than the latter. The spores in these are globose and 4–5 μ in diameter.

Osmunda cinnamomea bipinnatifida Clute

Woods south of Kenwood. May. S. H. Burnham. It differs from the common form in having some of the lower pinnae pinnatifid.

Plowrightia morbosa (Schw.) Sacc.

Specimens illustrative of the different effects of the black knot on the host plant were collected on chokecherry, Prunus virginiana L., near Meadowdale, Albany co., in July. Some of the branches were completely surrounded by the black knot, others were partly surrounded. Those surrounded showed dead leaves only above the knot, those partly surrounded showed green leaves only above the knot.

Polygonum hydropiper L.

A slender form with elongated drooping spikes bearing white flowers. Remsen. August.

Polyporus albellus Pk.

This species has been common this season while its near relative Polyporus chioneus Fr., which is usually plentiful, has been scarce. Peculiar weather conditions appear to be responsible for the comparative abundance of one and the scarcity of the other.

Polystictus parvulus Klotsch

This species has been unusually abundant in burnt places on Long Island whence specimens have been sent by W. H. Ballou. They are often confluent in tufts of two, three or more. Polyporus focicola B. & C. is considered synonymous with it in Sylloge.

Rubus sativus (Bail.) Brainerd

Thin woods. Karner. In fruit July and August.

Rynchospora fusca (L.) Ait. f.

Abundant along the shores of White lake. August.

Solidago juncea ramosa P. & B.

Association island, Henderson Harbor, Jefferson co. August. C. Guillet.

Stenophyllus capillaris (L.) Britton

Abundant in sandy soil of pastures. Round Lake. September.

Tipularia discolor (Pursh) Nutt.

This extremely rare orchidaceous plant is recorded in Torrey's Flora of the State of New York from a single locality, Parma, Monroe county. One additional station has been discovered for it by M. S. Baxter. This is at Adams Basin not far from Parma station. The past season Mr Roy Latham has discovered a third station for it at Orient Point where he collected fine specimens of it, some of which he has kindly contributed to the State herbarium.

Trichostema dichotomum L.

Orient Point. September. R. Latham. The flowers of this plant are generally blue. From this the common name blue curls is evidently derived. The plants sent by Mr Latham have pink flowers.

Ustilago osmundae Pk.

Fresh specimens of this singular and imperfectly understood parasitic fungus were collected on the royal fern, Osmunda regalis L., by S. H. Burnham, in Cambridge, Washington co., in June. An examination of them revealed a feature previously overlooked. In the early stage of the fungus the cell, which eventually becomes two spores, is single. Soon it develops into a pair of globose echinulate reddish brown spores, 12–16 μ in diameter, these finally separate and with others form a dusty layer of spores over the surface of the young pinnae on which they develop. In developing its spores in pairs this species is unlike the genus Ustilago and is therefore referred to the genus Mycosyrinx and takes the name Mycosyrinx osmundae Pk.

Mycosyrinx osmundae cinnamomeae n. var.

This differs from the typical form in the paler brown color of the spore mass and the even surface of the spores. It occurs on the base of the pinnae of the cinnamon fern, Osmunda cinnamomea L. It is very rare. Only two small specimens were found. Cambridge. June. S. H. Burnham.

Vaccinium oxycoccus L.

This cranberry is common to Bonaparte swamp, Cranberry marsh, Averyville marsh and Peacock marsh. It is found in nearly all our sphagnum marshes and on the open mossy summits of most of the high mountains of the Adirondacks. It is a very hardy species and can maintain itself where the larger and cultivated species, Vaccinium macrocarpon Ait, can not. It is therefore available for cultivation where the other would be a failure. For the purpose of exhibiting the peculiar flora of Peacock marsh a list of its plants is here given. This list was made June 15, 1911.

Amelanchier oligocarpa (*Mx.*) *Roem.*
Andromeda glaucophylla *Link.*
Carex canes. disjuncta *Fern.*
C. exilis *Dew.*
C. pauciflora *Lightf.*
C. paup. irrigua (*Wahl.*) *Fern.*
C. stricta *Lam.*
Chamaedaphne calyculata (*L.*) *Moench*
Eriophorum callitrix *Cham.*
Kalmia angustifolia *L.*
Kalmia polifolia *Wang.*
Larix laricina (*DuRoi*) *Koch*
Ledum groenlandicum *Oeder*
Nemopanthes mucronata (*L.*) *Trel.*
Picea mariana (*Mill.*) *BSP.*
Sarracenia purpurea *L.*
Smilacina trifolia (*L.*) *Desf.*
Vaccinium canadense *Kalm.*
V. oxycoccus *L.*
V. pennsylvanicum *L.*

This marsh, in the town of North Elba, is a small one, probably not over three acres in extent, lying apparently less than a mile east of Averyville marsh. It is circular in outline and has no visible stream running through it. It is a shrubby marsh with numerous trees of tamarack and black spruce scattered over it and indicating that the time is not far distant when it may properly be called a swamp. Except a half dozen sedges there were but two herbaceous plants found. These are the three-leaved smilacina, Smilacina trifolia (L.) Desf., a liliaceous plant and the pitcher plant, Sarracenia purpurea L., neither of which was found in Averyville marsh. No grass was found there. Of the twenty-one species occurring on the marsh, thirteen are trees and shrubs and eight are herbaceous. Of these herbaceous plants, five are carices, only one of which was found on Averyville marsh. It is remarkable that such a dissimilarity should exist in the herbaceous vegetation of two marshes so near to each other in location and stages of development.

Vernonia altissima Nutt.

Roadsides. Middleville, Herkimer co. September. Miss M. C. Burns. This species has also been found by Dr J. V. Haberer in New Hartford, Oneida co. It is a rare plant with us.

Veronica virginica L.

Brown's grove. Scottsville, Monroe co. August. Miss F. Beckwith. A noble appearing plant commonly known as Culver's physic or Culver's root and having some reputation as a medicinal plant.

NEW SPECIES AND VARIETIES OF EXTRALIMITAL FUNGI

Cercospora eustomae

Spots suborbicular, definite, grayish or grayish brown, surrounded by an elevated line; hyphae amphigenous, densely aggregated on the spots or occupying large areas of the unspotted parts of the leaves, simple or septate, irregular or nodulose at the top, 30–60 x 4–6 μ; spores very variable, straight, curved or flexuous, often irregular or of unequal diameter in different parts, oblong or subcylindric, subhyaline, continuous or obscurely 1–2-septate, 20–60 x 4–6 μ.

Living leaves of Eustoma andrewsii A. Nels. and E. russellianum (L.) Griseb. September. Denver, Colorado. E. Bethel. Wood River, Nebraska. J. M. Bates.

The species is peculiar in the variability of its spores. The tufts of hyphae are sometimes so crowded that they appear to form an effused sooty stratum.

Cercospora pastinacae (Sacc.) comb. nov.

Spots small, inconspicuous, amphigenous, yellowish green or brown, bounded by veinlets; hyphae hypophyllous, aseptate, nodulose at the top, pale brown, 40–60 x 6–8 μ; spores oblong or cylindric, rarely narrowed toward the apex or when uniseptate having the apical cell narrower than the other, straight or curved, 1–3-septate, 25–85 x 6–8 μ.

Living leaves of parsnip, Pastinaca sativa L. Red Cloud, Nebraska. October. J. M. Bates.

This fungus was originally referred by Mr Ellis to Cercospora apii Fres. though with some hesitation, as he says that he is strongly of the opinion that it will yet prove to be distinct. Professor Saccardo later gave it the name Cercospora apii pastinacae Sacc. It appears to us to be a distinct species in its numerous small spots limited by the veinlets of the leaf, in its broader aseptate hyphae and specially in its broader subcylindric conidia with only 1–3-septa.

Cercosporella mirabilis

Spots angular, irregular, 2–10 mm long, sometimes confluent, at first yellowish or pallid, soon reddish brown; hyphae long, creeping, branched and interwoven or short, simple, erect, hypophyllous, hyaline; spores cylindric or gradually tapering from near the base to the apex, multinucleate and sometimes 1–3-septate, more or less curved or flexuous, rarely curved at the apex, hyaline, 40–120 x 3–5 μ, sometimes rising from creeping hyphae, sometimes from minute sclerotioid bodies on the older and darker spots.

Living leaves of Crataegus rivularis Nutt. Morrison, Colorado. August. E. Bartholomew and E. Bethel.

This is a remarkable aberrant and variable species, and possibly the type of a new genus. The best development is from the younger spots or the margin of the older ones and in these cases its white flocculent masses are plainly visible to the naked eye. In the older spots minute black perithecialike dots scarcely visible to the naked eye appear. Under the microscope minute rather obscure hyphae appear to arise from these and bear smaller and less plentiful spores. Is this a sclerotioid state of this fungus?

Coryneum sorbi

Acervuli numerous, discoid, erumpent, orbicular or ellipsoid, .5–1 mm broad, black; spores oblong or oblong-ovoid, triseptate, often irregular, colored, 12–20 x 8–9 μ; sporophores short or obsolete.

Dead twigs of Sorbus californica Greene. Tulare co., California. August. J. D. Culbertson. Communicated by E. Bartholomew.

The disklike receptacles are crowded and surround the twigs. The small terminal cell of the spore is often semipellucid. Frequently the spore is abruptly contracted in some part of its outline. This gives it an irregular appearance.

Dermatea mori

Receptacle orbicular ellipsoid or slightly irregular, 1–2 mm broad, broadly convex or nearly plane, erumpent, surrounded by the remains of the ruptured epidermis but sometimes more elevated, black or brownish black; asci cylindric or subclavate, 60–90 x 20–25 μ; spores oblong or subcylindric, crowded or biseriate, continuous, hyaline, 20–30 x 8–10 μ.

On dead twigs of Russian mulberry, Morus alba tatarica Loud. Concordia, Kansas. April. E. Bartholomew.

The spores are sometimes slightly narrowed near the middle and then they resemble in outline the sole of a shoe. By the blackish color of the receptacle the species makes an approach toward the genus Cenangium, but the texture is somewhat waxy and indicates a closer relationship to Dermatea.

Diaporthe inornata

Perithecia collected in valsoid clusters 1–1.5 mm broad, 4–14 in a cluster, about .3 mm broad, black, whitish within, nestling in the inner bark with no circumscribing black line, the long crowded black ostiola piercing and obliterating the cortical stroma, erumpent, surrounded by the ruptured remains of the epidermis; asci subfusiform, 60–80 x 8–10 μ; spores crowded, oblong or subfusiform, with a short bristle at each end, constricted at the septum, 2–4-nucleate, 15–24 x 3–4 μ.

Dead branches of staghorn sumac, Rhus typhina L. Cabin John Bridge, Maryland. June. E. Bartholomew.

The species is apparently related to Diaporthe syngenesia (Fr.) Fckl. from which it differs in its smaller clusters, longer and differently shaped asci and in its longer spores. The stroma is cortical and surrounded by no black line. This suggests the specific name.

Diplodia polygonicola

Perithecia minute, abundant, densely gregarious, forming long patches on the stems, erumpent, black; spores oblong or broadly ellipsoid, at first hyaline, then colored, finally uniseptate, 14–16 x 8–9 μ.

Dead stems of dock leaved persicaria, Polygonum lapathifolium L. Blue Rapids, Kansas. July. E. Bartholomew.

Entoloma subtruncatum

Pileus subconic, thin, glabrous, hygrophanous, pale yellow ochre and striatulate when moist, paler and subshining when dry, truncate or slightly umbonate, the margin incurved, the cuticle separable; lamellae thin, broad, adnexed, moderately close, unequal, whitish becoming tinged with pink; stem slender, equal or slightly attenuated upward, terete or compressed, hollow, silky fibrillose, pale yellow, with a whitish mycelioid tomentum at the base; spores angular, apiculate at each end, 12–14 x 8–10 μ.

Pileus 2–3 cm broad; stem 3–8 cm long, 2–5 mm thick.

Solitary or gregarious. Under pine trees. Stow, Massachusetts. November. S. Davis.

The more or less truncate apex of the pileus affords a distinguished feature of this species and is suggestive of the specific name.

Gloeosporium psoraleae

Pustules minute, on brown or blackish brown orbicular spots, .25–.75 mm broad, partly concealed by the hairs on the lower surface of the leaf; spores oblong or subellipsoid, straight or slightly curved, hyaline, 14–20 x 4–5 μ.

Leaves of prairie apple, Psoralea esculenta Pursh. Webster, Nebraska. June. E. Bartholomew.

Graphyllium chloes junci

This variety differs from the type in its spores which are not distinctly constricted at the septa and in its paraphyses which are rudimentary or obsolete.

On stems of baltic rush, Juncus balticus Willd. Scotia, Nebraska. September. J. M. Bates.

Henningsinia caespitosa

Stroma subclavate, .5–1 cm high, 3–4 mm broad at the top, narrowed below into a stemlike base, cespitose or rarely only two united at the base, obtuse at the apex, sometimes with a slight umbo, black, sometimes shining; perithecia oblong, about 1 mm long, vertical in the upper part of the stroma, interior substance white beneath them; asci ovate or clavate, 35–40 x 14–16 μ; spores crowded in the ascus, oblong, continuous, colored, 10–12 x 6–7 μ.

Bark of West Indian birch, Bursera gummifera Jacq. Santiago de las Vegas, Cuba. November. C. F. Baker.

This species differs from Henningsinia durissima A. Moell. in its mode of growth, much smaller size, shorter perithecia, broader asci and broader spores.

Hysterium cubense

Perithecia gregarious or clustered, oblong or ellipsoid, straight, curved or rarely flexuous, at first erumpent, then superficial by the falling away of the epidermis, even, 1–2 mm long, .5 mm broad and high, black; asci cylindric, 160–200 x 15–20 μ; spores uniseriate, oblong or ellipsoid, 3-septate, colored, 30–40 x 12–16 μ, the terminal cells longer than the central cells.

Dead branches lying on the ground. Nazarene, Cuba. September. C. F. Baker.

This species is related to Hysterium pulicare Pers. from which it may be separated by the smooth perithecia, cylindric asci and uniseriate and larger spores.

Leptonia davisiana

Pileus thin, submembranous, convex becoming plane or broadly depressed, fragile, glabrous but slightly squamulose in the center, often widely striate when dry, blackish brown; lamellae thin, close, subventricose, adnexed, at first white then pinkish and pulverulent from the spores; stem slender, equal, glabrous, stuffed or hollow, colored like the pileus; spores angular, uninucleate, 10–12 x 8–10 μ.

Pileus 1–2.5 cm broad; stem 1.5–3 cm long, 1–2 mm thick.

Among short grass on a lawn. Brookline, Massachusetts. August. S. Davis, to whom the species is respectfully dedicated.

It differs from Leptonia abnormis Pk. in its smaller size, closer adnexed lamellae, squamulose disk and larger spores. The lamellae are somewhat tough in the dried state.

Leptostromella scirpina

Perithecia epiphyllous or rarely amphigenous, suborbicular or oblong, .20–.75 mm long, discoid or concave, subsuperficial, black; spores subbacillary, hyaline, curved, continuous, acutely narrowed at each end, 20–25 x 2–3 μ.

On dead leaves of dark green bulrush, Scirpus atrovirens Muhl. Superior, Nebraska. May. J. M. Bates.

The perithecia sometimes occur on a pallid spot, occasionally on both sides of the leaf. The species appears to be related to Leptostromella hysterioides (Fr.) Sacc. but the spores are neither guttulate nor cylindric.

Lysurus borealis serotinus

Specimens of this fungus in the egg state were collected in Salem, Mass., and contributed in fresh condition by Mr W. H. Ropes in October. These were placed in a damp chamber and two of them burst from the egg and completed their development. At first the arms, six in number, at the apex of the stem are curved inward their tips meeting at the center of the dome thus formed. In this position the margins of the arms are rolled backward but the edges are separated by a narrow white stripe, the central sterile exterior of the arm. The contiguous margins of any two adjacent arms are then in close contact and separated only by an inconspicuous impressed line, and the exterior surface of the dome is covered by a layer of the blackish or very dark olive green spores and the hymenial surface is apparently external, although interrupted longitudinally by the six white stripes. Anyone seeing the fungus in this condition for the first time would be likely to refer the species to the genus Anthurus. But soon the tips of the arms separate and the upper part of the dome opens outward or becomes divergent, when it is plainly seen that the inner surface is really the hymenial surface and the species must therefore be referred to the genus Lysurus.

In these specimens the external part of the arms is white, while in the typical form it is described as pink. In them there are also six white lines or stripes radiating from the base of the stem and marking the inner surface of the volva. I find no mention of a similar character in the type specimens. This character and the white color of the exterior of the arms and the late appearance of the fungus lead me to separate this form under the name Lysurus borealis (Burt) v. serotinus n. var.

Macrophoma burserae

Perithecia minute, 100–200 μ broad, covered by the epidermis, gregarious or aggregated and forming unequal slightly prominent and often confluent pustules, black, white within; spores ellipsoid, hyaline or nearly so, 16–20 x 10–12 μ.

Bark of West Indian birch, Bursera gummifera Jacq. Santiago de las Vegas, Cuba. July. C. F. Baker.

A species easily recognized by its habit of forming broad pustules or slightly prominent patches beneath the epidermis.

Macrophoma numerosa

Perithecia minute, .3–.5 mm broad, numerous, closely gregarious, membranaceous, nestling in the bark, erumpent, black, whitish within; spores oblong-fusiform, continuous or binucleate, acute at the ends, 12–20 x 3–4 μ; sporophores very short or obsolete.

Dead branches of locust, Robinia pseudacacia L. Cincinnati, Ohio. June. E. Bartholomew.

The fungus occupies small branches, surrounding them and extending several inches on them.

Morchella conica serotina

Pileus conic or irregular, pointed at the apex or rounded and obtuse, sometimes perforated by a small circular aperture, often sterile with the hymenium brown and the edge of the costae whitish.

Roslindale, Massachusetts. October. Mrs U. C. Sherman and Miss J. F. Conant.

The late appearance of this fungus is remarkable and the variability of the pileus makes it desirable that it should have a distinct designation.

Ovularia avicularis

Spots large, suborbicular or oblong, pale brownish red; hyphae amphigenous, erect, forming minute white crowded tufts, 25–35 x 3–4 μ; spores oblong or ellipsoid, sometimes slightly narrowed toward the base, hyaline, 12–20 x 6–8 μ.

Living leaves of knotgrass, Polygonum aviculare L. Wood River, Nebraska. June. J. M. Bates.

This species differs from Ovularia rigidula Delacr. which occurs on leaves of the same host plant, in being amphigenous, in having shorter and more narrow hyphae, shorter and broader spores and differently colored spots.

Paxillus microsporus

Pileus fleshy, thin, convex becoming nearly plane, subglabrous, white becoming whitish, sometimes brownish in the center, slightly viscid when moist, the margin involute, spreading when mature and even or distantly striate with short elevated ridges and intervening depressions, flesh white; lamellae thin, narrow, close, adnate when young, decurrent when mature, occasionally forked or slightly anastomosing at the base, whitish, becoming pale yellowish brown or raw umber; stem short, usually tapering downward, solid or stuffed, colored like the pileus; spores brownish ochraceous, minute, subglobose, 2–3 μ in diameter.

Pileus 1–6 cm broad; stem 1–6 cm long, 3–8 mm thick.

Solitary or cespitose. Ground under chestnut trees. Waltham, Massachusetts. October. G. E. Morris. The species is remarkable for its small spores.

Phoma roystoneae

Perithecia minute, about .2 mm broad, amphigenous, gregarious, abundant, black; spores minute, oblong or subcylindric, hyaline, 5–8 x 1.5–2 μ supported on short hyaline sporophores.

On royal palm, Roystonea regia (HBK.) O. F. Cook. Santiago de las Vegas, Cuba. July. C. F. Baker.

Pluteus alveolatus eccentricus

Stem short, curved, eccentric; spores pale pink, in old or water soaked specimens paler or yellowish, globose or subglobose, minutely rough or pitted, 6–8 μ in diameter.

On decaying wood. Rockville, Indiana. September and October. G. T. Howell. In other respects it matches the description of the type.

Septoria magnospora

Spots small, 2–3 mm broad, pallid or whitish with a reddish brown border; perithecia epiphyllous, minute, .20–.25 mm broad, depressed, black; spores large, broadly filiform or subcylindric, curved, hyaline or faintly tinged with greenish yellow, continuous or pluriseptate, 45–80 x 3–4 μ.

Living leaves of Prunus fremontii Wats. San Diego co., California. January. S. C. Mason. Communicated by E. Bartholomew.

Tricholoma terraeolens majus

Pileus 2–6 cm broad, umbonate, nearly plane or sometimes depressed around the umbo when mature; stem 6–10 cm long, 4–6 mm thick, solid.

In other respects similar to the type. Stow, Massachusetts. October and November. S. Davis.

EDIBLE FUNGI

Tricholoma subsejunctum n. sp.

SUBDISJOINED TRICHOLOMA

Plate 124, figures 1–5

Pileus fleshy, conic or convex, often wavy and lobed on the margin, slightly viscid when moist, virgate or reticulate with blackish brown fibrils, blackish brown, often pale yellow or greenish yellow on the margin, flesh white, taste farinaceous; lamellae thin, close, rounded behind, adnexed, white, sometimes tinged with yellow anteriorly; stem stout, solid, nearly equal, white, sometimes tinged with yellow; spores minute, 5–6 x 4–5 μ.

Pileus 2.5–7 cm broad; stem 3–5 cm long, 6–12 mm thick.

The subdisjoined tricholoma is a rare species. It has been seen by the writer but once and then only in limited quantity. It was found growing gregariously among mosses and fallen leaves under evergreen and deciduous trees on the margin of a swamp near Mohawk Hill, Lewis county, in September.

The cap is 1–2.5 inches broad, at first conic but expanding with age, with the margin sometimes irregular, wavy or lobed and the surface covered with brown or blackish brown fibrils which radiate from the center toward the margin and sometimes form reticulations by connecting with each other. The general color is grayish brown or blackish brown, yellow on the margin and at first nearly black in the center. In wet weather it is a little viscid. Its gills are white, sometimes yellow at the outer extremity. They are slightly attached to the stem, which also is white and occasionally tinged with yellow. The stem is 1–2 inches long and 3–6 lines thick, solid and firm. The taste is farinaceous. The plants may be sought in September and October.

Tricholoma equestre albipes n. var.

WHITE STEM EQUESTRIAN TRICHOLOMA

Plate 124, figures 6–9

Pileus fleshy, convex becoming plane or nearly so, viscid when moist, glabrous or with a few spotlike scales in the center, flesh white, taste farinaceous; lamellae thin, close, sinuate, slightly adnexed, yellow; stem equal, solid, glabrous, white; spores ellipsoid, 6–8 x 4–5 μ.

Pileus 2.5–6 cm broad; stem 2.5–5 cm long, 6–8 mm thick.

The white stem variety of the equestrian tricholoma scarcely differs from the typical form of the species except in having a white stem. It is gregarious or cespitose in its mode of growth, its cap is viscid when moist, and 1–2.5 inches broad, its stem is 1–2 inches long and 3–4 lines thick. The cap is yellow or greenish yellow on the margin, reddish yellow in the center and there usually adorned by a few spotlike appressed scales. The flesh is white and like that of the preceding species has a farinaceous taste. It grows in thin woods or open places and occurs in September. North River.

Volvaria bombycina (Pers.) Fr.

SILKY VOLVARIA

Plate 125, figures 1–3

Pileus fleshy, campanulate or very convex, densely silky fibrillose, white or whitish, flesh white, taste mild; lamellae broad, close, free, whitish becoming bright pink; stem straight or curved, solid, silky fibrillose, white, volva large white or whitish; spores flesh colored or pink, ellipsoid, 8–10 x 5–6 μ.

The silky volvaria is a large species which usually grows in a solitary manner. It inhabits the sugar maple, Acer saccharum Marsh., and grows from dead places in living trees. It is a noble looking species. Its pileus is 2–4 inches broad; the stem 2–4 inches long, 4–6 lines thick. It bursts from a large persistent volva which is white or whitish and appears like a cup or loose wrapper at the base of the stem. Its specific name has reference to the copious silky fibrils which persistently cover the cap. The species may be found at any time during July, August and September. Its flesh is firm but tender, palatable and satisfying. Unfortunately its scarcity detracts from its availability as an esculent species. The spores in our plant are larger than the dimensions given for those of the European plant and the color of the pileus is paler.

Pholiota discolor Pk.

FADING PHOLIOTA

Plate 127, figures 10–15

Pileus thin, convex, becoming nearly plane, glabrous, viscid, hygrophanous, watery cinnamon and often striatulate on the margin when moist, pale yellow or subochraceous when dry, flesh white, taste mild; lamellae narrow, close, adnate, pallid becoming pale ferruginous; stem equal or slightly tapering upward, hollow, fibrillosely striate, pallid or brownish, often with a white mycelioid tomentum at the base; spores ellipsoid, 6–8 x 5–6 μ.

Pileus 2–4 cm broad; stem 2–5 cm long, 2–5 mm thick.

The fading pholiota is a small but common species growing in woods on decaying wood or branches. It is easily distinguished from Pholiota autumnalis Pk. by its viscid cap. The change of color in the cap by the escape of its moisture is very noticeable and is suggestive of the specific name. It grows singly or somewhat gregariously and very rarely in small tufts. In this case the caps are apt to be smaller than usual. It usually appears in August and September. Its caps are rarely more than one and a half inches broad.

Psilocybe polycephala (Paul.)

MANY CAP PSILOCYBE

Plate 127, figures 1–9

Pileus fleshy but thin, subcampanulate convex or nearly plane, glabrous, even, hygrophanous, at first whitish with a reddish yellow center, then darker or brownish and obscurely striatulate on the margin while moist, paler or whitish when the moisture has escaped, flesh white or whitish when dry, taste mild; lamellae thin, narrow, close, adnexed or nearly free, whitish becoming purplish brown; stem equal or flexuous, hollow, glabrous, mealy or pruinose at the top, white; spores purplish brown, ellipsoid, 7–8 x 4–5 μ.

Pileus 1–3 cm broad; stem 2.5–5 cm long; 2–4 mm thick.

The many cap psilocybe is a small mushroom but it sometimes occurs in such abundance as to make it available for culinary purposes. It is not highly flavored but it is harmless. It has been classed as a mere variety of Psilocybe spadicea Fr. from which it differs chiefly in its mode of growth and in its nearly free fuscous brown gills. When growing on the ground it forms densely crowded troops or patches several inches in diameter. This is given as the typical form. It also grows on trunks of trees, but it then appears to be more cespitose and to grow larger. This form is represented in our plate by figures 3–9. Other marks by which it differs from P. spadicea Fr. are its smooth, not scabrous, pileus, and its clear white stem. The form growing on tree trunks is larger than that growing on the ground and has the cap more strongly convex approaching bell shape. It is darker brown when moist and paler or whitish when dry. The dried specimens retain this color better than the dried specimens of the terrestrial form in which the brown color is more permanent and more clearly shown. The moisture escapes first from the center of the cap, last from the thin margin.

The gills in the young plant are white or whitish, but they soon change to the purplish brown of the mature plant. The stem in the lignatile form is sometimes slightly stained toward the base. Our specimens were found in woods near Constableville, in September. The larger form was growing from a dead place in the trunk of a sugar maple tree about two feet from the ground; the smaller form was growing on the ground at the foot of the tree and on the same side. Specimens of both were collected at the same time.

Entoloma grayanum Pk.

GRAY ENTOLOMA

Plate 126, figures 1–7

Pileus fleshy, but thin toward the margin, broadly convex or nearly plane, sometimes broadly umbonate, glabrous, moist or subhygrophanous, whitish or grayish brown, flesh white, taste farinaceous; lamellae thin, moderately close, adnexed, whitish becoming flesh colored; stem equal or nearly so, solid, stuffed or hollow, silky fibrillose, white or pallid; spores angular, uninucleate, 7.5 μ in diameter.

Pileus 5–8 cm broad; stem 3–7 cm long, 4–10 mm thick.

The gray entoloma is a very variable mushroom, both in size, habit and color. The cap ranges from 1–3 inches broad and from watery white to grayish brown. Its stem also may be long, slender and flexuous or short, stout and straight and from 1.5–3 inches long and 2–6 lines thick. It may be solid, stuffed or hollow, and white whitish or pallid. The flesh of the cap is white when dry and its flavor is distinctly farinaceous. The gills are at first white but when mature they are pink. They never assume the brown color so characteristic of the common mushroom and other species of the genus Agaricus which have pink gills when young. The mode of growth is single, loosely gregarious or rarely cespitose. They usually grow among fallen leaves in mixed woods and may be found from July to September.

Cortinarius albidipes n. sp.

WHITE STEM CORTINARIUS

Plate 128, figures 1–6

Pileus fleshy, compact, hemispheric becoming broadly convex, obtuse or subumbonate, viscid, glabrous and shining when dry, buff color, flesh white, taste mild; lamellae 4–6 mm broad, moderately close, pale violaceous when young, cinnamon when mature; stem commonly narrowed upward from a thickened or bulbous base, firm, solid, silky fibrillose, white; spores subglobose, 8–10 x 7–9 μ.

Pileus 5–10 cm broad; stem 5–8 cm long, 1–1.5 cm thick at the top.

The white stem cortinarius is a large fine species easily recognized by its buff colored viscid cap, its violaceous young gills and its white stem thickened or bulbous at the base. In similar species, having the young gills violet, the top of the stem is also violet. The wholly white stem therefore separates this species from all such related species. Sometimes the spores lodge on the remains of the white webby veil and form a conspicuous rust or cinnamon colored ring near the top of the solid stem. The cap is from 2–4 inches broad, the stem is 2–3 inches long and about 5 lines thick at the top. The plants grow among fallen leaves in woods. Collected near Constableville in September. Found but once.

Agaricus campester majusculus n. var.

LARGER MUSHROOM

Plate 129, figures 1–5

Pileus fleshy, firm, convex or nearly plane, fibrillose and squamose on the margin, even in the center, the margin surpassing the lamellae, the color is dark umber brown, flesh firm, white, not at all or but very slightly and slowly assuming a faint ruddy tint when cut, taste mild, agreeable; lamellae thin, close, free, pink, becoming brown or blackish brown; stem stout, equal, stuffed, fibrillose, white, with a white annulus, the white veil at first concealing the lamellae; spores broadly ellipsoid, 7–9 x 6–7 μ.

Pileus 6–15 cm broad; stem 2.5–7 cm long, 1–2 cm thick.

The larger mushroom is one of very many varieties of the common mushroom. It closely approaches the garden mushroom, var. hortensis Cke., but differs from it in its rather larger size, darker colored cap with even center and more coarsely scaly margin.

In the color of the cap it approaches the brown mushroom var. umbrinus Vitt., but that has an even cap and a squamulose stem. The cap also resembles that of var. villaticus Brond., but that also has the stem squamose below the collar. It inhabits rich soil and was found in October at Schenectady by Mrs Geo. E. Duryee. The flesh is firm but not tough. It affords a very substantial, enjoyable and satisfactory dish scarcely inferior in this respect to the common mushroom.

Boletus albidipes Pk.

Boletus granulatus albidipes Pk. N. Y. State Mus. Rep't 54, p. 168

WHITE STEM BOLETUS

Plate 130, figures 1–5

Pileus fleshy, convex becoming broadly convex or nearly plane, viscid or glutinous, yellowish white when young becoming pale ochraceous with age and then obscurely spotted by the drying gluten, flesh white, tubes plane, adnate, whitish in the young plant, becoming yellow and finally brownish ochraceous, the edges of the dissepiments naked or rarely with few glandular dots; stem short, equal, solid, white, with few or no glandular dots at the top; spores 8–10 x 3–4 μ.

Pileus 5–8 cm broad; stem 2.5–5 cm long, 8–12 mm thick.

The white stem boletus is related to the granular boletus, Boletus granulatus L. It may be separated from that species by its paler cap, white flesh and few or no glandular dots at the top of the stem and on the edge of the dissepiments of the tubes. Gregarious. Under or near white pine trees. The cap is 2–4 inches broad; stem 1–2 inches long, 4–6 lines thick. This is an excellent edible species and may be sought in September in pine groves or under or near white pine trees, specially in rocky places.

NEW YORK SPECIES OF CLITOCYBE

Clitocybe Fr.

Pileus generally fleshy, specially in the center, flexible or rather tough, convex plane or centrally depressed, umbilicate or infundibuliform, involute on the margin, flesh confluent with the stem; lamellae adnate or decurrent, not normally sinuate; stem normally central, externally more compact, fibrous, somewhat elastic, solid stuffed or hollow; veil sometimes present as a slight silkiness on the pileus or its margin.

Terrestrial or occasionally lignicolous, usually gregarious or cespitose. They occur chiefly in late summer and autumn. Many species are edible but a few are known to cause sickness and one is very sudorific. None are known to be fatally poisonous.

The species are numerous, variable in color and not always sharply limited from each other. This has given rise to numerous synonyms and much difficulty in the identification of some of the species.

They have been divided into two large groups or series. The first includes all species having a dry pileus and those having a moist but not clearly a hygrophanous pileus, that is a moist pileus which does not essentially change its color with the escape of the superfluous moisture. This series includes all of the large species and many of medium size with a few small ones.

The second series includes those species in which the pileus is truly hygrophanous. The flesh is thin, soft and watery and changes color with the escape of moisture. The pileus is convex plane umbilicate or centrally depressed and sometimes cup shape but not normally infundibuliform. In one section the flesh is separable into two horizontal layers. The species are mostly terrestrial, gregarious and of medium or small size.

KEY TO THE SECTIONS

Series A

Not truly hygrophanous

Plant solitary or subgregarious, pileus fleshy, regular, lamellae regularly adnate or decurrent .... Disciformes

Plant commonly cespitose, pileus often irregular or eccentric, lamellae irregularly adnate or decurrent .... Difformes

Plant soon infundibuliform or deeply and umbilicately depressed, lamellae regularly decurrent from the first..Infundibuliformes

Series B

Plant truly hygrophanous

Pileus thin, depressed or cup shape, lamellae adnate becoming decurrent .... Cyathiformes

Pileus thin, convex flattened or depressed, glabrous, lamellae thin, close, horizontal, adnate or decurrent with a tooth .... Orbiformes

Section Versiformes differs from Orbiformes chiefly in having the pileus not glabrous. It is largely composed of species which we have placed in the genus Laccaria. Other New York representatives are wanting.

SERIES A

Not truly hygrophanous

Disciformes

Pileus subequally fleshy, convex, plane or depressed; lamellae at first adnate or regularly adnato-decurrent.

Solitary or gregarious, commonly terrestrial, rarely lignicolous. This section includes many species of very diverse size, habitat and appearance and they are not always sharply limited from each other. The pileus, in some of the more fleshy species, assumes a broadly obconic shape when mature. The pileus is dry in some, moist, but not truly hygrophanous, in others. The species have been assembled in groups depending on the color of the pileus.

KEY TO THE SPECIES

Pileus some shade of brown or cinereous 1
Pileus reddish or tan color 3
Pileus some shade of yellow 4
Pileus green or greenish .... odora
Pileus grayish or whitish 8
Pileus white or watery white when moist 12
1 Stem tapering upward 2
1 Stem not tapering upward .... media
2 Lamellae crowded .... nebularis
2 Lamellae not crowded .... clavipes
3 Taste and odor farinaceous, pileus even .... pinophila
3 Taste and odor not farinaceous, pileus rivulose .... rivulosa
4 Growing on decaying wood 5
4 Growing on the ground 6
5 Pileus minutely squamulose .... decora
5 Pileus glabrous .... sulphurea
6 Young pileus hairy or tomentose .... subhirta
6 Young pileus glabrous 7
7 Taste bitter, stem stuffed .... fellea

7 Taste not bitter, stem solid ....biformis
8 Pileus more than 4 cm broad ....trogii
8 Pileus not more than 4 cm broad 9
9 Plant odorous 10
9 Plant inodorous 11
10 Stem solid ....aperta
10 Stem stuffed or hollow ....albidula
11 Pileus umbilicate, shining ....hirneola
11 Pileus not umbilicate, not shining ....sudorifica
12 Growing on wood 13
12 Growing on the ground or among fallen leaves 14
13 Pileus dry ....truncicola
13 Pileus moist when young or in wet weather..................leptoloma
14 Pileus dry ....albissima
14 Pileus moist when young or in wet weather......................15
15 Stem brown ....fuscipes
15 Stem not brown, white or whitish 16
16 Stem fibrillosely reticulate ....subcyathiformis
16 Stem not fibrillosely reticulate 17
17 Pileus more than 5 cm broad.......................................18
17 Pileus less than 5 cm broad.......................................21
18 Stem solid 19
18 Stem stuffed or hollow 20
19 Lamellae very close, color white, persistent ....cerussata
19 Lamellae white becoming pallid ....difformis
19 Lamellae whitish ....robusta
20 Lamellae becoming yellowish with age..................phyllophila
20 Lamellae persistently white ....pithyophila
21 Taste acrid ....gallinacea
21 Taste not acrid 22
22 Stem bulbously thickened at the base ....regularis
22 Stem not bulbously thickened at the base.......................23
23 Stem glabrous, shining, hollow...........................candicans
23 Stem fibrous, pruinose or mealy above, stuffed ....dealbata

Clitocybe media Pk.

INTERMEDIATE CLITOCYBE

N. Y. State Mus. Rep't 48, p.173, pl.23, fig.1-7

Pileus fleshy, convex becoming plane or slightly depressed in the center, often wavy or irregular on the margin, not polished, grayish brown or blackish brown, flesh white, taste mild; lamellae broad, subdistant, adnate or decurrent, whitish, the interspaces often venose; stem equal or nearly so, solid, elastic, colored like or a little paler than the pileus; spores ellipsoid, 8 x 5 μ.

Pileus 5-19 cm broad; stem 2.5-5 cm long, 8-16 mm thick.

Gregarious or scattered. Mossy ground in woods. Essex co. September. Rare. Edible.

This species differs from the two following in its thinner pileus and equal stem.

Clitocybe nebularis (Batsch) Fr.

CLOUDED CLITOCYBE

N. Y. State Mus. Rep't 48, p.172, pl.23, fig.8–13

Pileus fleshy, compact, convex becoming plane or slightly depressed in the center, even, grayish or clouded with a grayish nebulosity, sometimes darker in the center becoming paler with age, sometimes with a yellowish tint, flesh white; lamellae close, narrow, adnate or slightly decurrent, white or pallid; stem firm, stuffed, generally tapering upward, fibrillosely striate, white or pallid; spores minute, ellipsoid, 4–5 x 2–3 μ.

Pileus 5–10 cm broad; stem 4–8 cm long, 10–20 mm thick.

Woods and bushy places. September. Rare. Edible.

Hitherto found in only two or three places in our State. The pileus is sometimes broadly obconic when mature.

Clitocybe clavipes (Pers.) Fr.

CLUB STEM CLITOCYBE

N. Y. State Mus. Mem. 4, p.139, pl.46, fig.1–6

Pileus very fleshy, convex or nearly plane, obconic, obtuse or with a small umbo, soft, grayish brown, sooty brown, sometimes darker in the center than on the margin, flesh white, taste mild; lamellae rather broad, subdistant, decurrent, white or cream colored; stem tapering upward from a thickened or subbulbous base, solid, elastic, soft and spongy within, glabrous or slightly fibrillose, colored like or a little paler than the pileus; spores ellipsoid, 6–8 x 4–5 μ.

Pileus 2.5–7.5 cm broad; stem 1–6 cm long, 6–12 mm thick at the top, 15–24 mm at the base.

Solitary, gregarious or rarely cespitose. Woods. Common. July to October. Edible.

This species is readily distinguished by its obconic pileus and upwardly tapering stem. Clitocybe carnosior Pk. is a synonym.

Clitocybe pinophila Pk.

PINE CLITOCYBE

N. Y. State Mus. Rep't 31, p.32

Pileus fleshy, thin, convex becoming umbilicate or centrally depressed, glabrous, pale tan color when moist, paler when dry, odor and taste farinaceous; lamellae moderately close, subarcuate, adnate or slightly decurrent, whitish; stem equal, glabrous or slightly pruinous, colored like the pileus; spores broadly ellipsoid or subglobose, 5–6 x 4–5 μ.

Pileus about 2.5 cm broad; stem 2.5–5 cm long, 2–4 mm thick.

Gregarious. Under or near pine trees. Not common. Albany, Essex and Warren counties. July and August.

Sometimes the pileus becomes striate on the margin in drying.

Clitocybe rivulosa (Pers.) Fr.

RIVULOSE CLITOCYBE

Sylloge V, p.153

Pileus thin, convex becoming plane or depressed, obtuse, often undulate on the margin, glabrous or at first adorned with whitish down, rivulose, rufescent, then pallid, flesh white, taste and odor agreeable; lamellae rather close, broad, slightly decurrent, white tinged with pink; stem equal, stuffed, subfibrillose, spongy within or hollow, tough, whitish; spores ellipsoid, 5–6 x 3.5–4 μ.

Pileus 2.5–6 cm broad; stem 2.5–5 cm long, 6–8 mm thick.

Gregarious. Woods. Adirondacks. Rare. Found but twice.

Clitocybe decora Fr.

DECORATED CLITOCYBE

N. Y. State Mus. Rep't 25, p.73 as Agaricus (Tricholoma) multipunctus Pk.

Pileus fleshy, thin, convex becoming plane or slightly depressed, dotted by minute brown or blackish hairy squamules, yellow, flesh yellow; lamellae close, narrow, obtusely adnate, yellow; stem equal, often curved, stuffed or hollow, fibrillose or squamulose, rarely glabrous, sometimes eccentric; spores subglobose, 5–6 x 4–5 μ.

Pileus 3–7 cm broad; stem 2.5–6 cm long, 4–6 mm thick.

Decaying trunks of coniferous trees. Hilly and mountainous regions. August.

Tricholoma multipunctum Pk. is a synonym. On account of its stem being occasionally eccentric the species might be sought among the Pleuroti.

Clitocybe sulphurea Pk.

SULFUR-COLORED CLITOCYBE

N. Y. State Mus. Rep't 41, p.62

Pileus convex, slightly umbonate, moist, pale yellow, flesh yellowish; lamellae subdistant, adnate, serrulate, pale yellow; stem equal or tapering upward, curved or flexuous, hollow, colored like the pileus; spores subglobose or broadly ellipsoid, 6–8 x 5–6 μ.

Pileus 2.5–5 cm broad; stem 2.5–7 cm long, 4–8 mm thick.

Decaying wood of spruce and balsam fir. Catskill mountains. September. Rare. Found but once.

Clitocybe subhirta Pk.

HAIRY CLITOCYBE

N. Y. State Mus. Rep't 32, p.25

Pileus convex or nearly plane, sometimes slightly depressed, incurved on the margin, at first hairy tomentose, then nearly glabrous, pale yellow or buff becoming whitish; lamellae close, adnate or decurrent, whitish or pale yellow; stem nearly equal, stuffed or hollow, sometimes eccentric; spores subglobose, 4–5 μ in diameter.

Pileus 2.5–7.5 cm broad; stem 2.5–5 cm long, 6–10 mm thick.

Woods. Onondaga co. September. Found but once.

Clitocybe fellea Pk.

BITTER CLITOCYBE

N. Y. State Mus. Rep't 51, p.284, pl.B, fig.8–11

Pileus thin, convex or hemispheric, obtuse or umbilicate, minutely furfuraceous, pale yellowish brown, flesh whitish, taste bitter; lamellae thin, subdistant, adnate or slightly decurrent, white; stem equal, firm, glabrous, flexuous, stuffed with a white pith, with a white mycelioid tomentum at the base; spores broadly ellipsoid, 6–8 x 4–5 μ.

Pileus 1.2–2.5 cm broad; stem about 2.5 cm long, 2–4 mm thick.

Gregarious. Woods. Saratoga co. July. Found but once.

The bitter taste suggests the specific name and is a convenient character by which to identify the species.

Clitocybe biformis Pk.

TWO-FORM CLITOCYBE

N. Y. State Mus. Bul. 150, p.25, pl.VI, fig.9–15

Pileus fleshy but thin, broadly convex or nearly plane becoming centrally depressed or subumbilicate, glabrous, even or obscurely striate on the involute margin, pale buff, more deeply colored in the center, flesh white; lamellae thin, close, narrow, decurrent, whitish or pallid becoming subcinnamon with age or in drying; stem equal, firm, solid or stuffed, often curved, sometimes eccentric, tomentose at the base, colored like or a little darker than the pileus; spores broadly ellipsoid or subglobose, 5–6 x 4–5 μ.

Pileus 2.5–7.5 cm broad; stem 2.5–3.5 cm long, 4–8 mm thick.

Growing in circles or arcs of circles in woods. Essex co. September. Found but once.

This species is remarkable for the change in form in passing from youth to old age, and also for the change in color of the lamellae. The pileus sometimes has a moist sodden appearance as if water-soaked. The mycelioid tomentum at the base of the stem causes a mass of decaying vegetable matter to adhere closely to the stem when pulled from its place of growth.

Clitocybe odora (Bull.) Sow.

SWEET CLITOCYBE

Sylloge V, p.153

Pileus fleshy, tough, convex becoming plane or nearly so, obtuse or subumbonate, even, glabrous, regular or sometimes wavy on the margin, moist in wet weather, green or dingy green, fading with age or in drying, flesh whitish, odor pleasant like anise; lamellae thin, not close, adnate or slightly decurrent, white or becoming pallid; stem equal or slightly thickened at the base, stuffed or hollow, elastic, glabrous, whitish or greenish; spores 6–8 x 4–5 μ.

Pileus 4–7 cm broad; stem 2.5–5 cm long, 4–8 mm thick.

Scattered or subgregarious. Woods and bushy places. Not rare. Albany, Suffolk and Saratoga counties and Adirondack mountains. August.

We have not found the typical form with lamellae "not close." In all our specimens reported under the names Agaricus virens Scop. and A. odorus Bull. or their equivalents Clitocybe virens (Scop.) and Clitocybe odora (Bull.) Sow. the lamellae are close and white or whitish and the stem is either solid, stuffed or hollow. Even in the same collection we have found some of the stems solid and some decidedly hollow. All our collections of these had the agreeable odor ascribed to C. odora. We have therefore followed the English mycologists in not trying to make a distinction between C. virens Scop. or its equivalent C. viridis Fr. and C. odora. We consider all of our plants as a mere form of C. odora differing from the European species only in having the lamellae close.

Var. anisaria Pk. differs from our ordinary form in having the pileus adorned with innate fibrils and the margin more or less striate. It is Agaricus (Clitocybe) anisarius Pk.

Clitocybe trogii Fr.

TROG CLITOCYBE

N. Y. State Mus. Rep't 26, p. 53, as Agaricus (Clitocybe) connexus Pk.

Pileus fleshy, thin on the margin, convex becoming nearly plane, obtuse, glabrous or minutely silky, white or grayish white, opaque, odor fragrant, spicy; lamellae close, adnate or slightly decurrent, white or whitish, 2 or 3 mm broad; stem equal or nearly so, firm, solid, whitish, downy or villose at the base; spores ellipsoid, 6–8 x 4–5 μ.

Pileus 5–7 cm broad; stem 2.5–7 cm long, 3–5 mm thick.

Woods. Lewis co. September. Rare.

In the American specimens the margin of the pileus is sometimes tinged with bluish green when young and fresh. The species is closely allied to Clitocybe odora (Bull.) Sow. from which it differs in the grayish and more compact pileus and the constantly solid stem.

Clitocybe aperta Pk.

OPEN CLITOCYBE

N. Y. State Mus. Rep't 30, p.38

Pileus convex becoming plane or centrally depressed, often irregular, whitish, sometimes tinged with lilac and marked by one or two darker zones, odor farinaceous, taste disagreeable; lamellae close, narrow, adnate or slightly decurrent, whitish, often with a faint pinkish tinge; stem short, equal or attenuated downward, solid, whitish; spores 4 x 3 μ.

Pileus about 2.5 cm broad; stem 2.5–5 cm long, 2 mm thick.

Gregarious or cespitose. Grassy ground by roadsides and in pastures. Otsego co. September. Rare.

Clitocybe albidula Pk.

WHITISH CLITOCYBE

N. Y. State Mus. Rep't 53, p. 841, pl. C, fig. 16–20 as C. centralis Pk.

Pileus thin, convex or nearly plane becoming umbilicate or centrally depressed, glabrous, whitish tinged with brown wholly or in the center only and faintly striatulate on the margin when moist, whitish when dry, flesh whitish, taste and odor farinaceous; lamellae thin, close, adnate or slightly decurrent, whitish; stem short, equal, glabrous or slightly pruinose, stuffed or hollow, colored like the pileus; spores minute, ellipsoid, 5–6 x 2.5–3 μ.

Pileus 1–3 cm broad; stem 2–4 cm long, 2–4 mm thick.

Gregarious. In pine or mixed woods. September and October. Common.

Clitocybe centralis Pk. differs from the type only in having the center of the moist pileus sometimes tinged with brown. It is therefore united with it.

Clitocybe hirneola Fr.

LITTLE JUG CLITOCYBE

Sylloge V, p.145

Pileus thin, broadly convex becoming plane or nearly so, centrally depressed or umbilicate, even, shining, dry, tough, involute on the margin, gray or whitish, flesh white; lamellae thin, rather broad, slightly decurrent, whitish gray; stem slender, tough, equal, subflexuous, stuffed, glabrous, similar to the pileus in color, white pruinose or mealy at the top; spores ellipsoid, grayish white, 5 x 3 μ.

Pileus 6–10 mm broad; stem 2–4 cm long, 1–2 mm thick.

Scattered or gregarious. Among mosses. Essex co. September. Rare. Found but once.

A small species, the pileus scarcely reaching 12 mm in diameter.

Clitocybe sudorifica (Pk.)

SUDORIFIC CLITOCYBE

Plate VII, fig.1–6

Pileus fleshy but thin, broadly convex or nearly plane, often becoming slightly depressed in the center or umbilicate, irregular and splitting or lobed on the thin spreading margin, glabrous, watery white when moist, whitish or grayish white when dry, flesh watery when moist, white when dry, taste mild, odor none; lamellae thin, narrow, close, adnate or slightly decurrent, whitish; stem short, equal or sometimes narrowed at the base, glabrous or merely pruinose, stuffed with a white soft or spongy center or hollow when old, often curved or somewhat flexuous, white or whitish; spores subglobose, 4–5 x 3–4 μ.

Pileus 2–4 cm broad; stem 1–3 cm long, 2–4 mm thick.

Gregarious. Lawns and grassy places. Albany, Ontario and Saratoga counties. September to November. Rarely the pileus has an obscure zone near the margin.

This species was at first confused with Clitocybe dealbata Sow. but after its sudorific property was discovered it was designated Clitocybe dealbata sudorifica Pk. N. Y. State Mus. Bul. 150, p. 43. Still further investigation leads me to consider it worthy of specific distinction. Dr W. W. Ford has found it sufficiently toxic to cause the death of frogs, rabbits and guinea pigs, though it may be eaten by man in moderate quantity with no more serious results than a profuse perspiration, sometimes continuing five or six hours. It should be considered medicinal and unwholesome and avoided as an article of food.

Clitocybe truncicola Pk.

TRUNK INHABITING CLITOCYBE

N. Y. State Mus. Rep't 26, p.54

Pileus thin, firm, expanded or slightly depressed in the center, glabrous, dry, white; lamellae close, thin, narrow, adnate or slightly decurrent, white; stem slender, equal, stuffed or hollow, glabrous, whitish, often curved and eccentric from the place of growth; spores broadly ellipsoid or subglobose, 4–5 x 3–4 μ.

Pileus 1.5–2.5 cm broad; stem about 2.5 cm long, 2 mm thick.

Trunks of deciduous trees, specially sugar maple. Adirondack mountains. September. Rare except in the mountains.

Clitocybe leptoloma Pk.

THIN MARGIN CLITOCYBE

N. Y. State Mus. Rep't 32, p.26

Pileus thin, plane or infundibuliform, umbilicate, glabrous, creamy white when moist, white when dry, very thin on the margin; lamellae thin, narrow, close, some of them forked, decurrent, white; stem equal, glabrous, generally curved or flexuous, stuffed, colored like the pileus, with a white villosity at the base; spores minute, globose or subglobose, 3–4 μ broad or 4 x 3 μ.

Pileus 3–5 cm broad; stem 3–5 cm long, 2–4 mm thick.

Gregarious or cespitose. Prostrate trunks of trees. Adirondack mountains. August. Not common.

The width of the lamellae is about equal to the thickness of the flesh of the pileus. They gradually taper toward each end. The stem is occasionally eccentric.

Clitocybe albissima Pk.

VERY WHITE CLITOCYBE

N. Y. State Mus. Rep't 26, p.53

Pileus fleshy, convex or nearly plane, dry, soft, even, pure white, inodorous; lamellae moderately close, some of them forked at the base, adnate or slightly decurrent, white; stem equal, glabrous, solid, white; spores ellipsoid, 8 x 5 μ.

Pileus 5–7 cm broad; stem 3–6 cm long, 4–6 mm thick.

Gregarious or sometimes growing in arcs of circles. Woods. Common. August and September.

The pure white color and soft texture are retained by the dried specimens. Closely related to Clitocybe cerussata Fr. but never moist nor are the lamellae very crowded as in that species. It is an attractive, neat-looking species. Clitocybe subsimilis Pk. is specifically the same differing only in the more conic or turbinate shape of the pileus.

Clitocybe fuscipes Pk.

BROWN STEM CLITOCYBE

N. Y. State Mus. Rep't 44, p.17

Pileus thin, broadly convex or plane, umbilicate, glabrous, whitish and striatulate when moist, pure white when dry, odor and taste farinaceous; lamellae nearly plane, subdistant, adnate or slightly decurrent, white; stem equal, hollow, glabrous or slightly mealy at the top, brown when moist, paler when dry; spores globose, 5–6 μ broad.

Pileus 8–16 mm broad; stem about 2.5 cm long, about 2 mm thick.

Under pine trees. Cattaraugus co. September. Rare. Found but once.

Clitocybe subcyathiformis Pk.

SAUCER CLITOCYBE

N. Y. State Mus. Bul. 122, p.136, pl.110, fig.1-6

Pileus fleshy but thin, broadly convex or nearly plane becoming centrally depressed, glabrous, watery white and often obscurely striatulate on the thin soon spreading margin when moist, white when dry, sometimes slightly colored in the center, flesh white, taste mild; lamellae thin, narrow, moderately close, adnate or slightly decurrent, white or whitish; stem equal or slightly tapering upward, stuffed or hollow, fibrillosely reticulate, whitish, often with a whitish mycelioid tomentum at the base; spores ellipsoid, 6–8 x 4–5 μ.

Pileus 2.5–5 cm broad; stem 2.5–4.5 cm long, 4–8 mm thick.

Gregarious. Among fallen leaves under alders and birches. Albany and Warren counties. September and October. Rare. Edible.

Clitocybe cerussata Fr.

WHITE LEAD CLITOCYBE

Sylloge V, p.154

Pileus fleshy, convex or plane, obtuse, even, moist, glabrous, white, flesh soft, thick in the center, white, taste mild; lamellae thin, narrow, very close, adnate or decurrent, white, unchangeable; stem elastic, downy at the base, naked above, white; spores minute, subglobose, 4–5 x 3–4 μ.

Pileus 4–8 cm broad; stem 3–7 cm long, 6–10 mm thick.

Scattered or gregarious. Woods. Adirondack mountains. September and October. Not common.

The lamellae in our specimens are apparently less close than is required by the description of the European plant.

Clitocybe difformis (Schum.) Sacc.

DEFORMED CLITOCYBE

Sylloge V, p.191

Pileus fleshy, large, undulately lobed, at first sprinkled with flocci or sometimes glabrous, white; lamellae white becoming pallid; stem short, thick, longitudinally rugose or grooved, white; spores 4–5 x 3–4 μ.

Pileus 5–15 cm broad; stem of the larger ones about 2.5 cm long, 2–2.5 cm thick.

Cespitose. Woods. Saratoga co. July. Rare. Found but once.

Some English mycologists and even Fries himself regarded this as an overgrown irregular form of Clitocybe cerussata Fr. In the Sylloge it is treated as a distinct species.

Clitocybe robusta Pk.

ROBUST CLITOCYBE

N. Y. State Mus. Rep't 49, p.17

Pileus thick, firm, convex becoming plane or slightly depressed in the center, glabrous, involute or decurved on the naked margin, white or slightly clouded in the center, flesh white; lamellae close, narrow, adnate or decurrent, whitish; stem stout, solid or hollow, glabrous, equal or tapering upward, white; spores ellipsoid, yellowish, 6–8 x 4–5 μ.

Pileus 7–10 cm broad; stem 2.5–7 cm long, 16–24 mm thick.

Single, gregarious or cespitose. Among fallen leaves in woods. Common in hilly and mountainous districts. September to November.

This is related to Clitocybe candida Bres. but may be separated from it by the naked margin of the pileus, the absence of any marked odor and specially by its broader spores.

Clitocybe phyllophila Fr.

LEAF-LOVING CLITOCYBE

Sylloge V, p.155

Pileus fleshy, convex or plane, becoming depressed or umbilicate, obtuse, even, dry, silvery on the margin by the silky veil, white; lamellae moderately broad, subdistant, adnate or slightly decurrent, white becoming yellowish ochraceous; stem equal, stuffed or hollow, tough, downy and incurved at the base, spongy within, white, sometimes eccentric; spores ellipsoid, 6–8 x 3–5 μ.

Pileus 4–7 cm broad; stem 5–7 cm long, 4–8 mm thick.

Solitary or cespitose. Albany co. September. Rare.

Clitocybe pithyophila Fr.

PINE-LOVING CLITOCYBE

Sylloge V, p.155

Pileus fleshy, thin, nearly plane, umbilicate, glabrous, often wavy or lobed on the margin, white when moist, shining white when dry;

lamellae close, plane, adnate or slightly decurrent, persistently white; stem equal, glabrous, downy at the base, somewhat hollow, often compressed, white; spores 6–7 x 3–4 μ.

Pileus 4–7 cm broad; stem 4–5 cm long, 3–4 mm thick.

Gregarious or subcespitose. Pine woods. Catskill mountains. September.

Clitocybe gallinacea (Scop.) Fr.

ACRID CLITOCYBE

Sylloge V, p.158

Pileus fleshy with a thin margin, convex or nearly plane, not infundibuliform, even, dry, opaque, white or whitish, flesh white, taste acrid, odor strong; lamellae close, narrow, thin, adnate or slightly decurrent, whitish; stem equal, solid, at first floccosely mealy, whitish; spores subglobose or ellipsoid, 4–6 x 3–4 μ.

Pileus 2.5–4 cm broad; stem 2.5–5 cm long, 4–6 mm thick.

Gregarious. In grassy or mossy places. Essex co. September. Rare. Found but once.

Distinguished by its dingy white color and its acrid taste.

Clitocybe regularis Pk.

REGULAR CLITOCYBE

N. Y. State Mus. Bul. 54, p.948, pl.K, fig.1–7

Pileus thin, flexible, broadly convex becoming nearly plane, often depressed in the center, orbicular, regular, whitish when moist, white when dry, flesh white, taste mild; lamellae thin, narrow, crowded, decurrent, whitish; stem firm, equal, glabrous, solid or rarely hollow, whitish, spongy and thickened at the base; spores minute, 4–5 x 2.5–3 μ.

Pileus 1–2.5 cm broad; stem about 2.5 cm long, 3–5 mm thick.

Woods. Warren co. August. Rare. Found but once.

Related to Clitocybe tornata Fr. from which its thin flexible moist pileus, its decurrent lamellae and the spongy mass of mycelioid tomentum at the base of the stem will separate it.

Clitocybe candicans Pers.

WHITISH CLITOCYBE

Sylloge V, p.157

Pileus slightly fleshy, convex becoming plane or depressed, umbilicate, regular, rarely slightly eccentric, even, shining with a superficial silky film, white when moist, shining white when dry; lamellae very thin, close, narrow, adnate becoming decurrent, white; stem even, equal, waxy, polished, hollow or nearly so, shining, often curved, rooting and villose at the base; spores 4–6 x 4 μ.

Gregarious. Among fallen leaves in woods. Common, September and October.

Said by Cooke to be farinaceous. By the character of the stem approaching Omphalia. In its form related to the section Cyathiformis, but not truly hygrophanous. Small and somewhat tough.

Clitocybe dealbata Sow.

IVORY CLITOCYBE

Sylloge V, p.157

Pileus slightly fleshy, convex becoming plane or with upturned and sometimes wavy margin, dry, even, glabrous, subshining, tough, white, taste mild; lamellae close, thin, adnate, white; stem fibrous, equal stuffed, pruinose or mealy at the top, white; spores ellipsoid, 4–5 x 2–2.5 μ.

Pileus 2.5–4 cm broad; stem 2–3 cm long, 2–3 mm thick.

Gregarious. Grassy places. Common. September and October.

Var. minor Cke. differs in its smaller more regular form, opaque pileus and agreeable farinaceous odor.

Var. deformata Pk. Pileus thin, very irregular, convex or centrally depressed, wavy or lobed on the margin, snowy white, flesh pure white, taste farinaceous; lamellae close, adnate or slightly decurrent, transversely venose, often anastomosing or connected by veins, frequently eroded on the edge and sometimes transversely split, whitish; stem irregular, sometimes compressed, more or less confluent at the base, stuffed or hollow, white, with a soft pure white downy tomentum below; spores subglobose, 3–4 μ long, nearly as broad.

On mushroom beds in a greenhouse. Wayne co. March. The specimens grew in mushroom beds made in a poorly lighted apartment, in which a temperature of 55°–60° was maintained. These conditions doubtless had some influence in causing the irregular, tufted mode of growth. The pure whiteness, thin pileus and the farinaceous taste and odor indicate a relationship with Clitocybe dealbata Sow. so intimate that it is recorded as a variety of it. That species is also sometimes found growing on mushroom beds.

Difformes

Pileus fleshy on the disk, thin on the margin, convex becoming expanded or centrally depressed, often irregular; lamellae irregularly adnate or decurrent; stem externally subcartilaginous, fibrous, commonly cespitose.

This section is easily recognized by its cespitose habit and the irregular character of the lamellae which are sometimes adnexed or sinuate on one side of the stem and decurrent on the other. The pileus is often irregular because of the crowded or tufted mode of growth. It is also sometimes umbonate and sometimes obtuse even in the same tuft. The stem too may be central or eccentric in the same tuft or the plant may sometimes be solitary.

KEY TO THE SPECIES

Mature pileus some shade of brown 1
Mature pileus some shade of yellow 3
Mature pileus white, whitish or grayish 4
1 Stem brown or brownish, colored like the pileus .... monadelpha
1 Stem white or whitish, paler than the pileus 2
2 Stem stuffed, plant commonly gregarious .... fumosa
2 Stem solid, plant commonly cespitose .... tumulosa
3 Mature pileus pale ochraceous .... patuloides
3 Mature pileus reddish yellow or saffron yellow .... illudens
4 Pileus spotted, plant growing on wood .... marmorea
4 Pileus not spotted, plant terrestrial 5
5 Margin of moist pileus striatulate, curved upward in age .... revoluta
5 Margin of moist pileus even, spreading in age 6
6 Stem not more than 6 mm thick, pileus usually white .... multiformis
6 Stem more than 6 mm thick, pileus usually grayish .... multiceps

Clitocybe monadelpha Morg.

UNITED CLITOCYBE

N. Y. State Mus. Mem. 4, p.140, pl.46, fig.7–12

Pileus fleshy, convex sometimes becoming centrally depressed, squamulose in the center, pale brown, reddish brown or honey color; lamellae moderately close, distinctly decurrent, pallid or pale flesh color; stem long, flexuous, fibrous, solid, often becoming hollow with age and twisted and tapering at the base, brown, pale brown or tinged with flesh color; spores broadly ellipsoid or slightly irregular, 7–9 x 5–6 μ.

Pileus 2.5–7 cm broad; stem 6–10 cm long, 4–6 mm thick.

Cespitose. Woods and open places. Near New York City, also Albany and Madison counties. September. Occasional.

The pileus sometimes has a dingy yellow or yellowish brown color. The species, as the author himself remarks, has the color and general appearance of Armillaria mellea Vahl. Armillaria mellea exannulata Pk. evidently belongs here. The species has been made a synonym of the European Agaricus tabescens Scop. by one author.

Clitocybe fumosa Fr.

SMOKY CLITOCYBE

Sylloge V, p.161

Pileus fleshy, convex becoming nearly plane, obtuse, somewhat gibbous when young, regular or irregular, even, glabrous, sooty brown soon becoming livid when moist, gray when dry, flesh whitish when dry; lamellae close, adnate or decurrent, grayish white; stem nearly equal, solid or stuffed, fibrous, fleshy, glabrous, mealy at the top, dingy white; spores subglobose, 6–7 μ broad.

Pileus 2.5–7.5 cm broad; stem 2.5–7.5 cm long, 4–10 mm thick.

Gregarious or rarely cespitose. Albany co. September.

Var. brevipes n. var. Stem short not exceeding 2.5 cm in length. Otherwise like the typical form. Ontario co. October. The stem in this variety seems to be constantly short so that the pileus appears to rest on the ground.

The specimens reported as Clitocybe ampla Pers. belong to C. fumosa Fr.

Clitocybe tumulosa Kalchb.

MOUND CLITOCYBE

Sylloge V, p.162

Pileus conic or convex becoming expanded, obtuse or umbonate, even, glabrous, brown, becoming paler; lamellae close, sinuate adnate and decurrent in the same plant, cinereous white; steam equal or nearly so, solid, floccose pruinose, pallid; spores ellipsoid, 6–7 x 4 μ.

Pileus 2.5–5 cm broad; stem 2.5–5 cm long, 6–8 mm thick.

Densely cespitose. Pine groves. Essex co. September. Very rare. Found but once.

Clitocybe patuloides Pk.

SPREADING CLITOCYBE

N. Y. State Mus. Rep't 54, p.163, pl.E

Pileus fleshy, firm, rather thick, convex becoming nearly plane or somewhat centrally depressed, glabrous, even and white or pale yellow when young with incurved margin, becoming yellowish or pale ochraceous and often squamose or rimosely areolate, flesh white, taste mild, odor mushroomlike; lamellae thin, close, slightly or strongly decurrent, forked or anastomosing at the base, white; stem usually short, equal or slightly tapering upward, solid, occasionally eccentric, white; spores broadly ellipsoid, 6–8 x 5–6 μ.

Pileus 2.5–10 cm broad; stem 2.5–7.5 cm long, 8–20 mm thick.

Gregarious or cespitose. Woods or their borders, specially of pine. Onondaga and Essex counties. September. Not common. It is remarkable for the different colors of the young and the mature pileus.

Clitocybe illudens (Schw.) Fr.

DECEIVING CLITOCYBE

N. Y. State Mus. Mem. 4, p.179, pl.68

Pileus convex or nearly plane, sometimes centrally depressed, obtuse or umbonate, glabrous or obscurely virgate, often irregular, saffron yellow or orange yellow, flesh white or yellowish, odor strong, taste disagreeable; lamellae close, decurrent, narrowed toward each end, colored like the pileus; stem long, firm, glabrous, solid, stuffed or rarely hollow, often attenuated toward the base, sometimes eccentric, colored like the pileus or sometimes brownish toward the base; spores globose, 4–5 μ in diameter.

Pileus 7–12 cm broad; stem 7–14 cm long, 6–12 mm thick.

Cespitose. Woods and open places. Often about old stumps. July to October.

A beautiful but unwholesome species. It causes nausea and vomiting if eaten. It is possible to make it comparatively harmless by heating it in salt water for a half hour, then taking it out and frying it in butter. It is phosphorescent. Large fresh specimens when placed in a dark place emit a glowing light.

Clitocybe marmorea Pk.

MOTTLED CLITOCYBE

N. Y. State Mus. Rep't 24, p.61

Pileus fleshy, firm, broadly convex, glabrous, white, mottled with darker watery spots, flesh white; lamellae close, narrow, arcuate, unequally decurrent, white; stem firm, solid, long, generally curved, slightly thickened at the base, white, sometimes pruinose; spores globose, 4 μ in diameter.

Pileus 5–10 cm broad; stem 10–15 cm long, 12–20 mm thick.

Cespitose. Prostrate trunks of trees in woods. Lewis co. September. Very rare. Found but once and then in small quantity.

The tufts are composed of few individuals.

Clitocybe revoluta Pk.

REVOLUTE CLITOCYBE

N. Y. State Mus. Rep't 46, p.23

Pileus convex or nearly plane, glabrous, whitish and slightly striatulate on the margin when moist, white when dry, the thin margin commonly and irregularly revolute; lamellae thin, narrow, close, adnate or slightly decurrent; stem glabrous, solid when young, stuffed or somewhat hollow when old, whitish; spores subglobose, 4–5 μ long.

Pileus 2.5–7 cm broad; stem 5–7 cm long, 6–10 mm thick.

Densely cespitose. Woods. Albany co. September. Rare. Found but once.

The pileus is often irregular from its densely tufted mode of growth. Occasionally the plant is solitary and then it is more regular with the margin spreading but not revolute.

Clitocybe multiformis Pk.

MULTIFORM CLITOCYBE

N. Y. State Mus. Mem. 4, p.141, pl.47, fig.1–9

Pileus thin, convex or nearly plane, often lobed or irregular, glabrous, whitish, grayish or yellowish when moist, paler when dry, flesh white when dry; lamellae thin, narrow, close, adnate or slightly decurrent, white or whitish; stem equal, solid, glabrous, white; spores ellipsoid, 5–6 x 3–4 μ.

Pileus 2.5–7 cm broad; stem 2.5–5 cm long, 4–6 mm thick.

Cespitose. Low damp places in woods. Albany co. October. Edible. Found but once.

The stem is often flexuous and compressed. The center of the pileus is sometimes tinged with brown. The mushroom does not retain its color well in drying. Its pileus is much thinner than that of Clitocybe multiceps Pk.

Clitocybe multiceps Pk.

MANY CAP CLITOCYBE

N. Y. State Mus. Bul. 139, p.37, pl.117, fig.7–9

Pileus fleshy, firm, convex, moist in wet weather, whitish, grayish, yellowish gray or grayish brown, sometimes slightly silky and brownish in the center, often irregular from mutual pressure, flesh white, taste oily, slightly disagreeable; lamellae close, adnate or slightly decurrent, white or whitish; stem equal or slightly thickened at the base, firm, glabrous, solid or stuffed, slightly pruinose at the top, white or whitish; spores globose, 5–8 μ in diameter.

Pileus 2.5–7 cm broad; stem 5–10 cm long, 6–12 mm thick.

Cespitose, rarely solitary. Open ground or in grassy places. June to October. Common. Edible.

The tufts may be composed of many or few individuals. The lamellae are sometimes sinuate on one side of the stem, thereby indicating a close relationship with the genus Tricholoma. In var. tricholoma Pk. nearly or quite all the lamellae are sinuate. Such specimens might easily be referred to that genus, but the habit and all other characters indicate its place here. The flavor of the uncooked mushroom varies. In some it is very disagreeable, in others but slightly so. Some pronounce it among the best of mushrooms when cooked, others say it is unfit to eat.

Infundibuliformes

Pileus becoming infundibuliform or evenly depressed or umbilicate in the center; lamellae deeply and evenly decurrent from the first; stem spongy, externally fibrous.

The funnel form pileus is characteristic of many of the species of this section and is suggestive of its name. The lamellae are equally decurrent, unlike, in this respect, those of the preceding section. The pileus is not truly hygrophanous, but in some species it is moist or subhygrophanous and becomes paler with the escape of the moisture, in others it is dry.

KEY TO THE SPECIES

Pileus dry 1
Pileus moist when young or in wet weather 7
1 Mature pileus normally infundibuliform 2
1 Mature pileus not normally infundibuliform 4
2 Pileus white .... catina
2 Pileus not white 3
3 Pileus 8 cm or more broad .... maxima
3 Pileus less than 8 cm broad .... infundibuliformis

4 Plant terrestrial 5
4 Plant lignatile 6
5 Pileus reddish or brick red, spores 8–10 μ long .... sinopica
5 Pileus reddish or brick red, spores 6–8 μ long .... sinopicoides
6 Pileus glabrous, lamellae white .... eccentrica
6 Pileus virgate and dotted, lamellae not white .... ectypoides
7 Dry pileus white 8
7 Dry pileus not white 9
8 Lamellae 6 mm broad .... tuba
8 Lamellae less than 6 mm broad .... adirondackensis
9 Lamellae yellowish or pale ochraceous .... gilva
9 Lamellae white or whitish .... splendens
9 Lamellae reddish .... inversa

Clitocybe catina Fr.

BOWL SHAPE CLITOCYBE

Sylloge V, p.174

Pileus fleshy but thin toward the margin, plane becoming infundibuliform, flaccid, dry, glabrous, white becoming tinged with pink or tan color in rainy weather, flesh white, odor agreeable; lamellae moderately close, decurrent, white; stem stuffed or solid spongy within, elastic, slightly thickened at the base, white; spores ellipsoid, 6–8 x 4–5 μ.

Pileus 4–5 cm broad; stem 4–7 cm long, 6–9 mm thick.

In or near woods. Adirondack mountains. August. Found but once.

The specimens were young but apparently belong here and are admitted with some hesitation. Related to Clitocybe infundibuliformis (Schaeff.) Fr. but easily distinguished by its white color. The spore dimensions here given are taken from American specimens.

Clitocybe maxima (G. & M.) Fr.

LARGE CLITOCYBE

Sylloge V, p.165

Pileus fleshy in the center, thin toward the margin, broadly infundibuliform, subumbonate, dry, pale tan color or whitish; lamellae close, soft, long decurrent, whitish; stem attenuated upwards, fibrillose, solid, whitish; spores subglobose, 4–6 x 3–4 μ.

Pileus 10–30 cm broad; stem 5–10 cm long, 12–25 mm thick.

Woods and grassy places. Adirondack and Catskill mountains. July and August. Not common.

Remarkable for and at once recognized by its large size.

Clitocybe infundibuliformis (Schaeff.) Fr.

FUNNEL FORM CLITOCYBE

N. Y. State Mus. Rep't 48, p.174, pl.24, fig.1-6

Pileus at first convex and slightly umbonate, becoming infundibuliform, thin and minutely silky on the margin, dry, reddish or pale tan color, fading with age, flesh white; lamellae thin, moderately close, decurrent, white or whitish; stem generally tapering upward, spongy or stuffed, soft, elastic, colored like the pileus or rarely whitish; spores 5–6 x 3–4 μ.

Pileus 4–7 cm broad; stem 5–7 cm long, 6–10 mm thick.

Single or scattered, rarely tufted. Among fallen leaves in woods. July and August. Common. Edible.

Var. membranacea Fr. Pileus thinner, not umbonate and stem more slender, equal.

Clitocybe sinopica Fr.

SINOPICAN CLITOCYBE

Sylloge V, p.167

Pileus fleshy but thin, plane or centrally depressed, often umbilicate, dry, glabrous or becoming flocculose and rivulose, ochraceous red sometimes becoming paler with age, flesh white, odor farinaceous; lamellae close, rather broad, slightly decurrent, white becoming yellowish; stem equal, somewhat fibrillose, stuffed, colored like the pileus; spores 8–10 x 5–6 μ.

Pileus 2–4 cm broad; stem 2.5–5 cm long, 2–4 mm thick.

Woods and on burned ground in open places. June to September. Adirondack mountains.

Clitocybe sinopicoides n. sp.

SINOPICANLIKE CLITOCYBE

Pileus thin, convex with decurved margin, umbilicate, floccose squamulose specially in the center, obscurely fibrillose on the margin, firm, tawny red or brick red, flesh white, taste and odor farinaceous; lamellae moderately close, arcuate, decurrent, white, the interspaces slightly venose; stem equal or slightly tapering upward, subfloccose or glabrous, solid or stuffed, colored like the pileus; spores 6–8 x 3–4 μ.

Pileus 2–4 cm broad; stem 2–4 cm long, 2–5 mm thick.

Among mosses in low wet places. Essex co. June.

This species closely resembles Clitocybe sinopica Fr. and probably has been taken for a small vernal form of that species. It may be separated from it by its wet mossy habitat, its smaller size and specially by its smaller spores. These are more or less obovate and pointed at one end. The farinaceous odor and taste is sometimes wanting as in C. incilis Fr. but it has not the crenate margin nor the hollow stem of that species.

Clitocybe eccentrica Pk.

ECCENTRIC CLITOCYBE

Torr. Bot. Club Bul. 25, p.321

Pileus very thin, umbilicate or subinfundibuliform, glabrous, watery white and shining when moist, white when dry, the thin margin often lobed, irregular or deeply cleft on one side; lamellae narrow, close, decurrent, white; stem slender, tough, solid, glabrous, strigosely hairy at the base, often eccentric, white, long branching strands of white mycelium often permeating the matrix; spores 4–5 x 2.5–3 μ.

Pileus 2.5–5 cm broad; stem 2.5–4 cm long, 2–4 mm thick.

Gregarious or cespitose. Much decayed wood. Essex, Warren and Wayne counties. July to October.

Clitocybe ectypoides Pk.

ECTYPOID CLITOCYBE

N. Y. State Mus. Rep't 24, p.61

Pileus fleshy but thin, broadly umbilicate or infundibuliform, with a spreading margin, finely virgate and squamulose punctate, the blackish points on the radiating fibrils, moist, grayish or grayish yellow; lamellae close, narrow, decurrent, some of them forked, yellowish; stem equal, firm, solid, colored like the pileus, with a white mycelium at the base; spores broadly ellipsoid, 5–8 x 4–5 μ.

Pileus 2.5–5 cm broad; stem 2–3 cm long, 2–4 mm thick.

Gregarious or cespitose. Decaying wood in woods. July to September. Common in mountainous districts.

Clitocybe tuba Fr.

TRUMPET CLITOCYBE

Sylloge V, p.175

Pileus thin, convex or nearly plane, umbilicate, even on the margin, whitish when moist, shining white when dry, flesh white;

lamellae close, 5–6 mm broad, very decurrent, white becoming pallid; stem equal, tough, stuffed or hollow, glabrous, white; spores subglobose, 4 x 3 μ.

Pileus 2.5–5 cm broad; stem 4–6 cm long, 2–5 mm thick.

Gregarious. Among fallen leaves in woods, specially pine woods. Warren co. September. Rare.

Similar to Clitocybe pithyophila Fr. from which it may be separated by its long decurrent lamellae. From C. adirondackensis Pk. it is separated by its broader lamellae.

Clitocybe adirondackensis Pk.

ADIRONDACK CLITOCYBE

N. Y. State Mus. Rep't 54, p.174, pl.69, fig.1–13

Pileus thin, convex or nearly plane and umbilicate, or soon very concave and infundibuliform, glabrous, moist in wet weather, white or pale tan color, flesh white; lamellae thin, close, narrow, very decurrent, white; stem equal or nearly so, glabrous, stuffed or hollow, colored like the pileus; spores subglobose or broadly ellipsoid, 4–5 x 3–4 μ.

Pileus 2.5–5 cm broad; stem 4–7 cm long, 2–4 mm thick.

Scattered or gregarious. Woods in hilly or mountainous districts. July to October. Common. Edible.

The lamellae are scarcely broader than the thickness of the flesh of the pileus. The white pileus is sometimes slightly tinged with brown in the center.

Clitocybe gilva (Pers.) Fr.

YELLOWISH CLITOCYBE

N. Y. State Mus. Rep't 54, p.174, pl.69, fig.14–21 as C. maculosa Pk.

Pileus fleshy, compact, convex becoming centrally depressed, glabrous, often marked with small round spots, minutely downy on the involute young margin which is sometimes obscurely striate, whitish or cream color, flesh white or tinged with the color of the pileus, taste mild; lamellae close, narrow, decurrent, whitish or yellowish, some of them forked; stem equal or slightly tapering upward, glabrous, stuffed or hollow, whitish, sometimes tomentose at the base; spores subglobose, 4–5 μ in diameter.

Pileus 2.5–7 cm broad; stem 5–7 cm long, 4–8 mm thick.

Woods. Adirondack mountains. August and September. Rare. Edible.

The American plant is commonly paler than the European and was described under the name Clitocybe maculosa Pk. Its stem is sometimes hollow but its essential characters are so close to those of C. gilva (Pers.) Fr. that it seemed best to unite them. Agaricus (Clitocybe) subzonalis Pk. also is now considered a mere form of this species having the pileus obscurely zonate.

Clitocybe splendens (Pers.) Fr.

SHINING CLITOCYBE

Sylloge V, p.172

Pileus fleshy but thin, nearly plane becoming centrally depressed and infundibuliform, glabrous, pale yellowish or yellow and shining, flesh white; lamellae narrow, simple, close, very decurrent, white; stem equal or slightly tapering upward, glabrous, solid, colored like the pileus; spores subglobose, 4–5 μ in diameter.

Pileus 5–8 cm broad; stem 4–5 cm long, 8–10 mm thick.

Solitary. Woods among fallen leaves. Essex co. June. Rare.

Clitocybe inversa Scop.

INVERTED CLITOCYBE

Sylloge V, p.172

Pileus fleshy, convex becoming infundibuliform, fragile, glabrous, obtuse, moist when fresh, involute on the thin margin, brick color, reddish or tan color, flesh colored like the pileus; lamellae close, simple, decurrent, pallid becoming reddish; stem equal or nearly so, slightly rigid, spongy, stuffed or hollow, glabrous, whitish; spores subglobose, 3–5 μ in diameter.

Pileus 4–6 cm broad; stem 4–5 cm long, 4–8 mm thick.

Gregarious or cespitose. Woods or open places. Fulton co. August. Rare.

SERIES B

Plant truly hygrophanous

Cyathiformes

Pileus hygrophanous, centrally depressed or cup shape, flesh thin, separable into two horizontal layers; lamellae adnate or decurrent.

The species of this section are separated from those of the preceding sections by the hygrophanous character of the pileus with its separable layers and by its more cuplike shape. Only four species are known to belong to our flora.

KEY TO THE SPECIES

Stem fibrillosely reticulate ....cyathiformis
Stem not fibrillosely reticulate..1
1 Plant cespitose, pileus usually irregular.......................caespitosa
1 Plant not cespitose 2
2 Pileus convex, deeply umbilicate, not infundibuliform.....subconcava
2 Pileus becoming infundibuliform ....brumalis

Clitocybe cyathiformis Fr.

CUP SHAPE CLITOCYBE

Sylloge V, p.176

Pileus fleshy but thin, centrally depressed or infundibuliform, hygrophanous, glabrous or nearly so, even on the margin or occasionally striate when old, blackish brown or grayish brown when moist, paler when dry, flesh colored like the pileus, separable into two horizontal layers; lamellae distant, adnate or decurrent, united behind, dingy or grayish brown; stem equal or slightly tapering upward, stuffed or hollow, fibrillose, obscurely reticulate by the fibrils, colored like the pileus; spores ellipsoid, 8–9 x 4–5 μ.

Decaying wood or on the ground. In woods or open places. August and September. Common.

Clitocybe poculum Pk. is referable to this species.

Clitocybe caespitosa Pk.

CESPITOSE CLITOCYBE

N. Y. State Mus. Rep't 41, p.61

Pileus thin, infundibuliform, often irregular, hygrophanous, grayish brown when moist, cinereous or clay color when dry; lamellae narrow, close, decurrent, some of them branched, white; stem equal or slightly tapering upward, stuffed or hollow, white; spores subglobose or broadly ellipsoid, 3–4 μ long.

Pileus 2.5–4 cm broad; stem 2–3 cm long, 4–6 mm thick.

Commonly cespitose. Woods. Catskill and Adirondack mountains. August and September. Rare.

This mushroom is remarkable for its irregular and deformed appearance. The pileus is sometimes perforate and the stem is stout in proportion to the size of the pileus. The tufts are composed of but few individual plants.

Clitocybe subconcava Pk.

SUBCONCAVE CLITOCYBE

N. Y. State Mus. Bul. 54, p.948, pl.K, fig.8–13

Pileus thin, convex, deeply umbilicate, glabrous, hygrophanous, brownish or reddish brown and usually striatulate on the decurved margin when moist, whitish when dry; lamellae arcuate, decurrent, close, pallid or subcinereous; stem equal, firm, solid or stuffed, sometimes with a small cavity, slightly fibrillose, colored like the pileus; spores ellipsoid, 5–6 x 3–4 μ.

Pileus 2.5–5 cm broad; stem 2.5–5 cm long, 3–4 mm thick.

Pine woods. Warren co. August. Rare. Found but once.

Related to Clitocybe concava (Scop.) Fr. from which it may be separated by its paler lamellae and smaller spores.

Clitocybe brumalis Fr.

WINTRY CLITOCYBE

Sylloge V, p.180

Pileus at first convex or expanded and umbilicate, then infundibuliform, glabrous, hygrophanous, livid when moist, whitish or yellowish when dry, often darker in the center, sometimes wavy or lobed on the margin, flesh thin; lamellae arcuate at first, narrow, close, decurrent, distinct, pallid or yellowish white; stem nearly equal, often slightly curved, stuffed or hollow, glabrous, whitish, sometimes downy at the base; spores 4–5 x 3–4 μ.

Pileus 2.5–5 cm. broad; stem 2–5 cm long, 2–4 mm thick.

Woods. Catskill and Adirondack mountains. September and October. Rare.

Our specimens were collected in the months mentioned, but the specific name indicates that it may also occur later in the season.

Orbiformes

Pileus hygrophanous, somewhat fleshy, convex or plane, umbilicate or centrally depressed, glabrous; lamellae thin, close, adnate or having a decurrent tooth.

The species of this section may be separated from those of the preceding by the more spreading decurved margin of the pileus, which is therefore more orbicular. They may be divided into three groups according to the color of the lamellae. They are mostly small and scarce.

KEY TO THE SPECIES

Lamellae yellow or yellowish . . . . . flavidella
Lamellae grayish or brownish 1
Lamellae white or whitish 4
1 Plant with a farinaceous odor . . . . . ditopoda
1 Plant without a farinaceous odor 2
2 Pileus umbilicate . . . . . peltigerina
2 Pileus not umbilicate 3
3 Stem pruinose or mealy at the top . . . . . metachroa
3 Stem naked at the top . . . . . vilescens
4 Plant inodorous . . . . . angustissima
4 Plant fragrant 5
5 Margin of the moist pileus striate . . . . . subditopoda
5 Margin of the moist pileus even 6
6 Pileus brownish when moist . . . . . compressipes
6 Pileus whitish when moist . . . . . fragrans

Clitocybe flavidella Pk.

YELLOWISH CLITOCYBE

N. Y. State Mus. Rep't 30, p.38

Pileus thin, convex becoming plane or centrally depressed, often irregular, glabrous, hygrophanous, dingy yellow when moist, paler or whitish when dry; lamellae close, narrow, adnate or slightly decurrent, yellow or yellowish; stem equal, glabrous, hollow, colored like the pileus; spores unknown.

Pileus about 2.5 cm broad; stem 2–3 cm long, 3–4 mm thick.

Gregarious. Low wet ground. Otsego co. September. Rare. Found but once.

Clitocybe ditopoda Fr.

DOUBLE STEM CLITOCYBE

Sylloge V, p.186

Pileus thin, convex becoming plane or centrally depressed, glabrous, hygrophanous, brownish when moist, gray when dry, odor farinaceous; lamellae thin, close, about 2 mm wide, slightly decurrent, brownish gray; stem equal, glabrous, hollow, often compressed, colored like the pileus; spores broadly ellipsoid, 5–6 x 3–5 μ.

Pileus 2–5 cm broad; stem 2–3 cm long, 2–4 mm thick.

Woods and among fallen leaves. Albany and Warren counties. September and October. Rare.

The stem in the Warren county specimens is sometimes compressed and grooved as if composed of two united stems. Such specimens are suggestive of the specific name. The spore dimensions here given are taken from American specimens. Some authorities say spores "sphaeroid, 2–3 μ in diameter."

Clitocybe peltigerina Pk.

PELTIGERINE CLITOCYBE

N. Y. State Mus. Rep't 30, p.38

Pileus thin, nearly plane, umbilicate, glabrous, hygrophanous, brown and striatulate on the margin when moist, whitish or pale gray when dry; lamellae subdistant, sometimes branched, decurrent, brownish, interspaces venose; stem nearly equal, solid, glabrous, rather firm, paler than the pileus, often with a minute white tomentum at the base; spores ellipsoid, 8 x 5 μ.

Pileus 4–10 mm broad; stem 12–20 mm long, 1–1.5 mm thick.

Among species of lichens (Peltigera). Albany and Oneida counties. May. Rare.

Sometimes two or three stems are united at the base, thus manifesting a tendency to become cespitose.

Clitocybe metachroa Fr.

CHANGEABLE CLITOCYBE

Sylloge V, p.185

Pileus thin, convex becoming plane or centrally depressed, glabrous, hygrophanous, brownish or grayish brown when young and moist, whitish when dry, margin slightly striate when old; lamellae thin, narrow, close, linear, adnate or slightly decurrent, whitish or cinerous; stem equal, tough, externally fibrous, stuffed or hollow, terete or compressed, whitish, mealy or pruinose at the top, colored like the pileus; spores 6–8 x 3–4 μ.

Pileus 2.5–4 cm broad; stem 3–4 cm long, 4–8 mm thick.

Pine woods. Albany co. November. Rare. Found but once.

The marked change of color between the moist pileus and the dry one is suggestive of the specific name. The mealy or pruinose top of the stem, its habitat in pine woods and its late appearance are guides in the identification of the species.

Clitocybe vilescens Pk.

WORTHLESS CLITOCYBE

N. Y. State Mus. Rep't 33, p.19

Pileus convex becoming plane or centrally depressed, sometimes irregular, glabrous, slightly pruinose on the involute margin, brown or grayish brown, becoming paler with age, sometimes concentrically rivulose, flesh pale gray; lamellae close, adnate or decurrent, cinereous or tinged with dingy yellow; stem short, equal, solid, sometimes compressed, grayish brown with a whitish tomentum at the base; spores subglobose, 5–6 x 4–5 μ.

Pileus 2.5–4 cm broad; stem 2–5 cm long, 2–4 mm thick.

Gregarious. Bushy places and pastures. Albany and Onondaga counties. August. Not common.

Clitocybe angustissima Lasch

NARROW GILL CLITOCYBE

Sylloge V, p.188

Pileus slightly fleshy, plane or centrally depressed, glabrous, hygrophanous, watery white when moist, shining white when dry, the spreading margin slightly striate when old; lamellae thin, narrow, very close, white; stem slender, stuffed, often curved or flexuous, naked at the top, glabrous or pubescent at the base, white; spores 4–5 x 2–3 μ.

Pileus 4–5 cm broad; stem 3–5 cm long, 2–3 mm thick.

Low wet ground in woods. Essex co. September. Rare.

Related to Clitocybe fragrans Sow. from which it may be separated by the lack of odor, the more slender stem and the purer white color.

Clitocybe subditopoda Pk.

DITOPODALIKE CLITOCYBE

N. Y. State Mus. Rep't 42, p.18

Pileus thin, convex or nearly plane, umbilicate, glabrous, hygrophanous, grayish brown and striate on the margin when moist, paler when dry, flesh concolorous, odor and taste farinaceous; lamellae broad, close, adnate, whitish or pale cinereous; stem equal, glabrous, hollow, colored like the pileus; spores ellipsoid, 5–6 x 3–4 μ.

Pileus 12–24 mm broad; stem 2.5–5 cm long, about 2 mm thick.

Mossy ground in woods. Essex co. September. Rare.

This is closely related to Clitocybe ditopoda Fr. from which it may be separated by the umbilicate pileus, its striate margin and its broader paler lamellae.

Clitocybe compressipes Pk.

FLAT STEM CLITOCYBE

N. Y. State Mus. Rep't 33, p.18

Pileus thin, convex or nearly plane, umbilicate, glabrous, hygrophanous, brownish when moist, whitish or pale tan color when dry, flesh white when dry, odor slight, farinaceous; lamellae close, subarcuate or horizontal, adnate or slightly decurrent, whitish; stem firm, hollow, generally compressed, often slightly tapering upward, slightly pruinose, colored like the pileus; spores 5–6 x 4–4.5 μ.

Pileus 2–3 cm broad; stem 2–4 cm long, 2–4 mm thick.

Gregarious. In pastures or grassy places. Albany and Warren counties. July. Not common.

The odor is not always perceptible unless the pileus is moist or broken. The umbilicate pileus, paler or whitish lamellae, time and place of growth separate this species from Clitocybe ditopoda Fr.

Clitocybe fragrans Sow.

FRAGRANT CLITOCYBE

Sylloge V, p.188

Pileus thin, convex becoming plane or umbilicate or centrally depressed, glabrous, hygrophanous, watery white when moist, whitish when dry, odor strong, aniselike; lamellae close, slightly decurrent, 2 mm broad, distinct, white; stem equal, slightly flexuous, elastic, glabrous, stuffed or hollow, whitish; spores 6–7 x 3–4 μ.

Pileus 2–5 cm broad; stem 4–5 cm long, 4–6 mm thick.

Woods among mosses and fallen leaves. Lewis co. July. Rare.

NEW YORK SPECIES OF LACCARIA

Laccaria B. & Br.

Pileus convex becoming umbilicate or depressed, flesh thin; lamellae broadly adnate, sometimes with a decurrent tooth, becoming mealy with the copious subglobose minutely warted white spores; stem central, externally fibrous, veil not evident.

The species of this genus have generally been included in Clitocybe, but they are so peculiar in their general appearance that it seems best to separate them. The lamellae are rather thick and subdistant broadly adnate and when mature are powdered or whitish pruinose from the abundant spores. These are typically globose or nearly so and rough. We have included one species in this genus that has oblong even spores; but in all other respects it is so closely allied to the genus that it seems best to consider the spore character a specific rather than a generic one.

KEY TO THE SPECIES

Base of the stem radicating, clavately thickened..............trullisata
Base of the stem not radicating, rarely thickened....................1
1 Mature pileus usually more than 4 cm broad ....ochropurpurea
1 Mature pileus usually less than 4 cm broad 2
2 Lamellae violaceous ....amethystina
2 Lamellae flesh colored or nearly white...............................3
3 Pileus regular, becoming unpolished or minutely squamulose......laccata
3 Pileus regular, persistently glabrous ....striatula
3 Pileus irregular, usually less than 12 mm broad..................tortilis

Laccaria trullisata (Ellis) Pk.

PLASTERED LACCARIA

Sylloge V, p.195

Pileus fleshy, convex or plane becoming depressed in the center, innately fibrous, squamose or squamulose, smoother in the center, thin on the margin, reddish flesh color; lamellae unequal, subdistant, thick, adnate or with a decurrent tooth, at first purplish violet, then brick red and pruinose or white pulverulent; stem stuffed, fibrillose, colored like the pileus, the enlarged more or less deeply radicating and clavately thickened base covered by a mass of mycelium and adhering sand; spores oblong or cylindric, even, granular within, 15–20 x 8–9 μ.

Pileus 2.5–5 cm broad; stem 2.5–7 cm long, 5–8 mm thick.

Solitary or sparsely gregarious. Sandy soil. Suffolk, Nassau, Madison and Albany counties. September and October.

The author of this species placed it in Clitocybe with the remark that it is related to Agaricus laccatus Scop. and A. ochropurpureus Berk. The fresh mycelium is violet colored. The specific name apparently has reference to the mass of soil adhering to the base of the stem which in consequence appears as if it had been plastered over with sand.

Laccaria ochropurpurea (Berk.) Pk.

PURPLISH OCHER LACCARIA

N. Y. State Mus. Bul. 116, p.41, pl.106, fig.7–11

Pileus fleshy, firm, subhemispheric or convex with decurved margin becoming plane or slightly centrally depressed, hygrophanous, purplish brown when moist, grayish or pale alutaceous when dry, unpolished; lamellae thick, distant, broad, adnate or decurrent, purplish; stem variable, short or long, equal or sometimes thicker in the middle, sometimes at each end, fibrous, solid, colored like or paler than the pileus; spores globose, verruculose, 8–10 μ in diameter.

Pileus 5–10 cm broad; stem 3–8 cm long, 4–12 mm thick.

Solitary or rarely gregarious. Open grassy or bushy places. Common. July to September. Edible.

This species is often very irregular and very variable in size and shape. The color of the lamellae is generally darker than in Laccaria laccata (Scop.) B. & Br. The pileus is much darker when moist than when dry. The stem is very fibrous and firm.

Laccaria amethystina (Bolt.) B. & Br. in part

AMETHYST LACCARIA

N. Y. State Mus. Rep't 48, p.176, pl.25, fig.23–27

Pileus thin, broadly convex, umbilicate or centrally depressed, hygrophanous, brown or violaceous brown when moist, grayish when dry, unpolished; lamellae subdistant, adnate or decurrent, violaceous, color more persistent than in the pileus; stem slender, equal, flexuous, hollow, colored like or paler than the pileus; spores globose, verruculose, 8–10 μ in diameter.

Pileus 1.2–2.5 cm broad; stem 2.5–5 cm long, 2–4 mm thick.

Solitary or gregarious. Damp ground in shaded places. Not common. Albany and Suffolk counties. July and August.

This beautiful and quite distinct species has commonly been confused with Laccaria laccata (Scop.) B. & Br. or considered a mere variety of it; but to me it appears to be distinct in its violaceous color, slender hollow stem, peculiar habitat, commonly smaller size and more rare occurrence. It is easily recognized and the change of color between the moist and the dry state is strongly marked.

Laccaria laccata (Scop.) B. & Br. in part

LACCATE LACCARIA WAXY CLITOCYBE

N. Y. State Mus. Rep't 48, p.175, pl.25, fig.1–13

Pileus fleshy, rather thin, convex or nearly plane, sometimes umbilicate or centrally depressed, hygrophanous, glabrous, furfuraceous or minutely squamulose, pale red, buff red or flesh red when moist, pale ochraceous, grayish or buff when dry, margin even; lamellae rather broad, thick, subdistant, adnate or decurrent, flesh color or pale flesh color; stem long or short, nearly or quite equal, fibrous, firm, straight or flexuous, stuffed, colored like the pileus; spores globose, verruculose, 8–10 μ in diameter.

Pileus 1.2–5 cm broad; stem 2.5–7.5 cm long, 2–6 mm thick.

Solitary, gregarious or cespitose. Woods, groves, swamps, mossy places and pastures in wet, dry or sandy soil and even in sphagnum. Common. May to October. Edible.

This is the most common and the most variable species of the genus. It is not at all particular concerning its habitat, soil nor season. It may be found at any time from spring to late autumn if the weather is not too dry. As in other species the color of the lamellae is more persistent than that of the pileus, and is one of the most available characters by which to separate this species from any of the preceding.

On account of its variability many varieties have been designated by European mycologists. We recognize among our specimens only two varieties: var. pallidifolia Pk. (N. Y. State Mus. Rep't 48, p.176, pl.25, fig.19–22) differing from the type in having the lamellae very pale, barely tinged with flesh color; and var. decurrens Pk. in which the lamellae are distinctly decurrent or arcuate decurrent. As an edible species it is not to be classed as first quality. It is inclined to be tough and not highly flavored.

Laccaria striatula (Pk.)

STRIATULATE LACCARIA

N. Y. State Mus. Rep't 48, p.176, pl.25, fig.14-18

Pileus very thin, submembranaceous, convex or nearly plane, glabrous, hygrophanous, buff red and striatulate when moist, grayish or pale buff when dry; lamellae broad, distant, adnate, pale flesh color; stem slender, equal, fibrous, hollow, colored like the pileus; spores globose or subglobose, verruculose, 11–13 μ in diameter.

Pileus 12–20 mm broad; stem 1.5–3 cm long, 1–2 mm thick.

Gregarious. In wet or damp places. Albany, Ulster and Warren counties. Not common. June to September.

This was formerly considered a mere variety of Laccaria laccata (Scop.) B. & Br., but its thinner glabrous striatulate pileus, which is usually convex, its smaller size, more slender hollow stem and specially its larger spores lead me to consider it a distinct species.

Laccaria tortilis (Bolt.) B. & Br.

TWISTED LACCARIA

Sylloge V, p.198

Pileus membranaceous, convex plane or centrally depressed, deflexed and sometimes torn on the margin, obscurely striate, irregular, subferruginous; lamellae thick, subdistant, adnate, flesh color; stem short, equal or slightly thickened at the base, stuffed or hollow, twisted, fragile, colored like the pileus; spores globose, echinulate, 12–16 μ in diameter.

Pileus 5–10 cm broad; stem 8–12 mm long, .5–1 mm thick.

Closely gregarious or cespitose. Damp places in woods or by roadsides. Rensselaer and New York counties. August. Rare.

This is the smallest of our species. It is easily recognized by its small size and irregular shape. Its spores are larger and more sharply verruculose than in the preceding species. Var. gracilis Pk. has a more regular pileus, a longer stem and a less ce[illegible]pitose mode of growth.

NEW YORK SPECIES OF PSILOCYBE

Psilocybe Fr.

Pileus more or less fleshy, glabrous, the margin at first incurved; lamellae brown or purplish brown, not decurrent; stem subcartilaginous, rigid or tenacious, tubular, either hollow or stuffed, often radicating; veil absent or rudimentary, not forming a membrane; spores either brown or purplish brown.

The genus has been divided into two sections characterized as follows:

Rigidae. Pileus thin, not pelliculose, hygrophanous, commonly some shade of brown and striatulate when moist, paler when dry; stem slender, rigid, usually brittle or fragile, glabrous or silky fibrillose, veil none.

Spadiceae is another name that has been applied to this section.

Tenaces. Pileus pelliculose, often slightly viscid in wet weather, becoming pale and mostly clear or bright in color; stem commonly tough flexible, glabrous or silky fibrillose, veil rarely conspicuous.

Callosae is another name sometimes applied to this section.

The species of these sections are not in all cases sharply separated from each other. We have included in the genus one species having red spores.

The absence of an interwoven veil will distinguish species of Psilocybe from those of Hypholoma on one hand, and the incurved margin of the young pileus will separate them from those of Psathyra on the other. Most of the species are terrestrial but a few small ones inhabit wood or fallen decaying leaves. Some occur both on wood and on the ground.

KEY TO THE SPECIES

Pileus hygrophanous 1
Pileus not hygrophanous 14
1 Stem tinged with blue .... caerulipes
1 Stem not tinged with blue 2
2 Plant growing in sandy soil .... arenulina
2 Plant not growing in sandy soil 3
3 Pileus rugose plicate and atomate .... atomatoides
3 Pileus not having these characters 4
4 Spores red .... conissans
4 Spores brown or purplish brown 5
5 Moist pileus yellow, reddish yellow or brownish 6
5 Moist pileus alutaceous, reddish brown or chestnut 7
5 Moist pileus brown, sooty brown or blackish brown 10

6 Stem reddish brown .... squalidella
6 Stem white .... polycephala
7 Plant growing in woods or uncultivated places 8
7 Plant growing in grassy places .... foenisecii
8 Spores globose or subglobose .... phyllogena
8 Spores ellipsoid 9
9 Pileus less than 2.5 cm broad .... castanella
9 Pileus 2.5 cm or more broad, bay brown when moist .... spadicea
9 Pileus 2.5 cm or more broad, tan color when moist .... fuscofolia
10 Moist pileus striatulate on the margin 11
10 Moist pileus not striatulate on the margin .... nigrella
11 Plant growing on decaying wood 12
11 Plant growing on mud or wet ground .... limicola
11 Plant growing in sphagnum .... fuscofulva
12 Young lamellae whitish .... camptopoda
12 Young lamellae brown or cinereous 13
13 Stem brownish, less than 2.5 cm long .... unicolor
13 Stem white, more than 2.5 cm long .... senex
14 Stem white or whitish 15
14 Stem some other color 17
15 Pileus viscid when moist .... semilanceata
15 Pileus not viscid when moist 16
16 Pileus striate on the margin .... clivensis
16 Pileus even on the margin .... limophila
17 Pileus striatulate on the margin .... dichroa
17 Pileus not striatulate on the margin 18
18 Pileus yellowish when moist .... elongatipes
18 Pileus tawny bay when moist .... uda

Psilocybe caerulipes Pk.

BLUE STEM PSILOCYBE

N. Y. State Mus. Rep't 38, p.89

Pileus thin, subcampanulate becoming convex, obtuse or obtusely umbonate, glabrous, hygrophanous, slightly viscid, brown and striatulate on the margin when moist, yellowish or subochraceous when dry, the center sometimes brownish; lamellae at first ascending, close, adnate, grayish tawny becoming rusty brown, whitish on the edge; stem slender, equal, flexuous, tenacious, hollow or containing a separable pith, slightly fibrillose, pruinose at the top, bluish, sometimes whitish at the top; spores 8–10 x 4–5 μ.

Pileus 10–20 mm broad; stem 2.5–4 cm long, 1–1.5 mm thick.

Cespitose or solitary. On decaying wood. Saratoga co. August. Rare.

The species may readily be recognized by its bluish stem. The pileus sometimes changes to blue where bruised. The spores are smaller than those of Psilocybe semilanceata caerulescens Cke. which has the stem slightly bluish at the base.

Psilocybe arenulina Pk.

SANDY PSILOCYBE

N. Y. State Mus. Rep't 30, p.42

Pileus convex becoming plane or centrally depressed, rarely umbonate, glabrous, hygrophanous, dark brown and coarsely striate on the margin when moist, dingy white or whitish when dry; lamellae close, adnate, cinnamon brown becoming darker or purplish brown; stem slightly tapering upward, hollow, often radicating and somewhat clavate at the base, whitish; spores ellipsoid, 10–12 x 5–6 μ.

Pileus 1–3 cm broad; stem 3–5 cm long, 1.5–2 mm thick.

Gregarious. Sandy soil. Albany co. September and October. Rare.

When moist the pileus has a peculiar radiate appearance as if distinctly striate. Large plants often have the margin of the pileus uneven or wavy and widely sulcate and irregularly striate. A mass of sand usually adheres to the base of the stem. This species is apparently closely related to the European Psilocybe ammophila Mont. from which it may be separated by its hygrophanous pileus which is commonly depressed in the center, rarely umbonate and constantly coarsely striate or sulcately striate both when moist and when dry. Its lamellae also differ, if we may rely upon the descriptions of the lamellae of that species, in having at first a cinnamon brown color which becomes dark purplish brown with age. They are not made "black pulverulent" by the spores as in P ammophila Mont. For these reasons it seems to me far better to consider our plant distinct from the European species.

Psilocybe atomatoides Pk.

ATOMATE PSILOCYBE

N. Y. State Mus. Rep't 29, p.41

Pileus thin, fragile, convex or subcampanulate becoming nearly plane, rugosely wrinkled, atomate, slightly and evanescently white floccose, slightly hygrophanous, grayish or ochraceous brown, sometimes with a pinkish tint, flesh cinereous; lamellae moderately broad, subventricose, rounded behind, adnexed, cinereous becoming dark brown; stem equal, hollow, minutely flocculent when young, pruinose at the top, whitish; spores blackish brown, 7–8 x 4–5 μ.

Pileus 1.6–2.4 mm broad; stem 3–5 cm long, 2 mm thick.

Ground and decaying wood under pine trees. Albany co. June and July. Rare.

In wet weather the pileus has a moist brownish appearance, but its moisture escapes quickly. The spore print on white paper is almost black, but the spores are much smaller than those of Psathyrella atomata Fr. It also approaches Hypholoma incertum Pk. in general appearance but differs in the color and character of the lamellae.

Psilocybe conissans Pk.

DUSTY PSILOCYBE

N. Y. State Mus. Bul. 122, p.131

N. Y. State Mus. Rep't 41, p.64; 42, p.45 as Clitopilus conissans Pk.

Pileus fleshy but thin, broadly convex becoming nearly plane, glabrous, hygrophanous, pale chestnut or ferruginous and striatulate on the margin when moist, pale alutaceous or pale buff and sometimes slightly rugose when dry, flesh whitish; lamellae thin, close, rounded behind, adnexed or rarely adnate, bay verging to dark purple or liver color; stem equal, rather slender, firm, glabrous, hollow, curved or flexuous, white, veil none; spores red or vinaceous, 8–10 x 4–5 μ.

Pileus 2.5–5 cm broad; stem 2.5–5 cm long, 2–4 mm thick.

Cespitose. On or about the base of deciduous trees. Ulster, Essex and Saratoga counties. September and October. Not common.

Remarkable for and easily distinguished from all other species of this genus by the color of the spores. By reason of their color the species was formerly referred to the genus Clitopilus. But their color is darker than pink and paler than purplish brown. Its other characters indicate Psilocybe as its proper genus.

Psilocybe squalidella Pk.

SQUALID PSILOCYBE

N. Y. State Mus. Rep't 29, p.40 as Agaricus (Hypholoma) squalidellus Pk.

Pileus thin, convex, subconic or subcampanulate, expanded when old, glabrous, hygrophanous, dark ochraceous and striatulate on the margin when moist, pale ochraceous or yellow when dry, spore stained and squalid when old; lamellae broad, subdistant, rounded behind, adnexed, whitish becoming purplish brown with a whitish edge; stem slender, stuffed, fibrous, subflexuous, reddish brown; spores 9–12 x 5–8 μ.

Pileus 1.2–2.4 cm broad; stem 2.5–5 cm long, 2–2.5 mm thick.

Gregarious or cespitose. Damp ground in woods. Adirondack mountains. September. Very variable. Rare except in the Adirondack region.

Var. umbonata Pk. has the pileus umbonate.

Var. macrospora Pk. has spores 12–15 x 6–8 μ.

Var. deformata Pk. has the pileus very irregular with the margin upcurved and the lamellae very broad, ventricose and irregular; spores 12–15 x 6–8 μ.

Perhaps the last two may be worthy of specific distinction. An unattractive species with the pileus often stained and defiled by the spores lodging on it.

Psilocybe polycephala (Paul.)

MANY CAP PSILOCYBE

Plate 127, fig.1–9

Pileus fleshy but thin, subcampanulate convex or nearly plane, glabrous, even, hygrophanous, at first whitish with a reddish yellow center, then darker or brown and striatulate on the margin while moist, paler or whitish when dry, taste mild; lamellae thin, narrow, close, adnexed or nearly free, whitish becoming purplish brown; stem equal, straight or flexuous, hollow, glabrous, mealy or pruinose at the top, white; spores purplish brown, ellipsoid, 7–8 x 4–5 μ.

Pileus 1–3 cm broad; stem 2.5–5 cm long, 2–4 mm thick.

Densely gregarious or cespitose. In woods on the ground about the base of trees or on dead wood. Lewis co. September. Rare. Edible.

This is commonly considered a variety of Psilocybe spadicea Fr. but it has seemed to us to be worthy of specific distinction. Its distinctive features have been mentioned in another place in this report.

Psilocybe foenisecii (Pers.) Fr.

HAYMAKERS PSILOCYBE MOWERS MUSHROOM

N. Y. State Mus. Bul. 75, p.33, pl.86, fig.1–11

Pileus thin, campanulate or convex, obtuse, glabrous, hygrophanous, brown or reddish brown when moist, paler when dry; lamellae broad, ventricose, adnate, subdistant, brown; stem slender, nearly straight, rigid, fragile, hollow, glabrous, pruinose at the top, pallid or rufescent; spores brown, ovoid or unequally ellipsoid, obscurely and bluntly apiculate at one end, 12–16 x 8–10 μ (10–12 x 6–7 μ in Sylloge).

Pileus 1.2–2.4 cm broad; stem 5–7 cm long, 1.5–2 mm thick.

Gregarious. Lawns and rich soil in grassy places. Albany co. May and June. Edible.

The spores in our plant are a little larger than the dimensions attributed to those of the European plant, but we have not considered this difference of sufficient weight to justify the separation of our plant as a distinct species. Sometimes the moist pileus shows striatulations on the margin but this character is not constant. The moisture escapes from the center of the pileus sooner than from the margin. This is according to the usual habit of hygrophanous species.

Psilocybe phyllogena Pk.

LEAF PSILOCYBE

N. Y. State Mus. Rep't 26, p.60 as Agaricus (Hypholoma) phyllogenus Pk.

Pileus thin, firm, convex, sometimes slightly umbonate, hygrophanous, reddish brown when moist, alutaceous when dry; lamellae plane, broad, close, brown, white on the margin; stem equal, fibrillose, stuffed or hollow, brownish, expanding at the base into a thin flat disk which adheres closely to the leaf on which it grows; spores pa'e brown, subglobose, 6–8 μ in diameter.

Pileus 4–8 mm broad; stem 1.5–2.5 cm long, 1–2 mm thick.

Fallen leaves in woods. Otsego co. July.

One of our smallest species. Because of the absence of a veil it belongs to the genus Psilocybe rather than to Hypholoma to which it was originally referred. The closely related Hypholoma modestum Pk. is probably only a form of this species, from which it differs slightly in its larger size, its grayish young lamellae and its inhabiting sticks and twigs instead of leaves. It may be designated Psilocybe phyllogena modesta Pk.

Psilocybe castanella Pk.

CHESTNUT PSILOCYBE

N. Y. State Mus. Bul. 2, p.7

Pileus thin, convex or subconic becoming plane or slightly depressed in the center, glabrous, hygrophanous, chestnut or umber brown and striatulate on the margin when moist, pale alutaceous when dry, flesh paler than the surface of the pileus; lamellae close, adnate or slightly rounded behind, pale brown becoming purplish brown; stem equal, flexuous, hollow or stuffed with a whitish pith, slightly silky fibrillose, brownish or subrufescent with a white mycelium at the base; spores ellipsoid, purplish brown, 8–10 x 4–5 μ.

Pileus 8–16 mm broad; stem 2.5–5 cm long, 1–2 mm thick.

Gregarious or subcespitose. Grassy ground by roadsides. Rensselaer co. June. Rare.

In drying, the moisture first disappears from the center of the pileus. The young pileus and its margin, as well as the stem, are sometimes adorned with a few white fibrils.

Psilocybe spadicea Fr.

BAY PSILOCYBE

Sylloge V, p.1052

Pileus fleshy, rigid, convex becoming nearly plane, obtuse, scabrous, even, hygrophanous, bay or bay brown when moist, pallid when dry; lamellae close, rounded behind, adnexed, dry, whitish becoming pinkish brown; stem equal, rather tough, glabrous, hollow, even at the top, whitish; spores brown, 8–9 x 4–5 μ.

Pileus 2.5–6 cm broad; stem 5–8 cm long, 4–6 mm thick.

Commonly cespitose. Ground in woods, among fallen leaves or on and about the base of trees. Cattaraugus co. September.

Psilocybe fuscofolia n. sp.

BROWN GILL PSILOCYBE

Pileus fleshy, thin, conic or hemispheric, becoming convex plane or centrally depressed, glabrous, even on the margin, hygrophanous, alutaceous when moist, subochraceous and rugose when dry, flesh whitish or yellowish; lamellae narrow, thin, close, adnate, sometimes forked, pale brown becoming reddish brown; stem equal, slender, hollow, silky fibrillose, white, thickened or subbulbous at the base, there covered with a white mycelioid tomentum; spores brown, ellipsoid, 6–8 x 3–4 μ.

Pileus 2.5–5 cm broad; stem 2.5–4 cm long, 2–4 mm thick.

Solitary, gregarious or cespitose. On or about stumps, on the ground, decaying wood and in crevices of rocks in woods or in open places. New York and Richmond counties. October and November. Common.

This species is well marked by having its pileus rugose when dry and its lamellae brown from the first. Its somewhat bulbous stem, firmly attached to its place of growth by its white basal tomentum is also a noticeable character. Its brown spores, the incurved margin of the pileus and the entire absence of a veil plainly indicate the genus to which this peculiar species belongs.

Psilocybe nigrella Pk.

BLACKISH PSILOCYBE

N. Y. State Mus. Bul. 139, p.28, pl.111, fig.7–11

Pileus thin, broadly convex becoming nearly plane, slightly umbonate, hygrophanous, seal brown, shining and even or obscurely striate on the margin when moist, raw umber or mummy brown when dry; lamellae thin, rather close, rounded behind, adnexed, purplish brown or seal brown, whitish on the edge; stem firm, rigid, equal, stuffed with a slender white pith, silky fibrillose, whitish; spores dark purplish brown, almost black, ellipsoid, 10–12 x 6–8 μ.

Pileus 2.5–4 cm broad; stem 3.5–7 cm long, 2.4 mm thick.

Scattered or gregarious. Damp mossy ground in swamps. Albany co. October. Rare. Found but once.

Psilocybe limicola Pk.

MUD PSILOCYBE

N. Y. State Mus. Rep't 24, p.70, pl.2, fig.9–13

Pileus thin, convex becoming nearly plane, glabrous, hygrophanous, dark brown and striatulate on the margin when moist, pale ochraceous brown and rugosely wrinkled when dry; lamellae close, rounded behind, adnexed, cinnamon brown, darker when old; stem slender, equal, brittle, silky, hollow above, stuffed with a pith below, whitish; spores ellipsoid, 10–12 x 6–8 μ.

Pileus 1.2–5 cm broad; stem 3–8 cm long, 1.5–3 mm thick.

Gregarious or cespitose. Damp muck soil in woods. Lewis and Franklin counties. September.

Psilocybe fuscofulva Pk.

TAWNY BROWN PSILOCYBE

N. Y. State Mus. Bul. 2, p.7

Pileus thin, convex or subcampanulate, subumbonate, glabrous, hygrophanous, dark brown and striatulate on the margin when moist, subochraceous when dry; lamellae rather broad, moderately close, adnate, subventricose, purplish brown; stem slender, flexuous, stuffed, slightly silky, reddish brown; spores purplish brown, 10–12 x 6–8 μ.

Pileus 1.2–2.5 cm broad; stem 3–5 cm long, 2–4 mm thick.

Solitary or scattered. In sphagnum. Albany co. October. Rare.

Psilocybe camptopoda Pk.

BENT STEM PSILOCYBE

N. Y. State Mus. Rep't 31, p.35

Pileus thin, broadly convex, glabrous, hygrophanous, brown and striatulate on the margin when moist, whitish when dry; lamellae narrow, close, adnate, whitish becoming brown; stem equal, curved or flexuous, solid, slightly pruinose or mealy at the top, with a white strigose mycelium at the base; spores 6 x 4 μ.

Pileus 5–20 mm broad; stem about 2.5 cm long, 1 mm thick.

Gregarious or solitary. On decorticated decaying prostrate trunks of trees in woods. Albany, Ulster and Wayne counties. September and October.

This is one of our smallest species.

Psilocybe unicolor Pk.

ONE-COLORED PSILOCYBE

N. Y. State Mus. Rep't 53, p.845

Pileus thin, broadly convex, hygrophanous, brown and striatulate on the margin when moist, even and pale brown or whitish when dry, flesh white, taste slightly disagreeable; lamellae narrow, thin, close, adnexed, brownish, becoming darker brown; stem short, straight or curved, equal, glabrous, stuffed or hollow, brownish, paler than the pileus; spores 6 x 4 μ.

Pileus 12–20 mm broad; stem 16–24 mm long, 2 mm thick.

Decaying prostrate mossy trunks in woods. Wayne co. October.

Growing in the same locality as Psilocybe camptopoda Pk. and closely related to it, but separated from it by its adnexed and darker colored lamellae and by its hollow, glabrous stem without a white strigose mycelium at the base.

Psilocybe senex Pk.

OLD PSILOCYBE

N. Y. State Mus. Rep't 41, p.70

Pileus thin, hemispheric, obtuse, hygrophanous, dark brown and striatulate on the margin when moist, pale cinereous and shining when dry, slightly squamulose with superficial subfasciculate whitish fibrils, the margin sometimes appearing slightly and fugaciously appendiculate with these fibrils; lamellae broad, subdistant, adnate, grayish or cinereous, becoming brown or blackish brown, white on the edge; stem slender, hollow, fragile, floccosely pruinose, white; spores brown, 8 x 5 μ.

Pileus 1.2–2 cm broad; stem 3–7 cm long, 2 mm thick.

Decaying wood in woods. Ulster co. September. Rare.

The superficial fibrillose and evanescent squamules of the pileus are similar to those on the pileus of Psilocybe canofaciens Cke. but the white stem of our plant at once distinguishes it from that species. The specific name has reference to the white fibrils of the pileus which suggest the white hairs of old age.

Psilocybe semilanceata Fr.

LIBERTY CAP PSILOCYBE

Sylloge V, p.1051

Pileus thin, acutely conic or convex, obtuse or sometimes umbonate or cuspidate, viscid and striatulate on the margin when moist, pale yellow or pallid when dry, the margin incurved; lamellae subdistant, adnate, brown becoming purplish brown; stem equal, tough, stuffed, flexuous, shining, whitish or pallid; spores 12–16 x 8–10 μ.

Pileus 1.2–2 cm broad; stem 5–7 cm long, 2–3 mm thick.

Gregarious. Pastures and rich grassy places. Autumn. Albany co. Rare.

Very variable in the shape of the pileus, ranging from acutely conic to broadly convex and from obtuse to almost cuspidate. It is classed as poisonous by M. C. Cooke.

Psilocybe clivensis B. & Br.

HILLY PSILOCYBE

Sylloge V, p.1055

Pileus thin, convex or hemispheric, even, atomate, pale brown or pale ochraceous, rarely almost white, striate on the margin; lamellae widely sinuate, adnexed, subdistant, brown; stem equal, hollow, silky above, white or whitish; spores 8–10 x 4–5 μ.

Pileus 1–2 cm broad; stem 3–7 cm long, 1.5–2 mm thick.

On the ground or on decaying wood lying on the ground. Ulster co. September. Rare. Found but once.

Psilocybe limophila Pk.

MUD-LOVING PSILOCYBE

N. Y. State Mus. Rep't 30, p.42

Pileus thin, convex becoming nearly plane, fragile, atomaceous, radiately rugulose, whitish, often splitting on the margin, sometimes areolately cracking; lamellae rather broad, subdistant, whitish becoming purplish brown; stem equal, striate and slightly mealy at the top, hollow, short, white; spores 10–12 x 5–6 μ.

Pileus 1.4–2.5 cm broad; stem 2–2.5 cm long, 1.5–2 mm thick.

Muddy alluvial soil under willows. Albany co. September. Rare.

Similar to Hypholoma incertum Pk. in color, but it differs in the absence of a veil and of the hygrophanous character of the pileus, the more distant lamellae and the larger spores.

Psilocybe dichroa (Pers.) Karst.

TWO-COLORED PSILOCYBE

Sylloge V, p.1045

Pileus thin, fleshy, conic or campanulate becoming convex, subumbonate, glabrous, subviscid, subshining, striatulate on the margin, brown or bay brown, subalutaceous in dry weather; lamellae broad, subclose, adnexed, ventricose, pallid, then purplish brown, whitish on the edge; stem equal or slightly thickened downward, hollow, silky, pallid becoming brownish; spores 10 x 5 μ.

Pileus 2.5–3.5 cm broad; stem 5–7 cm long, 2–4 mm thick.

Marshes and wet places. Albany co. October. Rare. Found but once.

Psilocybe elongatipes Pk.

LONG STEM PSILOCYBE

N. Y. State Mus. Rep't 29, p.40

Pileus thin, convex becoming nearly plane, glabrous, moist, yellow; lamellae broad, subdistant, ventricose, yellowish becoming brown, usually whitish on the edge; stem elongated, fragile, flexuous, stuffed or hollow, slightly silky fibrillose, pallid or reddish; spores ellipsoid, 10–12 x 6–8 μ.

Pileus 1.2–2.5 cm broad; stem 7–12 cm long, 1.5–2 mm thick.

Gregarious. Among sphagnum in marshes and wet places. Lewis co. September. Rare.

A sterile form sometimes occurs in which the lamellae are persistently pale or yellowish. In young plants slight vestiges of a veil sometimes are visible.

Psilocybe uda (Pers.) Fr.

MOIST PSILOCYBE

Sylloge V, p.1045

Pileus fleshy, thin, convex becoming plane, rugulose when dry, tawny bay becoming yellowish; lamellae subdistant, adnexed, ventricose, whitish becoming purplish brown; stem equal, elongated, thin, tough, fibrillose, hollow, straight or slightly wavy, pale above, ferruginous below; spores purplish brown, 16–20 x 7–9 μ.

Pileus 2–3 cm broad; stem 5–8 cm long, 2–3 mm thick.

Gregarious. In swamps among sphagnum and other mosses. Albany and Oswego counties. September and October.

The spore dimensions here given are taken from American specimens and agree with those given in Sylloge. Some English authors give much smaller dimensions, 10 x 5 μ.

Var. elongata (Pers.) Sacc. has the pileus striate on the margin when moist, even when dry. The color of the moist pileus is livid or greenish yellow, of the dry pileus pale yellowish. Gregarious. Among sphagnum. July to September. Albany and Fulton counties.

Psilocybe cernua Vahl has been reported but its identity is not well established and it is therefore omitted.

LATIN DESCRIPTIONS OF NEW SPECIES AND VARIETIES

Agaricus campester majusculus

Pileus carnosus, firmus, convexus vel subplanus, margine fibrillosus squamosusve, disco levis, lamellas excedens, umbrinus, carne alba, leviter tardeque rufescente caesa, sapore miti, dulce; lamellae tenues, confertae, liberae, incarnatae, demum atrobrunneae; stipes validus, aequalis, farctus, fibrillosus, albus, annulo albo; sporae late ellipsoideae, 7–9 x 6–7 μ.

Pileus 6–15 cm latus; stipes 2.5–7 cm longus, 1–2 cm crassus.

Ascochyta imperfecta

Maculae variabiles, 4–12 mm latae, amphigenae, orbiculares semiorbiculares subtriangularesve, majores vulgo terminales vel marginales, pallide brunneae vel fumosobrunneae, indefinite limitatae; perithecia pauca, amphigena, depressa, .3–.6 mm lata, brunnea vel nigrobrunnea; sporae variabiles, continuae vel pseudouniseptatae, oblongae subcylindraceaeve, utrinque obtusae, aliquando ad septum constrictae, hyalinae, 6–15 x 2.5–4 μ.

Boletus albidipes

Pileus carnosus, convexus deinde late convexus subplanusve, viscidus vel glutinosus, juvenis flavidoalbus, deinde subochraceus obscureque maculatus, carne alba; tubuli plani, adnati, albidi, deinde lutei, tandem subochracei, dissepimentis nudis vel glandularibus punctis paucis; stipes brevis, aequalis, solidus, albus, nudus vel punctis glandularibus paucis ad apicem; sporae 8–10 x 3–4 μ.

Pileus 5–8 cm latus; stipes 2.5–5 cm longus, 8–12 mm crassus.

Boletus ballouii

Pileus carnosus, firmus, saepe irregularis, convexus, subplanus vel in centro leviter depressus, siccus, impolitus vel minute tomentosus, primus aurantiacus, deinde brunneo-aurantiacus, brunneus vel subcinnamomeus, carne alba, sapore miti; tubuli albi albidive, deinde brunnescentes vel brunnei, ubi contusi fumoso brunnei, adnexi subdecurrentesve; stipes variabilis, solidus, farinosus vel minute furfuraceus, ad apicem striatus subreticulatusve, luteus aurantiacusve, saepe albidus in parte supera; sporae 8–10 x 4–5 μ.

Pileus 5–12 cm latus; stipes 2.5–12 cm longus, 7–15 mm crassus.

Camarosporium maclurae

Perithecia gregaria, .3 mm lata, in cortice nidulantia, erumpentia, conica vel subglobosa, vix papillata, atra; sporae primum continuae, hyalinae, deinde fuscae, 3–5-septatae, muriformes, saepe leviter curvatae, 15–20 x 8–10 μ.

In ramis emortuis M a c l u r a e p o m i f e r a e (Raf.) Schneid.

Cercospora eustomae

Maculae suborbiculares, definitae, griseae vel griseobrunneae, linea angusta cinctae; hyphae caespitosae, in maculis dense aggregatae vel areas magnas foliorum vivorum occupantes, continuae seu septatae, irregulares et ad apicem nodulosae, 30–60 x 4–6 μ; sporae variabillissimae, rectae curvae flexuosaeve, oblongae vel subcylindraceae, irregulares, continuae vel obscure 1–2-septatae, subhyalinae, 20–60 x 4–6 μ.

Foliis vivis E u s t o m a e a n d r e w s i i A. Nels. et E. r u s s e l l i a n i (L.) Griseb.

Cercospora pastinaceae n. comb.

(C e r c o s p o r a a p i i p a s t i n a c e a e Sacc.)

Maculae parvae, inconspicuae, amphigenae, flavidovirides vel brunneae, venulis limitatae; hyphae hypophyllae, aseptatae, ad apicem nodulosae, pallidobrunneae, 40–60 x 6–8 μ; sporae oblongae vel cylindraceae, rectae vel curvae, ad apicem rare angustatae, 1–3-septatae, 25–85 x 6–8 μ, uniseptatae sporae loculo superiore angustiore.

In foliis vivis P a s t i n a c a e s a t i v a e L.

Cercosporella mirabilis

Maculae angulares, irregulares, 2–10 mm latae, interdum confluentes, primum lutescentes vel pallidae, deinde brunneorufescentes; hyphae longae, repentes, ramosae, intertextae vel breves, simplices et erectae, hypophyllae, hyalinae; sporae cylindraceae vel gradatim ad apicem angustatae, plurinucleatae, interdum 1–3-septatae, curvae vel flexuosae, ad apicem rare hamatae, hyalinae, 40–120 x 3–5 μ.

In foliis vivis C r a t a e g i r i v u l a r i s Nutt.

Cercosporella terminalis

Maculae anguste oblongae, 1–3 cm longae, 3–5 mm latae, saepe confluentes et ad apicem omnino folium discolorantes, brunneae vel nigrobrunneae saepe steriles; caespites effusi, areas lineares flocculentes candidas formantes; sporae variabiles, curvae flexuosaeve, subcylindraceae vel ad apicem attenuatae, continuae vel 1–3-septatae, saepe nucleatae, 50–150 x 3–5 μ.

In foliis vivis Veratri viridis Ait.

Clitocybe fumosa brevipes

Stipes brevis, 1.2–2.5 cm longus, 1–2 cm crassus.

Clitocybe sinopicoides

Pileus tenuis, convexus, margine deflexus, umbilicatus, in centro floccososquamulosus, margine obscure fibrillosus, firmus, fulvorufus vel lateritius, carne alba, sapore odoreque farinaceis; lamellae subconfertae, arcuatae, decurrentes, albae, venis leviter connexae; stipes aequalis, glaber vel subfloccosus, solidus vel farctus, sublateritius; sporae 6–8 x 3–4 μ.

Pileus 2–4 cm latus; stipes 2–4 cm longus, 2–4 mm crassus.

Inter muscos in locis uliginosis.

Clitocybe sudorifica

Pileus carnosus, tenuis, late convexus vel subplanus, saepe in centre depressus vel umbilicatus, irregularis vel in margine in lobos fissus, glaber, siccus, albidus vel griseo albus, carne alba, sapore miti; lamellae tenues, angustae, confertae, adnatae vel leviter decurrentes, albidae; stipes vulgo brevis, aequalis vel basi attenuatus, glaber pruinosusve, farctus vel cavus, interdum curvus, albus albidusve; sporae subglobosae, 4–5 x 3–4 μ.

Pileus 2–4 cm latus; stipes 1–3 cm longus, 2–4 mm crassus.

In locis gramineis.

Cortinarius albidipes

Pileus carnosus, compactus, hemisphaeric deinde late convexus, obtusus vel subumbonatus, viscidus, glaber, nitidus, luteolus, carne alba, sapore miti; lamellae 4–6 mm latae, subconfertae, pallide violaceae, demum cinnamomeae; stipes vulgo sursum attenuatus, basi incrassatus vel bulbosus, firmus, solidus, sericeo fibrillosus, albus; sporae subglobosus, 8–10 x 7–9 μ.

Pileus 5–10 cm latus; stipes 5–8 cm longus, 1–1.5 cm crassus.

Cortinarius phyllophilus

Pileus carnosus, crassus, compactus, convexus subplanusve, viscidus, subnitidus, leviter innate fibrillosus, pallide fulvo ochraceus, carne alba, sapore miti; lamellae tenues, confertae, acie erosae, luteae, deinde brunneo cinnamomeae; stipes brevis, validus, firmus, abrupte bulbosus, sericeo fibrillosus, albidus, basi subferruginosus; sporae utrinque subacutae, 10–12 x 5–6 μ.

Pileus 7–12 cm latus; stipes 3–5 cm longus, 1–1.5 cm crassus.

Coryneum sorbi

Acervuli numerosi, discoidei, erumpentes, orbiculares vel ellipsoidei, .5–1 mm lati, nigri; sporae oblongae vel oblongo ovoideae, triseptatae, saepe irregulares, fuscae, 12–20 x 8–9 μ; sporophores brevissimi vel obsoleti.

In ramulis emortuis Sorbi californicae Greene.

Dasyscypha sulphuricolor

Cupulae sulphureae, gregariae subcaespitosaeve, subsessiles, 1–3 mm latae, minute villosae; hymenium planum vel convexum, cupulae margine incurvo cinctum; asci subcylindracei, 70–80 x 3–4 μ; sporae oblongae vel subfusiformae, 10–12 x 2–3 μ; paraphyses filiformes.

In ligno emortuo Fraxini nigri Marsh.

Dermatea mori

Ascomata orbicularia ellipsoidea vel leviter irregularia, 1–2 mm lata, late convexa vel discoidea, erumpentia, epidermide rupta cincta, nigra vel brunneo nigra; asci cylindracei vel subclavati, 60–90 x 20–25 μ; sporae oblongae vel subcylindraceae, subdistichae, continuae, hyalinae, 20–30 x 8–10 μ.

In ramulis emortuis Mori albae tataricae Loud.

Diaporthe inornata

Pustulae valsoideae, 1–1.5 mm latae, in cortice interiore nidulantes; perithecia .3 mm lata, 4–14 in caespite, nigra, cum linea nulla circumscripta, ostiola longa, conferta discum perforantia et obliterantia, erumpentia, epidermide rupta cincta; asci subfusiformes, 60–80 x 8–10 μ; sporae conferta, oblongae vel subfusiformes, utrinque seta breve auctae, ad septum constrictae, 2–4-nucleatae, 15–24 x 3–4 μ.

In ramis emortuis Rhois typhinae L.

Diplodia polygonicola

Perithecia minuta, abundantia, dense gregaria, areas longas in stipitibus occupantia, erumpentia, atra; sporae oblongae vel subellipsoideae, primum hyalinae, deinde fuscae, postremo uniseptatae, 14–16 x 8–9 μ.

In stipitibus emortuis Polygoni lapathifolii L.

Entoloma subtruncatum

Pileus tenuis, subconicus, glaber, hygrophanus, humidus pallide ochraceus et margine striatulus, siccus pallidior et subnitidus, subtruncatus, subumbonatus vel leviter depressus, margine involutus; lamellae tenues, latae, adnexae, subconfertae, inaequales, albidae, demum pallide incarnatae; stipes gracilis, aequalis vel sursum leviter attenuatus, cavus, sericeo fibrillosus, flavus, basi albido tomentosus; sporae angulares, basi apiculatae, 12–14 x 8–10 μ.

Pileus 2–3 cm latus; stipes 3–8 cm longus, 2–5 mm crassus.

Flammula sulphurea

Pileus carnosus, subconicus vel convexus, deinde late convexus, glaber, viscidus, hygrophanus, humidus luteus, siccus sulphureus, interdum in margine squamis albidis fibrillosis ornatus, carne alba, sapore odoreque ingratis; lamellae tenues, confertae, arcuatae, adnatae margine crenulatae, albidae deinde ferruginosae; stipes aequalis, flexuosus, fibrillosus vel squamulosus, farctus vel cavus, ad apicem flavidus et nudus, deorsum ferrugineus; sporae fusco ferrugineae, 8–11 x 5–6 μ.

Pileus 2–6 cm latus; stipes 3–6 cm longus, 4–8 mm crassus.

In pomariis et sub Pyro malo L.

Gloeosporium psoraleae

Acervuli minuti, maculas orbiculares brunneas vel nigrescentes brunneas occupantes, .25–.75 mm lati; foliorum pilis infra obscurati; sporae oblongae vel subellipsoideae, rectae vel leviter curvae, hyalinae, 14–20 x 4–5 μ.

In foliis vivis Psoraleae esculentae Pursh.

Graphyllium chloes junci

Sporae ad septa non constrictae; paraphyses obsoleti vel carentes.

In culmis Junci baltici Willd.

Helvella capucinoides

Ascoma tenue, lentum, submembranaceum, vulgo subbilobatum, uno lobo erecto, altero deflexo, margine nudo, libero, involuto, lobo inferiore stipitem circumdante, subter album, rugulosum; hymenium fuliginoso ochraceum, deinde brunneum vel ochraceo brunneum; stipes gracilis, firmus, aequalis, subteres, farctus vel cavus, pruinoso pubescens, candidus; asci cylindracei, 240–280 x 18–20 μ; sporae oblongae vel ellipsoideae, uniseriatae, uninucleatae, hyalinae, 20–28 x 12–16 μ; paraphyses filiformes, apicibus clavatis.

Ascoma .5–2.5 cm latum; stipes 2.5–7 cm longus, 2–4 mm crassus.

In terra in sylvis. A Helvella capucina Quel. in ascomatis forma marginēque nuda differt.

Henningsinia caespitosa

Stromata subclavata, .5–1 cm alta, 3–4 mm lata ad partem superiorem, ad partem inferiorem abrupta augustata, caespitosa, ad apicem obtusa vel subumbonata, atra, interdum nitida; perithecia oblonga, 1 mm longa, in stromatis parte superiore erecta; substantia inferior stromatis albida; asci ovato clavati, 36–40 x 14–16 μ; sporae inordinate confertae, oblongae, continuae, fuscae, 10–12 x 6–7 μ.

In cortice Burserae gummiferae Jacq.

Hygrophorus recurvatus

Pileus carnosus, margine tenuis, convexus, deinde planus vel margine recurvo concavus, saepe margine laceratus, udus griseo brunneus et margine obscure striatulatus, siccus subalutaceus levisque, glaber, interdum centro brunnescens, carne alba; lamellae distantes, subventricosae, venis connexae, decurrentes, albidae; stipes aequalis, fragilis, farctus cavusve, fibrosus, subpruinosus, albus albidusve; sporae late ellipsoideae vel subglobose, 6–8 x 4–6 μ vel 6–7 μ latae.

Pileus 1.2–2.4 cm latus; stipes 2–4 cm longus, 2–4 mm crassus.

Hysterium cubense

Perithecia gregaria vel subcaespitosa, oblonga ellipsoidea recta curva vel rare flexuosa, primum erumpentia, demum superficialia, epidermide dilapsa, levia, 1–2 mm longa, .5 mm lata altaque, atra; asci cylindracei, 160–200 x 15–20 μ; sporae uniseriatae, oblongae ellipsoideaeve, triseptata, fuscae, 30–40 x 12–16 μ.

In ramis emortuis in terra.

Leptonia davisiana

Pileus tenuis, submembranaceus, convexus, deinde planus vel late depressus, fragilis, glaber, centro leviter squamulosus, siccus saepe late striatus, nigrescente brunneus; lamellae tenues, confertae, subventricosae, adnexae, albae, deinde incarnatae et pulverulentae; stipes gracilis, aequalis, glaber, farctus cavusve, pileo in colore similis; sporae angulares, uninucleatae, 10–12 x 8–10 μ.

Pileus 1–2.5 cm latus; stipes 1.5–3 cm longus, 1–2 mm crassus.

In locis gramineis.

Leptostromella scirpina

Perithecia epiphylla vel rare amphigena, suborbicularia vel oblonga, discoidea concavave, subsuperficialia, atra; sporae subbacillares, hyalinae, curvae, continuae, utrinque acutae, 20–25 x 2–3 μ.

In foliis emortuis Scirpi atrovirentis Muhl.

Lysurus borealis serotinus

Pars externa loborum receptaculi alba; lineae candidae ab basi stipitis radiantes, aequales in numero receptaculi lobis, plagasque lineares in superficia interna volvae formantes.

Macrophoma burserae

Perithecia minuta, 100–200 μ lata, epidermide tecta, gregaria vel aggregata et pustulas parvas inaequales leviter prominentes et saepe confluentes formantia, atra, intus alba; sporae ellipsoideae, subhyalinae, 16–20 x 10–12 μ.

In cortice Burserae gummiferae Jacq.

Macrophoma numerosa

Perithecia minuta, .3–.5 mm lata, dense gregaria, membranacea, in cortice nidulantia, erumpentia, atra, intus albida; sporae oblongae fusiformesve, continuae, interdum binucleatae, utrinque acutae, 12–20 x 3–4 μ; sporophores brevissimi vel obsoleti.

In ramulis emortius Robiniae pseudacaciae L.

Morchella conica serotina

Pileus conicus vel irregularis, apice subactus vel late rotundatus, interdum perforatus, saepe sterilis et brunnescens, costis acie albidis; stipes minute squamulosus. Serotina. October et November.

Mycena atroumbonata

Pileus tenuis, submembranaceus, convexus, deinde late convexus subplanusve, umbonatus, late striato plicatus, glaber, subhygrophanus, udus brunneus et nitidus, siccus griseo brunneus, umbone nigro; lamellae tenues, subconfertae, late sinuatae, dente decurrentes, albae, deinde fumoso brunneae; stipes gracilis, glaber, cavus, radicans, basi albo villosus, pileo in colore similis; sporae oblongae vel ellipsoideae, intus granulares, saepe binucleatae, 6–9 x 5–6 μ.

Pileus 1.2–3.2 cm latus; stipes 5–8 cm longus, 1–2 mm crassus.

Solitaria vel gregaria. In truncis prostratis emortuis Tsugae canadensis Carr. in sylvis.

Naucoria arenaria

Pileus tenuis, convexus subplanusve, flavidus vel subaurantiacus margine pallidior; lamellae latae, inaequales, sinuatae, brunneo ferruginosae; stipes gracilis, rigidus, glaber, medulla alba farctus, pileo in colore similis, pseudobulbosus; sporae brunnescente ferruginosae, 15–20 x 10–12 μ.

Pileus .75–2 cm latus; stipes 2–3 cm longus, 1–2 mm crassus.

Ovularia avicularis

Maculae magnae, suborbiculares oblongaeve, brunneo rufae; hyphae amphigenae, erectae, caespites minutos confertos albidos formantes, 25–35 x 3–4 μ; sporae oblongae vel ellipsoideae, continuae, rare infra leviter angustatae, hyalinae, 12–20 x 6–8 μ.

In foliis vivis Polygoni avicularis L.

Paxillus microsporus

Pileus carnosus, tenuis, deinde subplanus, subglaber, albus, demum albidus, interdum in centro brunnescens, udus leviter viscidus, primum margine involutus, demum repandus levisque vel distante striatus, carne alba; lamellae tenues, angustae, confertae, primum adnatae, demum decurrentes, interdum basi furcatae vel leviter anastomosantes, flavescentes, mox lutescente umbrinae; stipes brevis, vulgo deorsum attenuatus, solidus farctusve, pileo in colore similis; sporae brunneo ochraceae, minutae, subglobose, 2–3 μ latae.

Pileus 1–6 cm latus; stipes 1–6 cm longus, 3–8 mm crassus.

Solitarius vel caespitosus. In terra subter Castaneae dentatae (Marsh.) Borkh.

Peniophora tenuissima

Tenuissima, late effusa, indeterminata, adnata, siccitate levis vel leviter rimosa, subpruinosa, albida; sporae ellipsoideae, 8 x 4 μ; cystidia subcylindracea vel conica elongata obtusa, 50–80 x 15–20 μ.

Phacidium lignicola

Perithecia subsuperficialia, circiter 1 mm lata, orbicularia vel late ellipsoidea, prominentia, rugosa, atra, laciniate aperientia, margine 3–5 dentibus ornata; hymenium nigricans; asci clavati, 60–80 x 10–12 μ; sporae confertae vel subdistichae, continuae, rectae vel leviter curvae, oblongae, interdum basi leviter attenuatae, hyalinae, 12–15 x 3.5–4 μ.

In ligno decorticato Populi tremuloidis Mx.

Pholiota rigidipes

Pileus carnosus, subtenuis, firmus, late convexus, leviter et late umbonatus, squamulis hirtis appressis brunnescentibus obscure squamulosus, flavidus vel luteolus, carne alba, sapore miti; lamellae tenues, sublatae, confertae, brunneo ferruginosae; stipes longus, rigidus, gracilis, saepe flexuosus, cavus, obscure fibrilloso squamulosus, infra annulum parvum saepe evanescentem pallidus, ad apicem albus et pruinosus; sporae ellipsoideae, 8–10 x 5–6 μ.

Pileus 5–8 cm latus; stipes 6–8 cm longus, 5–7 mm crassus.

Inter folia dilapsa in sylvis.

Phoma bacteriophila

Perithecia minuta, .2–.3 mm lata, primum epidermide tecta, deinde erumpentia, sparsa vel dense gregaria, interdum conferta et ramulum omnino obtegentia, atra; sporae obovatae vel ellipsoideae, hyalinae, 6–8 x 4–5 μ.

In maculis morbidis truncorum parvorum Pini strobi L. et in ramulis emortuis.

Phoma leprosa

Perithecia .3–.5 mm lata, depressa subglobosave, perforata, incrustatione albida tecta; sporae rectae, cylindraceae, hyalinae, 10–15 x 3–4 μ.

In pomis dilapsis Crataegi punctatae Jacq.

Phoma roystoneae

Perithecia minuta, circiter, .2 mm lata, amphigena, gregaria, abundantia, atra; sporae minutae, oblongae subcylindraceaeve, hyalinae, 5–8 x 1.5–2 μ, sporophoribus brevibus hyalinis suffultae.

In foliis Roystoniae regiae (HBK.) O. F. Cook.

Pluteus alveolatus eccentricus

Stipes brevis, 2.5–3.5 cm longus, 4–6 mm crassus, curvus, eccentricus; sporae pallide incarnatae, interdum luteo incarnatae, globosae vel subglobosae, minute asperae, 6–8 μ latae.

Psilocybe fuscofolia

Pileus carnosus, tenuis, conicus hemisphaericusve, deinde convexus planus vel in centro depressus, glaber, margine levis, hygrophanus, udus alutaceus, siccus subochraceus et rugosus, carne albida flavidave; lamellae tenues, angustae, adnatae, interdum furcatae, pallide brunneae, deinde rubescente brunneae; stipes aequalis, gracilis, cavus, sericeo fibrillosus, albus, basi subbulbosus, albo tomentosus; sporae brunneae, ellipsoideae, 6–8 x 3–4 μ.

Pileus 2.5–5 cm latus; stipes 2.5–4 cm longus, 2–4 mm crassus.

Septoria magnospora

Maculae parvae, 2–3 mm latae, pallidae albidaeve, margine rufo brunneae; perithecia minuta, .2–.25 mm lata, depressa, atra; sporae magnae, late filiformes vel subcylindraceae, curvae, continuae, hyalinae, interdum plurinucleatae, 45–80 x 3–4 μ.

In foliis vivis Pruni fremontii Wats.

Septoria mirabilissima

Perithecia minutissima, .1–.2 mm lata, sparsa, superficialia, atra; sporae filiformes, flexuosae curvaeve, continuae, hyalinae, 40–150 x 1.5–2 μ; sporophores graciles, 20 x 1 μ.

In cortice leviter discolorato et leve Pini strobi L.

Tricholoma equestre albipes

Stipes albus. In alteris typo similis.

Tricholoma planiceps

Pileus carnosus, tenuissimus, late convexus planusve, glaber, griseo brunneus vel flavo brunneus, margine acuto, minutissime albo flocculente, carne alba; lamellae tenues angustae, confertae, leviter sinuatae, albae albidaeve; stipes gracilis, aequalis, farctus cavusve, pileo in colore similis vel pallidior; sporae late ellipsoideae, 7–8 x 5–6 μ.

Pileus 2–5 cm latus; stipes 4–6 cm longus, 4–6 mm crassus.

Sub arboribus Thujae occidentalis L.

Tricholoma subsaponaceum

Pileus carnosus, compactus, flexibilis, convexus subplanusve, glaber, albidus, cremeus vel pallidus, in centro fumoso brunneus vel alutaceus, interdum maculis parvis submarginalibus ornatus, carne alba, fracta tarde lutescente vel crocea, odore grato, aniseo, sapore farinaceo; lamellae latae, confertae, adnexae vel subliberae, albidae; stipes variabilis, aequalis, nunc apice, nunc basi incrassatus, interdum compressus, rare radicans, sericeo fibrillosus, solidus, deinde cavus, albidus; sporae late ellipsoideae vel subglobosae, 5–6 x 4–5 μ.

Pileus 6–14 cm latus; stipes 4–5 cm longus, 1.5–3 cm crassus.

Inter folia dilapsa in sylvis.

Tricholoma subsejunctum

Pileus carnosus, conicus convexusve, saepe irregularis vel margine repandus et lobatus, udus leviter viscidus, subnitidus, fibrilis nigris virgatus vel reticulate virgatus, nigrescente brunneus, vulgo margine flavidus vel virescente luteolus, carne alba, sapore farinaceo; lamellae tenues, confertae, adnexae, albae, saepe anterius lutescentes; stipes validus, aequalis, solidus, albus, interdum lutescens; sporae minutae, 5–6 x 4–5 μ.

Pileus 2.5–7 cm latus; stipes 3–5 cm longus, 6–12 mm crassus.

Inter muscos et folia dilapsa in sylvis.

Tricholoma terraeolens majus

Pileus 2–6 cm latus, vulgo umbonatus, subplanus vel circum umbonem depressus; stipes solidus, 6–10 cm longus, 4–6 mm crassus.

In alteris typo similis.

Vermicularia hysteriiformis

Perithecia ellipsoidea oblongave, .3–.6 mm longa, primum epidermide tecta, demum erumpentia, setosa, atra; setae erectae divergentesve, 50–120 x 4–5 μ, atrae, ad apicem subhyalinae, acutae; sporae oblongae vel subfusiformes, rectae vel leviter curvae, utrinque acutae, continuae, hylinae, 20–25 x 3–4 μ.

In caulibus emortuis Caulophylli thalictroidis (L.) Mx.

EXPLANATION OF PLATES

Plate 124

Tricholoma subsejunctum Pk.

SUBDISJOINED TRICHOLOMA

1 Two young plants
2 Plant with conic cap
3 Plant with convex cap and lobed margin
4 Vertical section of the upper part of a plant
5 Four spores x 400

Tricholoma equestre albipes Pk.

WHITE STEM EQUESTRIAN TRICHOLOMA

6 Plant with convex cap
7 Plant with fully expanded cap
8 Vertical section of the upper part of a plant
9 Four spores x 400

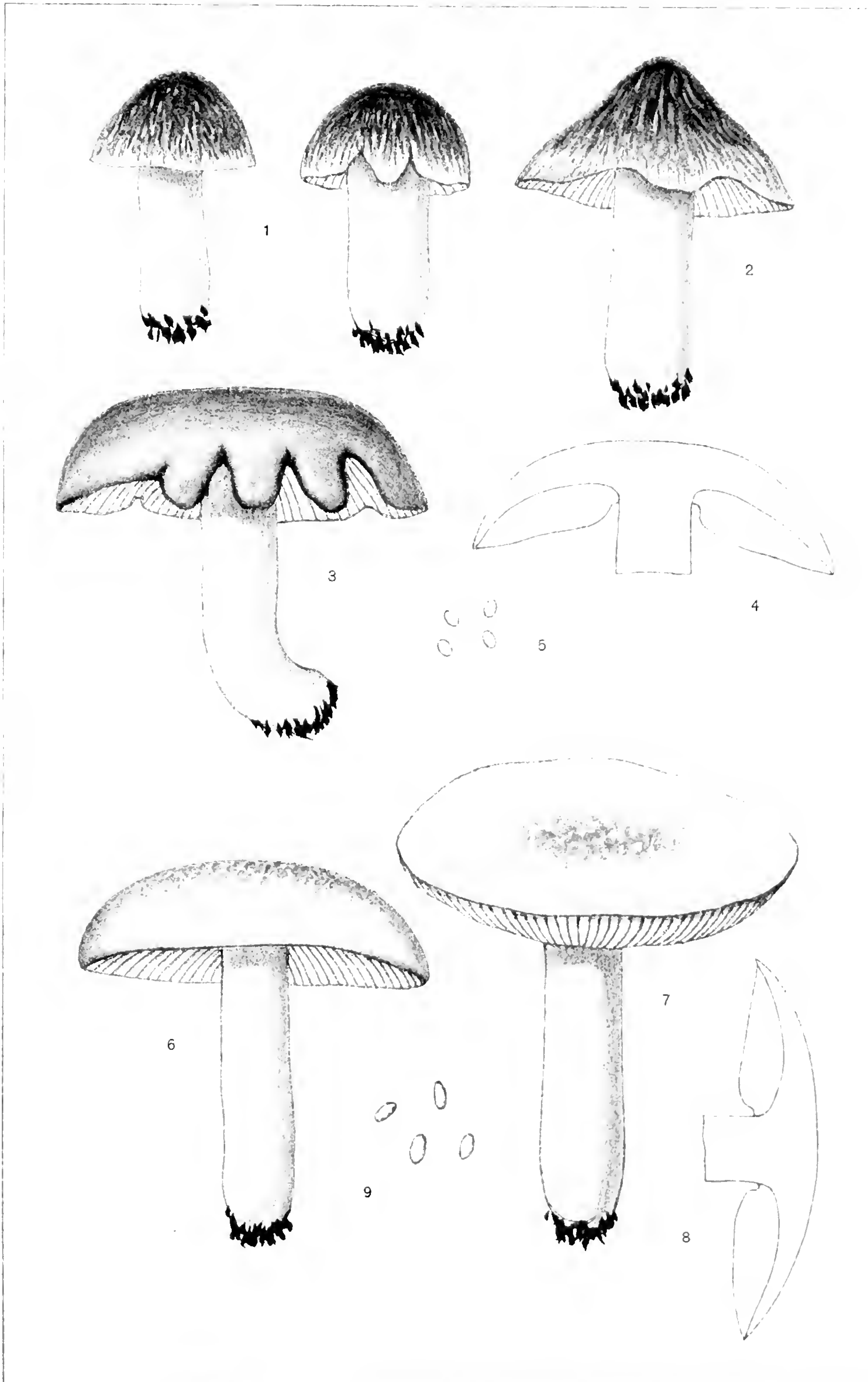


FIG. 1-5
TRICHOLOMA SUBSEJUNCTUM PK.
SUBDISJOINED TRICHOLOMA

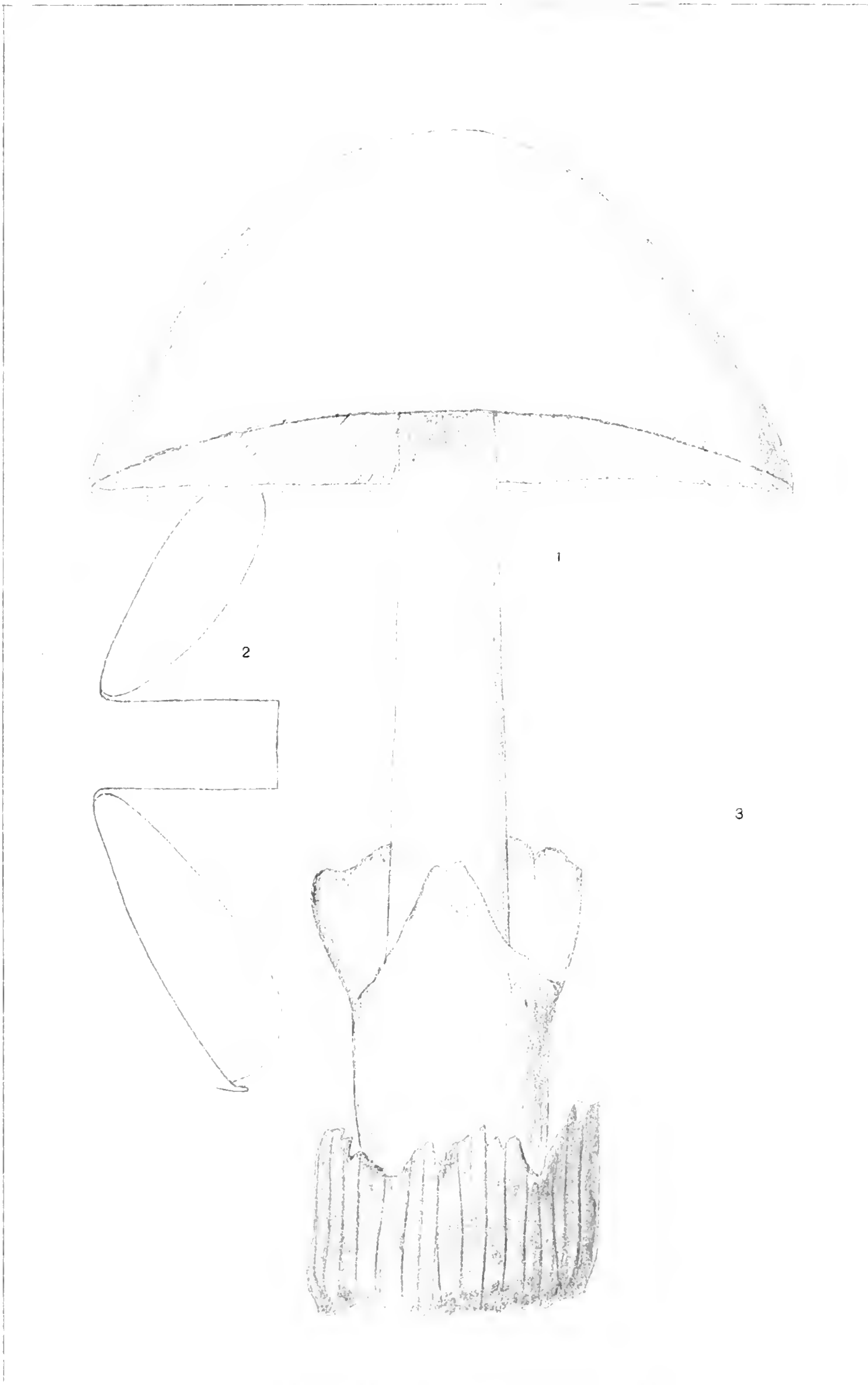
FIG. 6-9
TRICHOLOMA EQUESTRE ALBIPES PK
WHITE STEM EQUESTRIAN TRICHOLOMA

Plate 125

Volvaria bombycina (Pers.) Fr.

SILKY VOLVARIA

1 Plant of medium size with white cap
2 Vertical section of the upper part of a plant
3 Four spores x 400



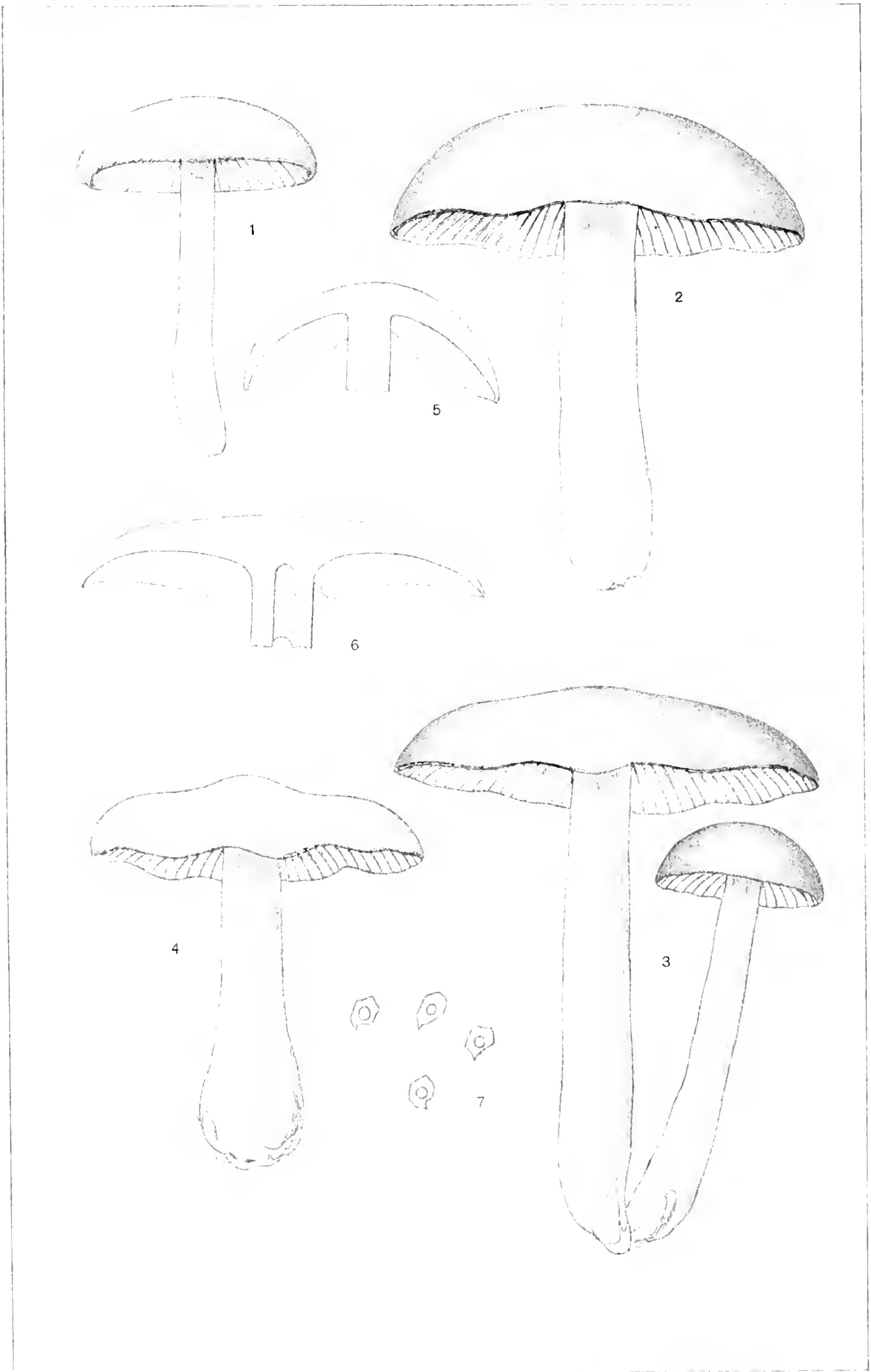
VOLVARIA BOMBYCINA (PERS.) FR.
SILKY VOLVARIA

Plate 126

Entoloma grayanum Pk.

GRAY ENTOLOMA

1 Immature plant
2 Mature plant
3 Mature and immature plants united at the base
4 Whitish plant with broadly umbonate cap
5 Vertical section of the upper part of an immature plant
6 Vertical section of the upper part of a mature plant
7 Four spores x 400



ENTOLOMA GRAYANUM Pk.
GRAY ENTOLOMA

Plate 127

Psilocybe polycephala (Paul.)

MANY CAP PSILOCYBE

1 Cluster of immature plants growing on the ground
2 Two immature plants of larger size
3 Mature moist plant growing on dead wood
4 Mature plant with center of cap free from moisture
5 Mature plant with entire cap free from moisture
6 Vertical section of the upper part of an immature plant
7 Vertical section of the upper part of a mature plant
8 Transverse section of a stem
9 Four spores x 400

Pholiota discolor Pk.

FADING PHOLIOTA

10 A mature and an immature plant united at the base
11 Mature plant after the escape of the moisture from the cap
12 Vertical section of the upper part of an immature plant
13 Vertical section of the upper part of a mature plant
14 Transverse section of a stem
15 Four spores x 400

FIG. 1-9
PSILOCYBE POLYCEPHALA (PAUL.)
MANY CAP PSILOCYBE

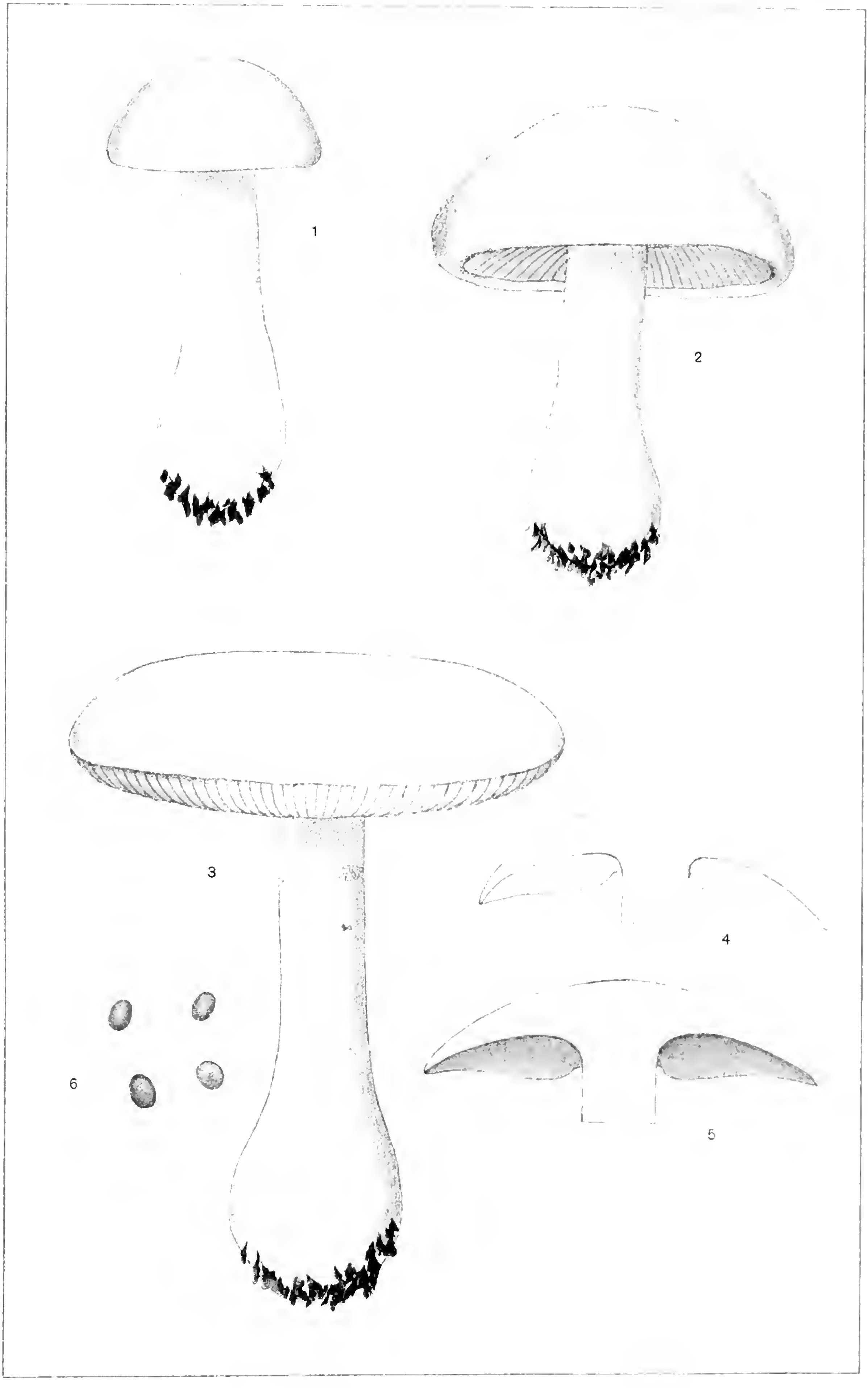
FIG. 10-15
PHOLIOTA DISCOLOR PK.
FADING PHOLIOTA

Plate 128

Cortinarius albidipes Pk.

WHITE STEM CORTINARIUS

1 Immature plant
2 Immature plant showing color of the gills
3 Mature plant
4 Vertical section of the upper part of an immature plant
5 Vertical section of the upper part of a mature plant
6 Four spores x 400



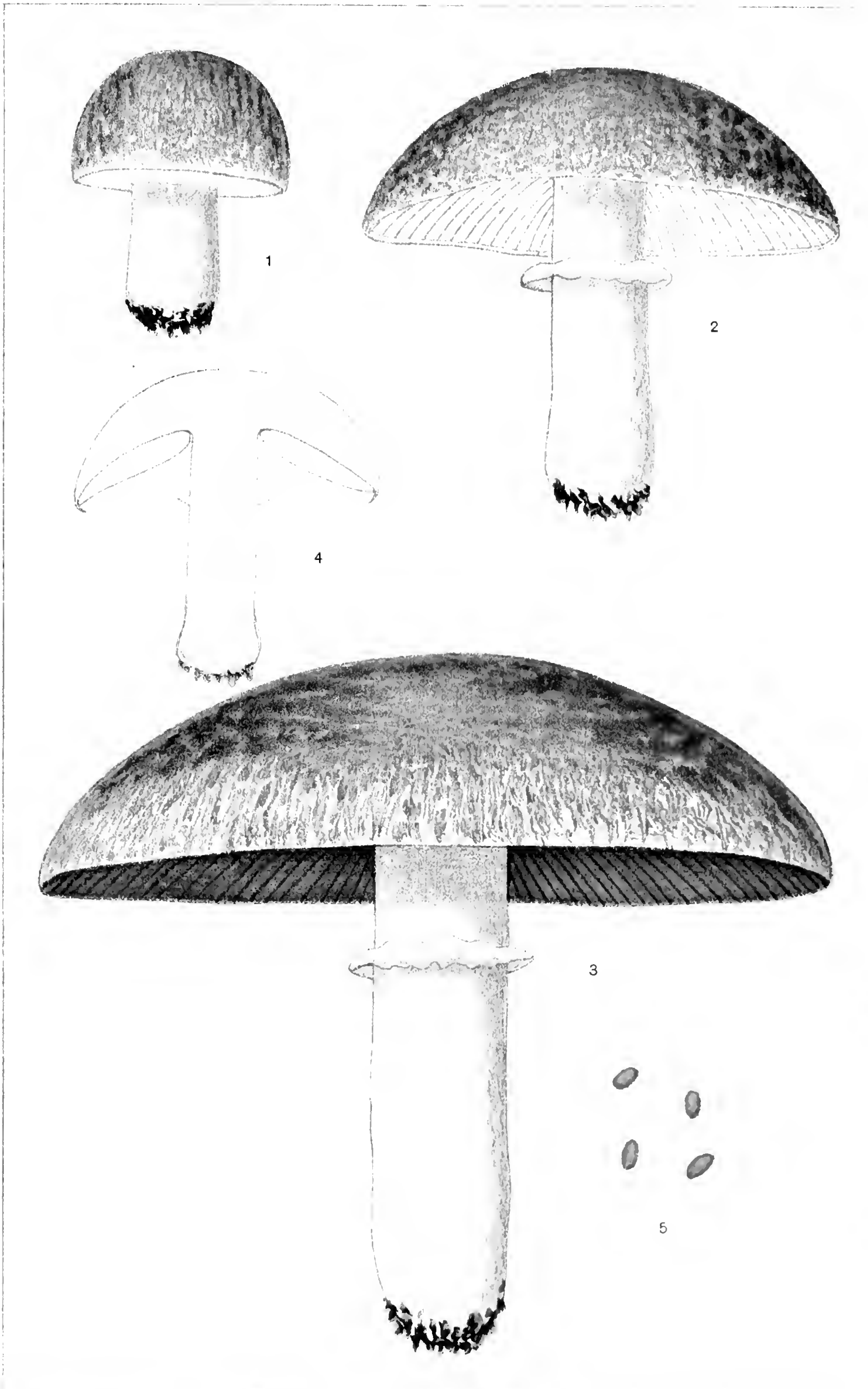
CORTINARIUS ALBIDIPES Pk.
WHITE STEM CORTINARIUS

Plate 129

Agaricus campester majusculus Pk.

LARGER MUSHROOM

1 Young plant or " button " with gills concealed by the white veil
2 Immature plant showing pink color of the gills
3 Mature plant showing blackish brown color of the gills
4 Vertical section of an immature plant
5 Four spores x 400



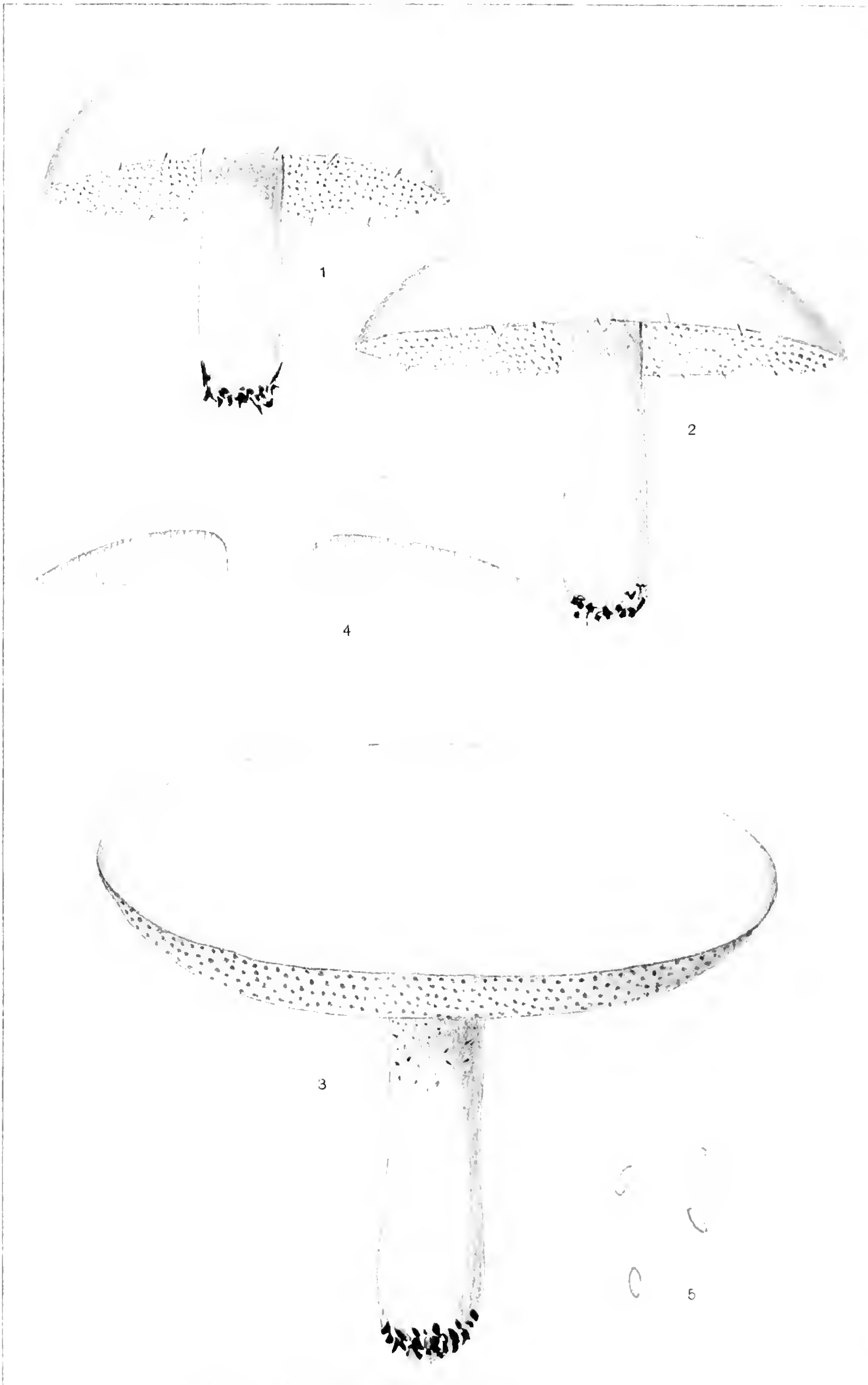
AGARICUS CAMPESTER MAJUSCULUS Pk.
LARGER MUSHROOM

Plate 130

Boletus albidipes Pk.

WHITE STEM BOLETUS

1 Immature plant showing whitish tubes
2 Immature but older plant showing yellowish tubes
3 Mature plant with expanded cap and ochraceous tubes
4 Vertical section of the upper part of a plant
5 Four spores x 400



BOLETUS ALBIDIPES Pk.
WHITE STEM BOLETUS

Plate VII

Clitocybe sudorifica Pk.

SUDORIFIC CLITOCYBE

1 Immature plant with convex cap
2 Mature plant with centrally depressed cap
3 Cluster of plants
4 Mature plant with the margin of the cap lobed
5 Vertical section of the upper part of a plant
6 Four spores x 400

Flammula sulphurea Pk.

SULFUR-COLORED FLAMMULA

7 Immature plant
8 Tuft of plants, two of them showing the color of the mature gills
9 Vertical section of the upper part of an immature plant
10 Vertical section of the upper part of a mature plant
11 Four spores x 400

FUNGI

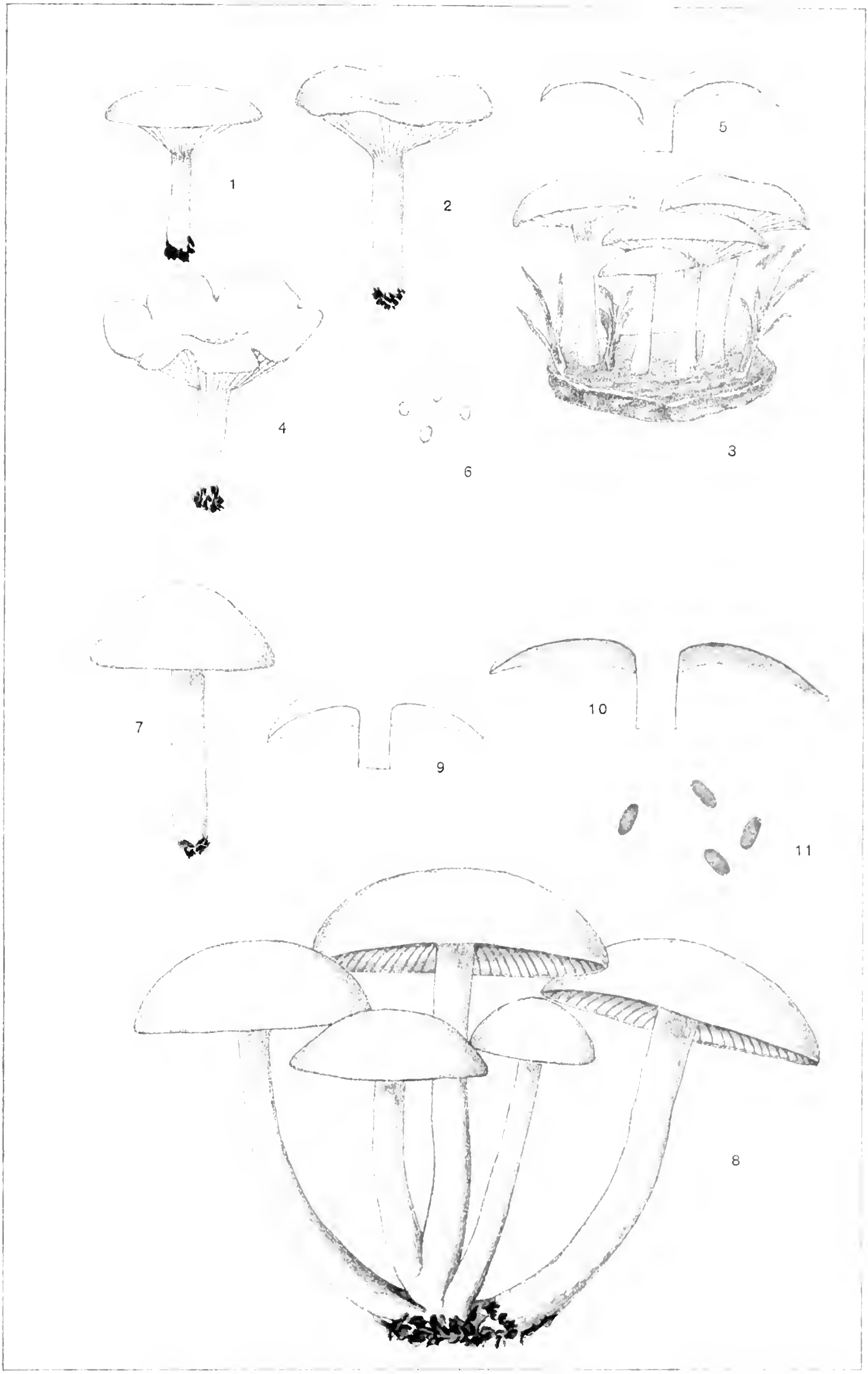


FIG. 1-6
CLITOCYBE SUDORIFICA PK.
SUDORIFIC CLITOCYBE

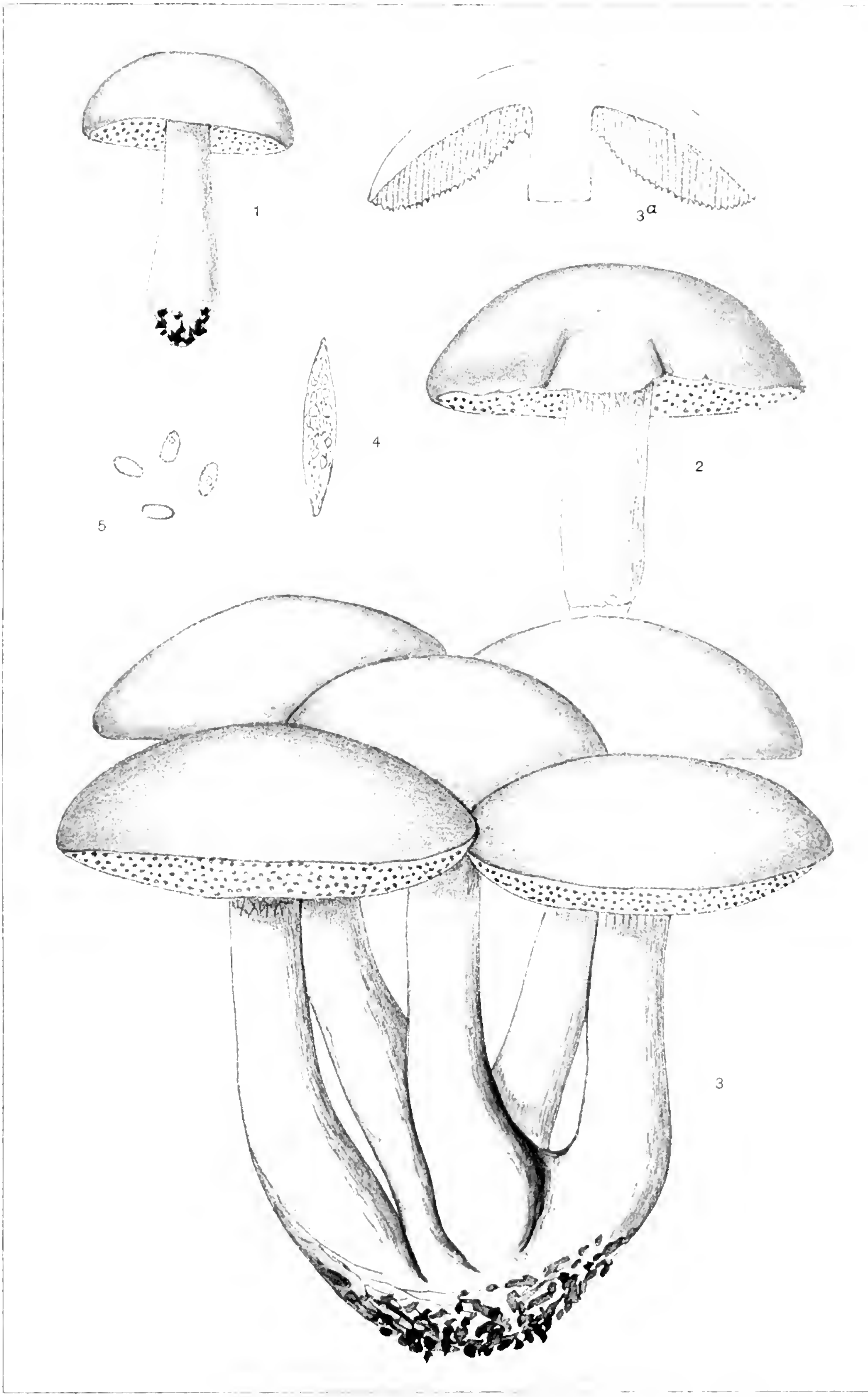
FIG. 7-11
FLAMMULA SULPHUREA PK.
SULFUR-COLORED FLAMMULA

Plate VIII

Boletus ballouii Pk.

BALLOU BOLETUS

1 Immature plant
2 Mature plant
3 Tuft of plants, two of them showing faded color
3*a* Vertical section of the upper part of a plant
4 Cystidium x 400
5 Four spores x 400



BOLETUS BALLOUII Pk.
BALLOU BOLETUS

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