New York State Education Department

NEW YORK STATE MUSEUM

59th ANNUAL REPORT

1905

VOL. 2

APPENDIXES 3-6

TRANSMITTED TO THE LEGISLATURE JANUARY 22, 1906

ALBANY

NEW YORK STATE EDUCATION DEPARTMENT

1907

STATE OF NEW YORK

EDUCATION DEPARTMENT

Regents of the University

1905

With years when terms expire

[1] Director since January 1, 1906.

STATE OF NEW YORK

No. 66

IN ASSEMBLY

JANUARY 22, 1906

59th ANNUAL REPORT

OF THE

NEW YORK STATE MUSEUM

To the Legislature of the State of New York

We have the honor to submit herewith, pursuant to law, as the 59th 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

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Museum bulletin 98

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Published monthly by the
New York State Education Department
BULLETIN 363 DECEMBER 1905

New York State Museum

JOHN M. CLARKE Director

Bulletin 98

MINERALOGY 4

CONTRIBUTIONS FROM THE MINERALOGIC LABORATORY

BY

H. P. WHITLOCK

New York State Education Department

Science Division, June 13, 1905

Hon. Andrew S. Draper LL. D.

Commissioner of Education

DEAR SIR: I transmit herewith for publication as a bulletin of the State Museum a paper entitled *Contributions from the Mineralogic Laboratory*, prepared by H. P. Whitlock, Mineralogist of this division.

It is with some satisfaction that I communicate a paper, brief in itself and wholly concerned with pure science, which constitutes a really substantial addition to our knowledge of the mathematical and physical characters of New York minerals.

Very truly yours,

JOHN M. CLARKE

Director and State Geologist

Approved for publication June 14, 1905

A. S. Draper

Commissioner of Education

New York State Museum

JOHN M. CLARKE Director

Bulletin 98

MINERALOGY 4

CONTRIBUTIONS FROM THE MINERALOGIC LABORATORY

BY

H. P. WHITLOCK

MINERALS FROM RONDOUT, ULSTER CO.

In the spring and fall of 1904, the New York State Museum came into possession, through purchase and by the gift of Mr P. E. Clark, of a very complete and representative collection of minerals from the mines of the Newark Cement Co., at Rondout. As such a mass of mineralogic material from this interesting locality has probably never before been available for study, the writer has availed himself of this opportunity to contribute these brief notes in the hope that they may prove of value in furthering a detailed knowledge of the mineral occurrences of New York. The writer wishes to express his thanks to Mr Clark for the many courtesies extended to him in his work.

General description. The mineral material consists principally of the filling of seams or veins in the Rondout limestone which constitutes the cement rock of these deposits. Of these vein minerals calcite predominates and is characterized by a wide and interesting variation in crystal habit. Crystallized quartz and dolomite occur associated with the calcite together with pyrite and marcasite of a younger generation. All of these present characters of interest and will be described in detail.

Marcasite. Marcasite occurs implanted on the calcite and quartz of the vein filling and less frequently impregnating the calcite in minute detached crystals. The crystals vary from 5mm in width, parallel to the *b* axis, to microscopic individuals. In crystal habit they present the usual types, the combination shown in figure 1[a] representing the prevailing habit. The faces are in general marred and distorted by striations and vicinal planes to such an extent that exact goniometrical measurements were

[a]Figures 1 and 2 are shown with the *b* axis vertical.

rendered difficult, and where fairly sharp reflections were obtained from the corresponding faces of a number of crystals, the results showed a considerable variation, probably due to incipient groupings of a number of crystals in approximately parallel position. The brachi dome *r* (014) was noted in a number of cases but always trending toward a connection with (011) and (001) by series of vicinal planes giving curved surfaces [fig. 2]. Twinning parallel to (110) is quite common producing the usual stellate forms. In one case the repeated twinning shown in figure 2 was noted. Aggregates of the usual "cockscomb" aspect are common.

Pyrite. The pyrite which occurs at Rondout presents several features of interest both from a crystallographic and a genetic point of view. In addition to the small brilliant crystals (1 millimeter diameter) which in places thickly incrust the calcite of this locality, in a number of specimens a decided and unusual distorted habit was noticed in the pyrite crystals occurring associated with the dolomite, which latter appeared to be of a younger generation than the calcite. The distortion takes place perpendicular to the opposite faces of a cube (100) and varies in extent from an elongation of five times the cross section to thin acicular crystals somewhat resembling the acicular habit of millerite. Twinning occurs parallel to the dodecahedral (110) face [fig. 3], giving rise to L and T shaped crystals. Repeated twinning occurs in several cases. Scepter crystals resembling those common to quartz were observed in several instances, the relation between the acicular shaft and the crowning individual being that shown in figure 4. Pyrite dendrites of remarkable size and beauty occur in seams in the limestone. These bear a marked resemblance to the arborescent forms of native copper and may owe their origin to similar crystallographic development.

Quartz. Crystallized quartz is found at Rondout for the most part in detached crystals contained in the clay pockets of the Manlius limestone which forms the hanging wall of the cement beds. These exhibit in a great number of instances the phenomenon of a clearly marked inner crystal of smoky quartz surrounded by a secondary layer of colorless quartz. These phantoms of smoky quartz occasionally occur in series showing successive deposits of smoky and clear quartz. Small amounts of anthracite were noted in the associated limestone. In many of the crystals a marked tendency toward parallel grouping, very similar to the occurrence of quartz at New Baltimore[1], often results in cavernous crystals which closely resemble those from Stony Point, N. C.

[1] N. Y. State Mus. Bul. 58, pl. 1.

Penetration twins on twinning axis *c* are quite common resulting in the forms shown in figures 5 and 6. Measurements of a number of crystals yielded the following results:

ZONE (1010), (1011)

Forms	Measured angle on 1010	Calculated angle on 1010
m $(60\bar{6}5)$	33° 15′	33° 13′
j $(30\bar{3}2)$	27 44½	27 42
i $(50\bar{5}3)$	25 18½	25 17
Γ $(40\bar{4}1)$	11 11	11 8
v $(71\bar{8}1)$	8° 50′	8° 52′
ε $(12\bar{3}1)$	24 59	25 5
s $(11\bar{2}1)$	38 7	37 58

The presence of vicinal forms in the zone [1010.1011] interfered materially with the measurement of this zone.

Calcite. The vein calcite of Rondout occurs, for the most part, as a secondary deposit on dolomite and presents types of crystallization of marked variety and unique development. The associated pyrite which is here present in extremely minute crystals, occurs in many cases included in the larger calcite individuals arranged along the crystallogenetic lines of the latter mineral in distinct bands on the surface of, or as phantoms within, the crystals of the calcite. These structure lines as outlined by the pyrite inclusions are of notable interest in their relation to the development of the calcite. Somewhat similar inclusions have been noted in the calcite from Phoenixville Pa[1]. A careful study of some 200 specimens has led to the division of the observed combinations of crystal forms into nine types, of which the second and third may be regarded as variations of the same type with respect to crystal habit.

DISCUSSION OF TYPES

First type. The simple combination of the prism $(10\bar{1}0)$ with the rhombohedron $(01\bar{1}2)$ which is the prevailing type throughout the vein calcite of the Siluric limestones of the Hudson valley, is here present in crystals which occasionally reach a diameter of 3 cm. As elsewhere noted in this region, this type appears to mark a condition of regular and uninterrupted deposition as distinct from the disturbed and brecciated vein structure characteristic of some of the types to be subsequently discussed. The planes of the rhombohedron *e* $(01\bar{1}2)$ are dull whereas those of the prism are fairly brilliant and marked with natural etchings. Twins occur parallel to *c* (0001).

[1]Smith, J. L. Am. Jour. Sci. Ser. 2. 20:251.

Second type. The scalenohedron Λ (15.4.19.3) which is common in crystals from this locality is developed in long, slender forms, the brilliant faces of which give excellent reflections and are susceptible of exact measurements. The rhombohedron *e* $(01\bar{1}2)$ terminates this type [fig. 7]. Twins occur according to two laws, parallel to *c* (0001) and parallel to *e* $(01\bar{1}2)$. The pyrite inclusions observed in connection with crystals of this type take the form of phantoms outlining the faces of a steep scalenohedron, possibly Λ $(15.4.\overline{19}.3)$. The largest crystals of this type were 25 mm in length.

Third type. As in the preceding type the scalenohedron Λ $(15.4.\overline{19}.3)$ and the rhombohedron *e* $(01\bar{1}2)$ form the distinguishing habit of this type, but developed in rather more equal proportions, giving rise to crystals of rather blunter aspect. The basal scalenohedral edges are beveled by the prism *e* $(11\bar{2}0)$ and those between the scaleonohedron and rhombohedron by the small triangular faces of the rhombohedron *M* $(04\bar{4}1)$, this latter being only occasionally present. The basal plane *c* (0001) is also occasionally present in this type [fig. 8]. Twins are of frequent occurrence parallel to *c* (0001). The largest crystal noted measured 8 centimeters in length.

Fourth type. Crystals of this type, which were noted on but one specimen, are of prismatic habit showing *a* $(11\bar{2}0)$ terminated by the rhombohedron *e* $(01\bar{1}2)$ and modified by the positive scalenohedron Λ $(15.4.\overline{19}.3)$ and the negative scalenohedron n $(3.16.\overline{19}.2)$ [fig. 9]. Crystals are small but with bright faces giving fair reflections.

Fifth type. Crystals of the fifth type though by no means common were noted in a number of instances. They are characterized by the equal development of the rhombohedrons *e* $(01\bar{1}2)$and η $(0\bar{4}41)$, the modifying form being the prevailing scalenohedron Λ $(15.4.\overline{19}.3)$. The rhombohedrons of this type are notably striated parallel to their intersection edges [fig. 10].

Sixth type. Crystals referable to this type are quite common, being noted in as many as eight specimens. They are of rhombohedral habit, the preponderance of the rhombohedron T $(0.12.\overline{12}.1)$ (*new*) giving to them an aspect almost prismatic. The rhombohedron *l* (0445) which with *e* $(01\bar{1}2)$ terminates the type is of variable development from a face equal to *e* $(01\bar{1}2)$ in habit to a mere line [fig. 11]. Vicinal planes are frequent in crystals of this type and are often present to such an extent as to modify the basal edges to curved lines and give to the crystal the aspect shown in figure 12.

Seventh type. Crystals of the seventh type are rhomhohedral in aspect and present scalenohedrons of the zone [$01\bar{1}2.10\bar{1}1.11\bar{2}0$] as shown in figure 13. Of these the faces composing the middle band belong to the form *v* ($61\bar{7}5$) while those which, with the rhombohedron *e* ($01\bar{1}2$), form the termination are built up faces, probably belonging to *D* ($8.1.\bar{9}.10$) though the presence of vicinal planes and striations render the measurements obtained from these faces vague and the form uncertain. The rhombohedron *r* ($10\bar{1}1$) and the prism *a* ($11\bar{2}0$) also occur. The presence of pyrite inclusions arranged on the phantom faces of the rhombohedron *a* ($10\bar{1}1$) suggest that crystals of this type were produced by a "building up" process from secondary calcareous solutions upon primative, rhombohedral crystals. Small amounts of galena and sphalerite were found associated with this phase of the Rondout calcite.

Eighth type. Crystals of this type are notably larger than those heretofore described and are characterized by rather dull faces. The combination shown in figure 14 which represents this phase consists of the positive scalenohedrons λ ($31\bar{4}2$) Y ($53\bar{8}2$) and Θ ($10.3.\bar{13}.2$) terminated with the rhombohedron ($01\bar{1}2$). Of these the scalenohedron λ ($31\bar{4}2$) is represented by dull and roughened faces and the scalenohedron γ ($53\bar{8}2$) is frequently absent from crystals of this type. Pyrite inclusions are present on, or just below, the surface of *e* ($01\bar{1}2$), as distinct bands bisecting the symmetry along the edges of *r* ($10\bar{1}1$) and often terminating in brushes [fig. 15]; in some cases noted these bands were connected by lateral extensions along the basal edges of *r* ($10\bar{1}1$). Phantoms of opaque white calcite which are shown on the cleavage and take the form of the rhombohedron *r* ($10\bar{1}1$) suggest the secondary derivation of this type from a simpler primitive crystal.

Ninth type. The rhombohedron *r* ($10\bar{1}1$) which gives to crystals of this type a distinct rhombohedral habit, is represented by large dull faces. The rhombohedron *e* ($01\bar{1}2$) which modifies the terminal edges, and the prism *a* ($11\bar{2}0$) which modifies the basal edges of *r* ($10\bar{1}1$) are present as narrow bright faces. The scalenohedron Λ ($15.4.\bar{19}.3$) is occasionally present as a modification represented by small faces of medium brilliancy [fig. 16].

TWINNING

Twin crystals are quite frequent among the calcite forms from Rondout, the common type being that formed with the twinning plane parallel to *c* (0001). Several instances were noted of crystals of the second type twinned parallel to *e* ($01\bar{1}2$). Figure 17 shows a crystal of the first type twinned parallel to *c* (0001) in which the natural etchings present on the prismatic planes, emphasize the twinning habit. Figures 18 and 19 show twin crystals of the second type twinned according to both laws mentioned above. Figure 20 shows a twin crystal of the third type.

SUMMARY OF OCCURRING FORMS

Forms		First type	Second type	Third type	Fourth type	Fifth type	Sixth type	Seventh type	Eighth type	Ninth type
0001	*c*			×						
$10\bar{1}0$	*m*	×								
$11\bar{2}0$	*a*			×	×			×		×
$10\bar{1}1$	*r*							×		×
$0\bar{1}12$	*e*	×	×	×	×	×	×	×	×	×
$04\bar{4}5$	*l*						×			
$04\bar{4}1$	*η*					×				
$0.12.\overline{12}.1$	*T*						×			
$8.1.\bar{9}.10$	*D*							× ?		
$61\bar{7}5$	*ν*							×		
$31\bar{4}2$	*λ*								×	
$5.3.\bar{8}.2$	*Γ*								×	
$10.3.\overline{13}.2$	*θ*		×	×	×	×				×
$15.4.\overline{19}.3$	*A*				×					
$3.16.\overline{19}.2$	n								×	

SUMMARY OF MEASURED AND CALCULATED ANGLES[a]

Forms		0001 ∧ 0hhl measured	0001 ∧ 0hhl calculated	X hkil ∧ hikl measured	X hkil ∧ hikl calculated	Y hkil ∧ ikhl measured	Y hkil ∧ ikhl calculated	Z hkil ∧ khil measured	Z hkil ∧ khil calculated
$0\bar{1}12$	*e*	45° 3′	45° 3′						
$04\bar{4}5$	*l*	38° 6′	38° 16¾′						
$04\bar{4}1$	*η*	75° 43′	75° 47′						
$0.12.\overline{12}.1$	*T*[b]	85° 15	85° 10½						
$8.1.\bar{9}.10$	*D*					7° 30′	7° 29½′		
$6\,1\bar{7}5$	*ν*					12° 4′	12° 0′	85° 54′	85° 59′
$3\,1\bar{4}2$	*λ*					24° 13′	24° 10′	66° 39′	66° 15½′
$10.3.\overline{13}.2$	*θ*					25° 19′	25° 5′	39° 15½′	39° 13′
$15.4.\overline{19}.3$	*A*			95° 3′	95° 2′	22° 43′	22° 41′	41° 44′	41° 54′
$3.16.\overline{19}.2$	n					16° 46′	16° 52′	44° 56′	44° 57½′

[a] The scalenohedron $(5\bar{3}82)$ was identified by means of measurements taken with a contact oniometer. [b] New.

CALCITE FROM UNION SPRINGS, CAYUGA CO.

In the summer of 1899 Dr John M. Clarke, then State Paleontologist, found at Union Springs some extremely interesting crystals of calcite. Several specimens of these were sent to Yale University and were described by Messrs Penfield and Ford[1]. The writer has found by a careful study of the bulk of the material collected by Dr Clarke (some 70 specimens) some points of additional interest not shown in the comparatively small amount of material available for the above article.

The calcite crystals under consideration occur in vein material in the Onondaga limestone associated with saddle-shaped aggregates of dolomite and more rarely with crystallized quartz. They represent two generations, separated by a period in which dolomite was deposited, of which the older consists of brilliant individuals of extremely varied habit which are for the most part small, varying from 3 to 10 millimeters in length. One type of these crystals of the first generation is represented in figure 1, of the article by Penfield and Ford, above cited.

The crystals of the second or younger generation are generally larger in size than those of older deposition and are largely of scalenohedral type, showing a marked tendency to twinning according to several laws. They are frequently of a dull surface and black or dark gray in color as the result of bituminous inclusions. It is these latter which have been described at length by Penfield and Ford.

The small brilliant crystals of the first generation contain frequent inclusions of pyrite chalcopyrite and marcasite in microscopic individuals, the latter mineral in beautiful doubly terminated twin crystals, specially prevalent in forms of the rhombohedral type. Frequent zones of deposition of these inclusions occur which renders their aspect almost that of a phantom within the crystal.

Pyramidal type. The second order pyramid, γ $(8.8.\overline{16}.3)$ is a peculiarly dominant form in crystals from this locality, particularly so with crystals of the first generation. In the type shown in figure 21 which occurs in the lining of a thin seam, the form occurs developed to the exclusion of all modifications except those of the terminal rhombohedrons r $(10\overline{1}1)$ and e $(01\overline{1}2)$. These crystals are exceedingly small, the largest not exceeding 4 millimeters in length and quite brilliant, giving very satisfactory reflections when measured.

The pyramidal type as shown in figure 21 is, in some cases, modified by narrow faces in the prismatic zone, the type gradually merging into the combination shown in figure 23 which may be regarded as a transitional type between the pyramidal [fig. 21] and

[1] Penfield, S. L. & Ford, W. C. Some Interesting Developments of Calcite Crystals. Am. Jour. Sci. 1900. 10:237-41.

the scalenohedral [fig. 25] types. In this series the combination shown in figure 24 forms an additional link in the sequence of development from the pyramidal to the scalenohedral types.

Regarding the genetic relationships of the members of this interesting series, the writer can do little more than speculate. It is, however, quite apparent, from its position, which is always that of close proximity to the walls of the seam, that the pyramidal type occupies the lowest place in the crystal development, representing the oldest generation of calcite. It is equally certain that the scalenohedral type is predominant in crystals of the second generation which might possibly have been, in a measure, derived from the re-solution of the first generation of calcite. Between these limits we find a variety of expressions of crystal habit which, when considered with reference to the main facts above noted, leads us to seek for the solution of the crystallogenetic problem along several lines. It is the opinion of the writer that, in the case of the Union Springs locality at least, development in crystal habit is not dependent solely on chemical or physical differences in the crystallizing solutions, but is further complicated by the presence of external forces.

Occurring forms and combinations

As previously noted, the second order pyramid γ $(8.8.\overline{16}.3)$ is of characteristic occurrence in the Union Springs calcites, specially in those of the first generation. It is present as a series of brilliant faces giving good reflections and only in the case of the prismatic crystals shown in figure 22 does it show any tendency toward merging into vicinal planes. In the above exception there appear traces of a steeper pyramid which could not, however, be identified from the material at hand. Figure 22 shows a prismatic habit which is clearly a phase of the second generation. The crystals of this habit are considerably larger than those generally noted from this locality, individuals 30 millimeters in length being not uncommon. Inclusions of marcasite in microscopic crystals are so plentiful as to render the calcite, which would otherwise be transparent, quite translucent. These inclusions are distributed along planes parallel to the rhombohedron r $(1\overline{1}01)$. The planes of a $(11\overline{2}0)$ and γ $(8.8.\overline{16}.3)$ are both sharp and brilliant as are also, to a lesser degree, those of π $(3.16.\overline{19}.2)$. As has already been shown[1] the rare scalenohedron π $(3.16.\overline{19}.2)$ also occurs on crystals of prismatic habit at Rondout. The planes of e $(0\overline{1}12)$ are dull and

[1]See page 8.

those of *m* $(10\bar{1}0)$ brilliant but somewhat rounded and covered with vicinal prominences.

In the combination shown in figure 23 which is represented by small, bright transparent crystals of the first generation, the prismatic zone is developed as a narrow band encircling the crystal, both *a* $(11\bar{2}0)$ and *m* $(10\bar{1}0)$ being present. The second order pyramid γ $(8.8.\overline{16}.3)$ which is here present as a characteristic form is beveled on alternate edges by the positive rhombohedron $M(40\bar{4}1)$ lying in the zone $[8.8.\overline{16}.3.\ 16.8.\bar{8}.3]$. A new scalenohedron X $(81.41.\overline{122}.40)$ very near the common v $(21\bar{3}1)$, is present as a prominent form. This combination is quite similar to that figured by Penfield and Ford[1]; it is common on a number of specimens and, as previously noted, appears genetically to form a connecting link between the pyramidal type of the first generation and the scalenohedral type of the second.

Figure 24 shows a combination which mainly differs from the preceding in that the scalenohedron v_1 $(7.4.\overline{11}.3)$ takes the place of X as a predominating form, the latter form being present only as a subsidiary modification and frequently passing into the commoner form, v $(21\bar{3}1)$. This combination is distinctly scalenohedral in habit and occurs mingled with secondary crystals of the form shown in figure 25 which latter frequently shows the suppression of the pyramid γ. The type shown in figure 26 is found in crystals of the second generation which occur deposited on a thin layer of first generation calcite of rhombohedral habit [*see* figure 28]. These differ from all which have been previously described in two essential characteristics: they are opaque and milky white in color and show a complete absence of all marcasite or pyrite inclusions. In crystallization this type is also unique showing the scalenohedron U $(10.4.\overline{14}.3)$ in the zone $[40\bar{4}1.8.8.\overline{16}.3]$ as a highly developed form. A negative rhombohedron η $(04\bar{4}1)$ is present as a narrow face beveling the alternate pyramidal edges. M, X, r and γ are all present as bright, well defined faces.

The rhombohedron r $(10\bar{1}1)$ which is present as a modification on the combinations shown in figures 21, 23, 24, 26 is developed to the extent of a crystal habit in the case of the types shown in figures 27 and 28 which represent crystals of the first generation. Of these figure 27 may be regarded as a rhombohedral phase of figure 23 showing an additional scalenohedron C $(61\bar{7}8)$ in the zone $[01\bar{1}2.10\bar{1}1.11\bar{2}0]$. The crystals, which contain the marcasite in-

[1]Penfield, S. L. & Ford, W. E. Some Interesting Developments of Calcite Crystals. Am. Jour. Sci. 1900, 10: 237, fig. 1.

clusions characteristic of the younger calcite in this locality, often show elongation parallel to the rhombohedral zone assuming a somewhat prismatic aspect. They apparently fill a gap in the genetic series between the pyramid scalenohedral habit [fig. 23] and the distinctly rhombohedral habit shown in figure 28.

Crystals of this last type [fig. 28] occur in a loosely compacted mass deposited on a layer of crypto-crystalline carbonate of lime occupying the space between the crystallized calcite and the limestone wall of the cavity or vug to the depth of about 5 millimeters. The calcite crystals are piled upon this crystalline layer to the depth of from 10 to 15 millimeters, the largest individuals lying in the top layers. The order and manner of deposition suggest the possible derivation from a solution which originally completely filled the space and deposited its dissolved carbonate of lime first from a rapidly then from a slowly cooling medium. The crystals of this type which are remarkably clear, brilliant and well developed, range in size from 5 to 20 millimeters in diameter. All the faces give excellent reflections. The middle edges of the rhombohedron r $(10\bar{1}1)$ are beveled by the scalenohedron X $(81.41.\overline{122}.40)$ which throughout this occurrence replaces the common form v $(21\bar{3}1)$ which it approaches very closely. It was only after repeated measurement of a number of crystals, both of this and of the foregoing types that the form was considered as established. The prism a $(11\bar{2}0)$ is present as a small face in this zone. In the zone of the pyramidal faces $[16.8.\bar{8}.3.8.8.\overline{16}.3]$ occur the forms M $(40\bar{4}1)$ and S' $(19.10.\overline{29}.6)$ both lying well within the zone and agreeing as to measured angles well within the limits of accuracy.

The twin crystals of the second generation have been so amply described by Messrs Penfield and Ford that there is little to add. The twin crystal shown in figure 29 occurs on several specimens in milky individuals of about 20 millimeters diameter, which suggest in their rather peculiar development the familiar types occurring at Rossie, St Lawrence co[1].

Figure 30 shows the prevailing type of scalenohedral twin, the habit being that of the scalenohedron v. $(7.4.\overline{11}.3)$ and the twinning plane parallel to the rhombohedron e $(01\bar{1}2)$. The reentrant angle or "gash" is chiefly formed by the planes of γ $(8.8.\overline{16}.3)$ and m $(10\bar{1}0)$.

[1]Nason, F. L. Some New York Minerals and their Localities. N. Y. State Mus. Bul. 4. 1888.

SUMMARY OF MEASURED AND CALCULATED ANGLES

		$0001 \wedge h.h.\overline{2h}.l$		$h.h.\overline{2h}l \wedge 2h.\bar{h}.\bar{h}.l$		X $hk\bar{i}l \wedge \bar{h}ik\bar{l}$		Y $hk\bar{i}l \wedge ik\bar{h}l$		Z $hk\bar{i}l \wedge khi\bar{l}$		
		Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated	
$8.8.\overline{16}.3$	γ	77° 48′	77° 37′	58° 25′	58° 28′							*a*
$61\bar{7}8$	*C*					59° 44′	59° 46′	9° 37′	9° 31′			
$21\bar{3}1$	*v*					75° 17′	75° 14′	35° 36′	35° 36′	47° 7′	47° 1½′	*a*
$81.41.\overline{122}.40$	*X*							35° 52′	36° 00′	46° 21′	46° 20′	*b*
$7.4.\overline{11}.3$	*v′*							40° 1′	40° 4′	39° 2′	39° 11′	*a*
$19.10.\overline{29}.6$	*S′*							38° 10′	38° 33′	33° 17′	33° 28′	*a*
$3.16.\overline{19}.2$	n							17° 4′	16° 52′	44° 32′	44° 57½′	

*a*Found also on calcite from Rhisnes. *b*New.

The prevalence of the rare pyramid γ ($8.8.\overline{16}.3$) throughout the varied types of calcite crystals occurring at Union Springs has led the writer to compare these latter with the types presenting this form, which have been noted at other localities. The pyramid γ ($8.8.\overline{16}.3$) is found in the calcite at Rhisnes, about 4500 meters northeast of Namurs in Belgium[1], at Andreasberg in the Hartz[2] and in the Bad Lands of South Dakota[3]. Regarding the crystals from Rhisnes, Cesàro has noted not only the pyramid γ ($8.8.\overline{16}.3$) above mentioned, but also the forms *M* ($40\bar{4}1$), η ($0\bar{4}41$), *v* ($21\bar{3}1$) and S′ ($19.10.\overline{29}.6$) as well as the occurrences of the prismatic zone [$11\bar{2}0.10\bar{1}0$]. Several of his types are identical in form and habit with figures 21 and 23 as well as a twin crystal similar to figure 30. Cesàro finds evidence that many of the crystals from Rhisnes of the first generation have been formed around a parent crystal having γ ($8.8.\overline{16}.3$) as the dominant form.

He announces a theory of genesis of these crystals as follows:

The examination of these crystals has led us to the conclusion that they have been formed encircling a pre-existing second order pyramid and were deposited by the action of three successive mediums: the first producing pyramidal types, the second forming around the first a combination the faces of which are truncations of the lateral edges of γ, the third depositing around the second stage a crystal having for fundamental form scalenohedrons of the zone [$10\bar{1}1.11\bar{2}0$].

This sequence of generation appears to agree perfectly with that already given on page 12 with reference to the Union Springs calcites. The truncation of the lateral edges being produced in the latter instance by the rhombohedron *M* ($40\bar{4}1$) as shown in

[1] Cesaro, G. Les Formes Cristallines de la Calcite de Rhisnes. Ann. de la Soc. Geol. de Belgique 1880. 16:163.
[2] vom Rath, G. Pogg. Annalen 1867. 138:521.
[3] Penfield, S. L. & Ford, W. E. Siliceous Calcites from the Bad Lands, Washington County, S. D. Am. Jour. Sci. 1900. 9:352.

figure 23. Certainly the occurrence of such similarity in crystal habit involving one or more rare forms can not be set down as a mere coincidence and when, as will be presently pointed out, the geological conditions show a corresponding similarity at the two localities, we are led to connect the two phenomena.

At Andreasberg the pyramid Y was first noted by vom Rath in 1867. Sansoni[1] in 1884 failed to find this pyramid, but as pointed out by Cesàro, the doubtful scalenohedron $(7.8.\overline{15}.4)$ given by Sansoni approaches very near the pyramid $(8.8.\overline{16}.3)$ in intercepts and is probably the same. The latter compares the forms of the Rhisnes calcites with those found by Sansoni at Andreasberg and points out several interesting similarities.

Both Rhisnes and Andreasberg lie in the horizon of the Devonic and Upper Carbonic rocks and present the phase of subordinate beds of limestone overlaid by graywacke, clay slate, silicious slate and quartzite. In the vicinity of Andreasberg, these strata are frequently broken through by granite masses[2]. These conditions show a marked analogy to those existing at Union Springs, where the limestone beds are overlaid by the shale and silicious slate of the Marcellus and Hamilton groups and show evidences of considerable local disturbance. The limestone on which the Union Springs pyramidal calcite crystals are deposited is unique in that the silicious residue obtained from its solution consists of minute but perfectly formed quartz crystals. As pointed out by Penfield and Ford[3] pyramidal crystals of calcite, of the form $(8.8.\overline{16}.3)$ and containing nearly 50% quartz sand, have been found in the Bad Lands of South Dakota. It would, therefore, appear that in at least two localities producing this rare pyramid as a crystal habit, the occurrence is marked by the presence of silica under rather unusual circumstances. When we add to this fact the equally significant one that the formations at Union Springs and at the Belgium and Hartz localities show in each instance disturbed limestone beds overlaid by strata rich in silica we would seem to have reason for connecting the pyramidal habit of calcite with a crystallizing solution carrying silica in quantities approaching saturation.

CALCITE FROM HOWES CAVE

Calcite occurs at Howes Cave, Schoharie county, N. Y. in brilliant transparent crystals filling or partly filling the veins in the Rondout limestone. The specimens which form the basis for the

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[1] Sansoni. Att. Acc. Linc. Mem. 3. 1884. 19:450.
[2] Phillips, J. A. & Louis, Henry. A Treatise on Ore Deposits. 1896. p. 384.
[3] Penfield, S. L. & Ford, W. E. Silicious Calcites from the Bad Lands, Washington County, S. D. Am. Jour. Sci. 1900. 9:352.

following notes were collected by the writer, through the courtesy of the Helderberg Cement Co., from the mine which furnishes natural cement rock to this company. The crystals which vary in size from 40 millimeters in diameter to microscopic individuals are of uniform habit and are invariably characterized by a marked twinning parallel to e $(01\bar{1}2)$. They are frequently associated with tufted aggregates of acicular aragonite which appears, in one instance at least, to have been derived from the re-solution of the calcite. In the instance noted a geodic mass almost completely filled with crystallized calcite yielded on fracture several fine tufts of aragonite deposited on calcite crystals of the prevailing habit which latter were found to be deeply pitted with natural etchings. Calcite crystals of a second type were found in the Helderberg limestone, overlying the Rondout, lining the fossil remains of Rhynchonella wilsoni with which portions of this formation are thickly studded. These latter differ somewhat from the type of the principal occurrence and will be discussed as a supplementary type.

The crystals of the principal type shown in figure 31 exhibit a complex combination of forms occurring in several clearly defined zones; the relation of these is shown in the spherical projection [fig. 33].

Rhombohedrons. The rhombohedron r $(10\bar{1}1)$ is frequently present alternating with the low scalenohedron q $(51\bar{6}7)$ which latter, although clearly defined, is without question a built up form more or less vicinal in character. The planes of r are smooth but rather dull. The rhombohedrons M $(40\bar{4}1)$ and τ $(70\bar{7}1)$ occur as narrow but extremely brilliant faces, giving excellent reflections and beveling the edges of U $(10.4.\overline{14}.3)$ and V $(62\bar{8}1)$ respectively. In the zone with these is also found the negative rhombohedron Φ $(0.14.\overline{14}.1)$ occurring as small triangular faces of fine brilliancy.

The rhombohedron e $(01\bar{1}2)$ is universally present as brilliant faces which make excellent points of reference in this zone.

Scalenohedrons. As previously noted the scalenohedron q $(51\bar{6}7)$ is present in many instances as a built up form with deeply striated faces giving poor reflections. The basal edges of q are modified by the common scalenohedron v $(21\bar{3}1)$ the obtuse polar edges of which are terminated by the scalenohedrons U $(10.4.\overline{14}.3)$ and V $(62\bar{8}1)$. Owing to the fact that the indexes of these latter forms are quite near those of v and to one another their intersection edges are not distinctly marked, the successions of forms tending to produce a slight rounding of the crystal toward the rhombohedral zone. Excellent reflections were, however, obtained from all of these scalenohedrons and the closeness in agreement of the observed angles with theoretical values, taken, together with the fact that the rhombohedrons *M* and *τ*, which truncate the polar edges of *U* and *V* respectively, lie well in the zones of these faces, establish their identity beyond peradventure. The negative scalenohedron *N* $(4.16.\overline{20}.3)$ which is invariably present is characterized by small, sharp and brilliant faces.

Twinning. A very marked tendency toward twinning parallel to the plane *e* $(01\bar{1}2)$ results in the production of thin flat extensions of one individual of the pair and the formation of a deep reentering angle as shown in figure 32. So common is this form of twinning that it is rarely absent from crystals of this occurrence to which it gives a distinct character. Twinning according to this law is common in calcite crystals and examples of it may be found in almost every important occurrence. The abnormal extension of one member of the twin above noted is, however, unique and seems to indicate a metagenic rather than a paragenic mode of twinning.

The calcite crystals found in the fossil remains of Rhynchonella wilsoni show combinations of the supplementary type illustrated in figures 34 and 35. The crystals though small are remarkably brilliant and give excellent reflections in all zones. Of the observed forms *M* $(40\bar{4}1)$, *e* $(01\bar{1}2)$, *r* $(10\bar{1}1)$ and *v* $(21\bar{3}1)$ are common to the crystals previously described from the underlying beds of the Rondout limestone. The scalenohedrons are all of the zone $[01\bar{1}2.10\bar{1}1]$. The scalenohedron *E* $(41\bar{5}6)$, here replaces *q* of the principal type. This form appears as a series of well developed planes having none of the vicinal characters which mark the development of *q* of the principal type. The scalenohedron λ $(31\bar{4}2)$ occurs as a series of narrow faces between *v* and *r*. Traces of the characteristic twinning which mark the crystals of the principal type are here noted; the twinning tendency is, however, very weak and only finds expression in an occasional shallow reentering "gash."

SUMMARY OF MEASURED AND CALCULATED ANGLES

		$0001 \wedge h0hl$		X $hk\bar{i}l \wedge hi\bar{k}l$		Y $hk\bar{i}l \wedge ik\bar{h}l$		Z $hk\bar{i}l \wedge kh\bar{i}\bar{l}$	
		Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated
$70\bar{7}1$	*τ*	82° 3′	81° 45½′						
$40\bar{4}1$	*M*	75° 46′	75° 47′						
$10\bar{1}1$	*r*	44° 44′	44° 37′						
$0.14.\overline{14}.1$	*Φ*	85° 54′	85° 51½′						
$01\bar{1}2$	*e*	26° 14½′	26° 15′						
$21\bar{3}1$	*v*			75° 27′	75° 22′	35° 28′	35° 36′	46° 56′	47° 1½′
$31\bar{4}2$	*λ*							66° 17′	66° 15½′
$41\bar{5}6$	*E*			54° 9′	54° 7′	13° 12′	13° 3½′		
$10.4.\overline{14}.3$	*U*					31° 11′	31° 16′	38° 50′	38° 49′
$6.2.\bar{8}.1$	*V*					27° 26′	27° 31′	35° 43′	35° 52′
$4.16.\overline{20}.3$	*N*					21° 29′	21° 30′	42° 20′	42° 27′

DATOLITE FROM WESTFIELD MASS.

In February 1905 the State Museum acquired by exchange from Mr R. F. Jones a number of specimens of datolite from Lane's trap quarry near Westfield Mass. As the quality of this occurrence far exceeds that of the datolite hitherto described from this region, in size, beauty and complexity of crystallization, the writer has added the following notes to the foregoing descriptions of New York minerals in the hope that the unusual interest attached to these crystals will prove sufficient excuse for such an extralimital digression.

The datolite occurs in veins in a diabase which shows evidence of considerable folding and decomposition, particularly along the walls of the vein where it is entirely replaced by prochlorite. The crystals which in some instances measure 10 cm. on the *b* axis are deposited on a thin layer of calcite. They are cut through by deep parallel furrows due to the former presence of mica which has been dissolved away leaving the cast, partly filled with calcite of a later generation; fragments of this mica, highly altered, were found in place. In color the crystals are whiter than those from the New Jersey trap region which they strongly resemble in crystal habit. The presence of second generation calcite of the form *f* ($0\bar{2}21$), which also occurs associated with the datolite from West Paterson, gives added significance to this similarity. The faces are almost universally sharp and brilliant and fall well within several clearly marked zones, greatly facilitating the ease and accuracy of their identification.[1]

Cleavage was noted parallel to a, quite perfect, and parallel to c, somewhat less so; the measured angles gave $m \wedge a$ (cleavage) = $32° \ 18\frac{1}{2}'$, and $g \wedge c$ (cleavage) = $19° \ 18'$, the calculated value for these angles being $32° \ 23\frac{1}{2}'$ and $19° \ 22'$ respectively.

Figures 37 and 38 represent the prevailing crystal habit, the disposition of the planes in zones being shown in the spherical projection, figure 36. The intersection of zones in the plus half of the projection is specially interesting. Three new hemipyramids were observed in zone [001.140] as narrow faces beveling the edges between the clino dome *g* (012) and three prominent hemipyramids ϵ ($\bar{1}12$), λ ($\bar{1}13$) and μ ($\bar{1}14$) in the zone [001.110]. These gave the indexes $\bar{1}48$, $\bar{1}49$ and $\bar{1}.4.10$ respectively and were assigned the letters ϵ', λ' and μ'. A plane in the zone [001.120] which is quite prominent in these crystals gave the indexes $\bar{1}22$ and is noted in the text and projections as *M*. An enlarged projection of a portion of one of the typical crystals drawn in reversed position to show the disposition of these rare planes is given in figure 39.

Pinacoids. The three pinacoids *a* ,(100); *b*, (010) and *c* (001) are commonly present, the two former as brilliant faces and the latter as a somewhat dull series. The clinopinacoid *b* which is present as a very narrow face serves as an excellent plane of reference in orienting the crystal.

Prisms. The faces in the prismatic zone are characterized by considerable brilliancy. The prisms *m* (110) and *o* (120) are commonly present; *r* (230) was noted in two instances on quite small crystals.

Domes. In the zone of the hemiorthodomes *x* (102) is prominent giving to the combination a habit very similar to the Bergen Hill and West Paterson occurrences; *v* (103) is often absent. The presence of one or more hemidomes between *a* and *x* was noted in several instances, but the faces were so minute and ill defined that it was impossible to obtain any definite measurements from them.

The zone of the clinodomes is, on the other hand, very well developed, showing *m* (011), *g* (012), *t* (013) and Ω (018), the latter sometimes present.

[1] In measuring the dull faces, notably 012 and 018 in the zone of the clinodomes and 103 in the zone of the orthodomes, the method of placing a drop of alcohol on the dull face was successfully used to obtain a clear reflection of the goniometer signal. The face was brought into approximate position and moistened by a drop of alcohol applied by means of a dropping tube. The curved surface of the drop at first gives the effect of a series of multiple images; these, however, as the drop reduces in thickness by evaporation, gradually merge to a center and at the instant preceding complete evaporation combine in a clear and bright image of the signal. The writer finds this expedient more satisfactory than the usual method of a cemented cover glass and suggests it for crystals not soluble in alcohol.

Pyramids. The hemipyramids of the zone [001.110] form a regular series universally present as well defined planes; of these n (111), ν ($\bar{1}11$) and ϵ ($\bar{1}12$) are particularly well developed. The hemipyramids λ ($\bar{1}13$), μ ($\bar{1}14$) and κ ($\bar{1}15$) are represented by relatively narrow faces often showing natural etchings. In the zone [001.120] the planes of the hemipyramids Q (122), β (121), M (122), i (123) and α (124) are represented by small narrow faces beveling the edges between the planes of the clinodome zone and those of the zone [001.110]. They were for the most part identified by zone equasions. The rare faces ($\bar{1}48$), ($\bar{1}49$) and ($\bar{1}$.4.10) have been already noted in the zone [001.140]. This series of planes gave fair reflections and were measured on five crystals, the results agreeing with theory within the limits of accuracy.

Twinning was observed on one crystal 8 centimeters in length on the b axis. This crystal which is shown in figure 40 is a penetration twin parallel to a (100); having c for the twinning axis. The larger individual is of the snowy white color, which is common to the occurrence and which suggests the color of cryolite: the smaller individual which is shown protruding from this last is light greenish in color, transparent and resembles the typical Bergen Hill datolite.

A list of the occurring forms with the measured and calculated angles is given below.

SUMMARY OF OCCURRING FORMS, MEASURED AND CALCULATED ANGLES

Zone [a. c]

			Measured	Calculated
a	100	*ax*	45° 0′	45° 0
x	102	*cx*	44 53	44 51
v	103	*cv*	33 46	33 35
c	001			

Zone [c.b]

b	010	bm_x	38° 15′	38° 18½′
*m*x	011	$m_x m'_x$	103 16	103 23
g	012	*gg′*	64 37	64 39½
t	013	$m_x g$	19 22	19 22
Ω	018	*gt*	9 26	9 27½
		tΩ	13 43	13 53

Zone [a.m]

m	110	*am*	32° 25⅓′	32° 22½′
o	120	*ao*	51 50	51 45½
r	230	*or*	8 12	8 10

Zone [m.n.ε]

n	111	nm	22° 54′	22° 56′
ν	$\bar{1}11$	$m\nu$	22 56	22 57
ε	$\bar{1}12$	$\nu\varepsilon$	17 18⅓	17 21
λ	$\bar{1}13$	$\varepsilon\lambda$	11 30½	11 33
μ	$\bar{1}14$	$\lambda\mu$	7 36	7 40
κ	$\bar{1}15$	$\mu\kappa$	5 13	5 17

[Zone [β.o.α]

Q	122	oQ	31° 47′	31° 48′
β	121	$o\beta$	17 13	17 13½
α	$\bar{1}24$	$m_{x}i$	28 19	
i	123			
M	$\bar{1}22$			

Zone [r.π]

π	$\bar{2}31$	$r\pi$	10° 29′	10° 15′

Zone [g.ε]

		$g\varepsilon$	39° 59′	40° 10′
ε'	$\bar{1}48$	$g\varepsilon'$	11 46	11 54
		$g\alpha$	22 45	22 51

Zone [g.λ]

λ'	$\bar{1}49$	$g\lambda$	32° 59′	32° 45′
		$g\lambda'$	11 26	11 19½

Zone [g.μ]

μ	$\bar{1}.4.10$	$g.\mu$	29° 11′	29° 13′
		$g\mu'$	11 28	11 21

EXPLANATION OF PLATES

PLATE 1

1 Marcasite from Rondout showing prevailing habit of crystals. Forms: *c* (001), *m* (110), *e* (101), *l* (011), *S* (111).

2 Marcasite from Rondout, showing repeated twinning. Forms: *c* (001), *m* (110), *e* (101), *l* (011). Figures 1 and 2 are shown with *b* axis vertical.

3 Pyrite from Rondout, showing cube twinned parallel to (110), producing L-shaped form.

4 Pyrite from Rondout, showing scepter crystal.

5,6 Quartz from Rondout, showing penetration twins on twinning axis *c*. Forms: *m* ($10\bar{1}0$), *r* ($10\bar{1}1$), 𝔪 ($60\bar{6}5$), *i* ($50\bar{5}3$), *z* ($01\bar{1}1$), *s* ($11\bar{2}1$), *v* ($71\bar{8}1$), ε ($12\bar{3}1$).

7 Calcite from Rondout showing crystals of the second type. Forms: Λ ($15.4.\overline{19}.3$), *e* ($01\bar{1}2$).

8 Calcite from Rondout showing crystal of the third type. Forms: *c* (0001), *a* ($11\bar{2}0$), *e* ($01\bar{1}2$) Λ ($15.4.\overline{19}.3$).

Plate 1

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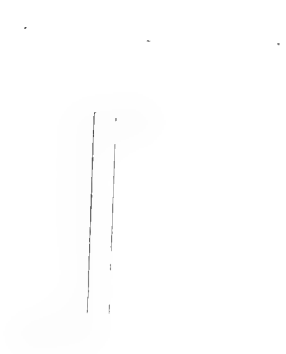

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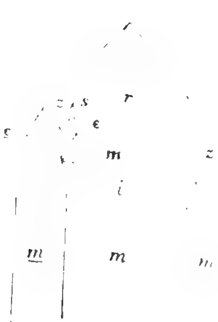

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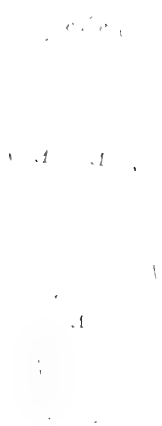

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PLATE 2

9 Calcite from Rondout, showing crystal of the fourth type (prismatic habit). Forms: *a* $(11\bar{2}0)$, *e* $(01\bar{1}2)$, Λ $(15.4.\overline{19}.3)$, **n** $(3.16.\overline{19}.2)$.

10 Calcite from Rondout, showing crystal of the fifth type. Forms: *e* $(01\bar{1}2)$, *η* $(04\bar{4}1)$, Λ $(15.4.\overline{19}.3)$.

11 Calcite from Rondout showing crystal of the sixth type. Forms: *e* $(01\bar{1}2)$, *l* $(04\bar{4}5)$, *T* $(0.12.\overline{12}.1)$, the latter form is new to the species.

12 Calcite from Rondout, showing variation of the sixth type. The presence of vicinal planes in the zone of the negative rhombohedrons produce highly curved faces.

13 Calcite from Rondout, showing crystal of the seventh type. Forms: *r* $(10\bar{1}1)$, *e* $(01\bar{1}2)$, *v* $(61\bar{7}5)$, *D* $(8.1.\bar{9}.10)$ (?).

14 Calcite from Rondout, showing crystal of the eighth type. Forms: *e* $(01\bar{1}2)$, λ $(31\bar{4}2)$, ϒ $(53\bar{8}2)$, *θ* $(10.3.\overline{13}.2)$.

Plate 2

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PLATE 3

15 Calcite from Rondout, showing the development of pyrite inclusions on crystals of the eighth type.

16 Calcite from Rondout, showing crystal of the ninth type (rhombohedral habit). Forms: *a* $(11\bar{2}0)$, *r* $(10\bar{1}1)$, *e* $(01\bar{1}2)$, Λ $(15.4.\overline{19}.3)$.

17–20 Calcite from Rondout showing twin crystals. Figure 19 is drawn with the twinning plane *e* $(01\bar{1}2)$ vertical.

Plate 3

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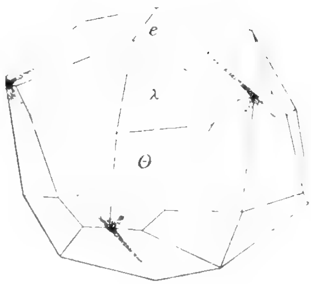

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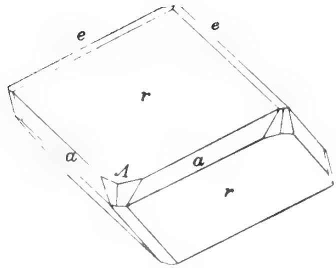

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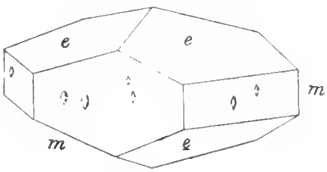

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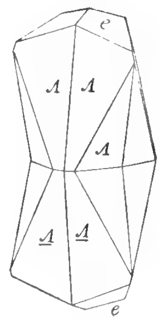

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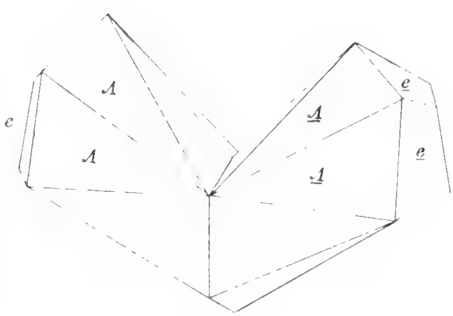

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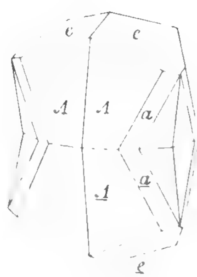

PLATE 4

21 Calcite from Union Springs, showing crystals of the pyramidal type characteristic of the first generation. Forms: γ $(8.8.\overline{16}.3)$, r $(10\bar{1}1)$, e $(01\bar{1}2)$.

22 Calcite from Union Springs, showing crystal of prismatic habit marking one phase of the second generation. Forms: m $(10\bar{1}0)$, a $(11\bar{2}0)$, γ $(8.8.\overline{16}.3)$, **n** $(3.16.\overline{19}.2)$.

23 Calcite from Union Springs, showing crystal of transitional habit between pyramidal forms of the first generation [fig. 21] and scalenohedral forms of the second [fig. 25]. Forms: m $10\bar{1}0)$, a $(11\bar{2}0)$, γ $(8.8.\overline{16}.3)$, r $(10\bar{1}1)$, M $(40\bar{4}1)$, X $(81.41.\overline{122}.40)$; the latter scalenohedron is new to the species.

24 Calcite from Union Springs, showing crystal of scalenohedral habit characteristic of the second generation, but with subsidiary development of the predominating forms of figure 23. Forms: m $(10\bar{1}0)$, γ $(8.8.\overline{16}.3)$, r $(10\bar{1}1)$, m $(40\bar{4}1)$, X $(81.41.\overline{122}.40)$, $v_{\prime}$ $(7.4.\overline{11}.3)$.

25 Calcite from Union Springs showing crystal of distinctly scalenohedral habit. This combination is typical of the second generation. Forms: m $(10\bar{1}0)$, a $(11\bar{2}0)$, M $(40\bar{4}1)$, $v_{\prime}$ $(7.4.\overline{11}.3)$.

26 Calcite from Union Springs showing milky white crystal of second generation occurring with first generation crystals of rhombohedral habit [fig. 28.] Forms: m $(10\bar{1}0)$, γ $(8.8.\overline{16}.3)$, r $(10\bar{1}1)$ M $(40\bar{4}1)$, η $(04\bar{4}1)$, X $(81.41.\overline{122}.40)$, U $(10.4.\overline{14}.3)$.

Plate 4

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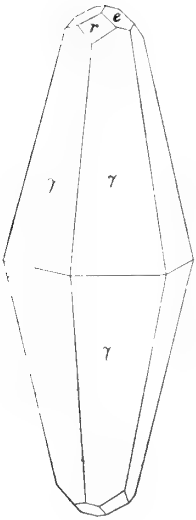

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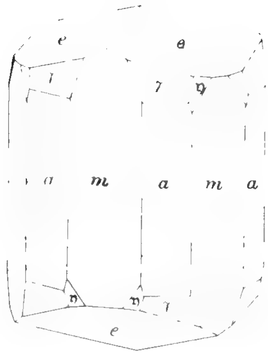

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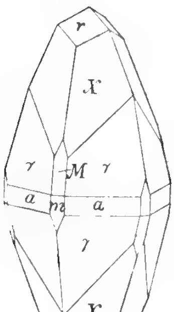

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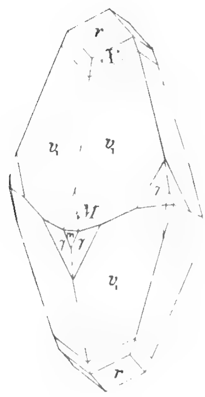

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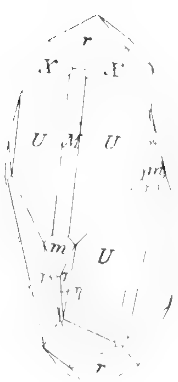


PLATE 5

27 Calcite from Union Springs, showing crystal of the first generation, transitional in habit between the pyramid-scalenohedral type [Fig. 23], and the rhombohedral type [fig. 28]. Forms: m $(10\bar{1}0)$, a $(11\bar{2}0)$, γ $(8.8.\overline{16}.3)$, r $(10\bar{1}1)$, M $(40\bar{4}1)$, e $(01\bar{1}2)$, C $(61\bar{7}8)$, X $(81.41.\overline{122}.40)$.

28 Calcite from Union Springs, showing crystal of the first generation of rhombohedral habit. Forms: a $(11\bar{2}0)$, γ $(8.8.\overline{16}.3)$, r $(10\bar{1}1)$, M $(40\bar{4}1)$, e $(0\bar{1}12)$, X $(81.41.\overline{122}.40)$, S' $(19.10.\overline{29}.6)$.

29 Calcite from Union Springs, showing milky crystal of the second generation twinned parallel to *c*. Forms: a $(11\bar{2}0)$, r $(10\bar{1}1)$, M $(40\bar{4}1)$.

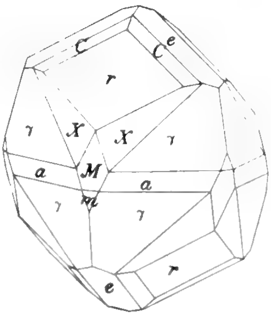
30 Calcite from Union Springs, showing the prevailing type of scalenohedral twin of the second generation. This combination is drawn with the twinning plane e $(01\bar{1}2)$ vertical. Forms: m $(10\bar{1}0)$, γ $(8.8.\overline{16}.3)$, $v_{,}$ $(7.4.11.3)$.

31 Calcite from Howes Cave, showing principal type of crystal. Forms: M $(40\bar{4}1)$, τ $(70\bar{7}1)$, Φ $(0.14.\overline{14}.1)$, e $(01\bar{1}2)$, q $(51\bar{6}7)$, v $(21\bar{3}1)$, U $(10.4.\overline{14}.3)$, V $(62\bar{8}1)$, N $(4.16.\overline{20}.3)$.

32 Calcite from Howes Cave, showing a characteristic penetration twin.

Plate 5

27



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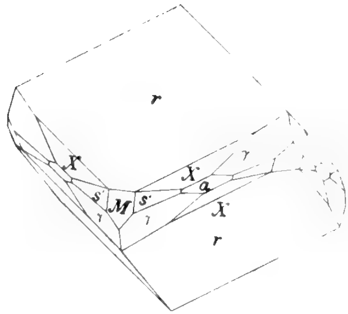

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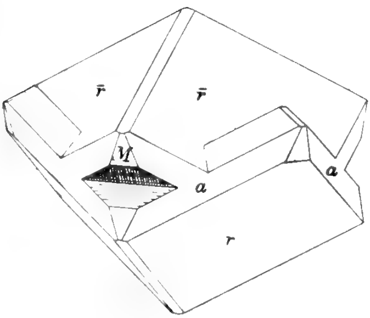

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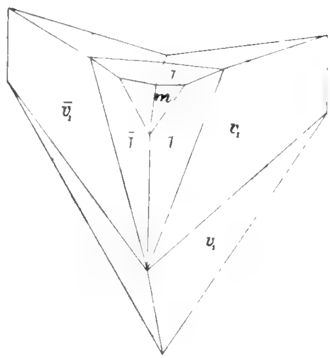

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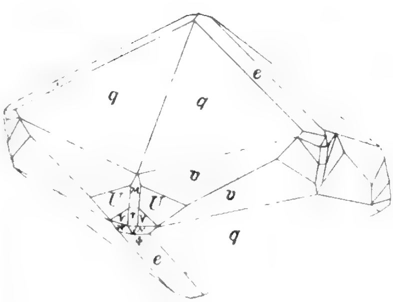

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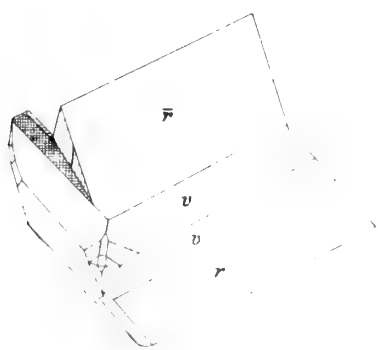


PLATE 6

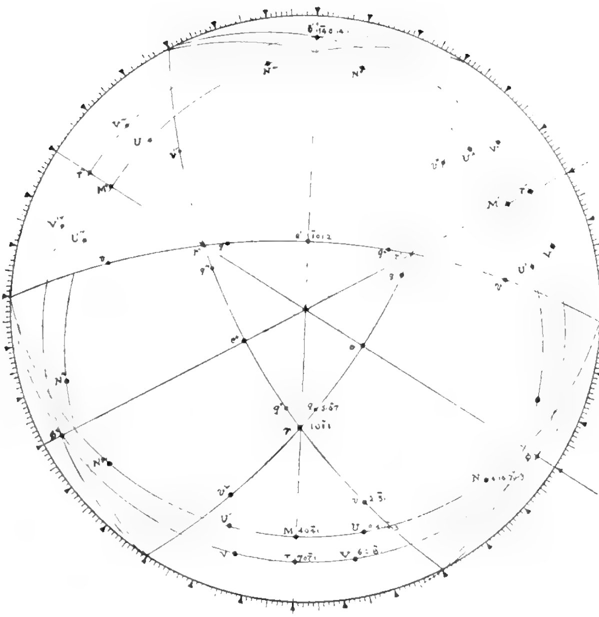
33 Calcite from Howes Cave. Spherical projection showing zonal relations of forms of principal type.

34 Calcite from Howes Cave showing supplementary type found in fossil remains of Rhynchonella wilsoni. Forms: *r* $(10\bar{1}1)$, *M* $(40\bar{4}1)$, *E* $(41\bar{5}6)$, λ $(31\bar{4}2)$, *v* $(21\bar{3}1)$.

35 Calcite from Howes Cave. Basal projection of figure 34.

Plate 6

33



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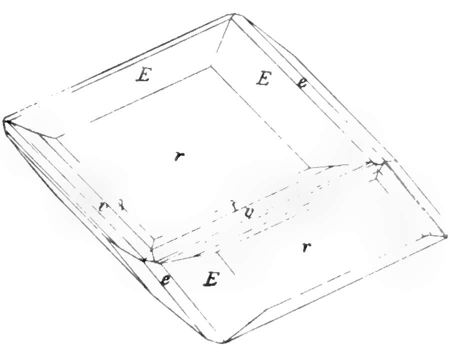

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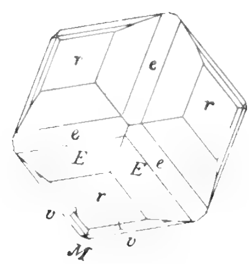


PLATE 7

36 Datolite from Westfield Mass. Stereographic projection showing zonal relations of occurring forms.

37 Datolite from Westfield Mass., showing typical crystal habit. Forms: *a* (100), *x* (102), *v* (103), *c* (001), *b* (010), m_x (011), *g* (012), *t* (013), Ω (018), *m* (110), *o* (120), *n* (111), ν (111), ε ($\bar{1}$12), λ ($\bar{1}$13), μ ($\bar{1}$14), κ ($\bar{1}$15), *Q* (122), β (121), α ($\bar{1}$24), *i* ($\bar{1}$23), *M* ($\bar{1}$22), ε′ ($\bar{1}$48), λ′ ($\bar{1}$49), μ′ ($\bar{1}$.4.10); the last three are new to the species.

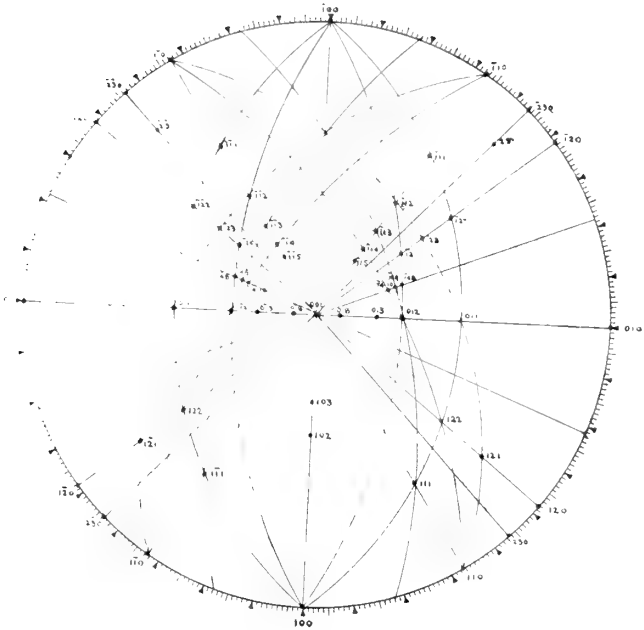
38 Datolite from Westfield Mass. Basal projection of figure 37.

39 Datolite from Westfield Mass., enlarged projection of a portion of figure 37, viewed in reversed position to show the position of the new planes.

40 Datolite from Westfield Mass. Penetration twin parallel to *a* (100); having *c* for the twinning axis. The faces *g* and *a* are composition planes.

Plate 7

36



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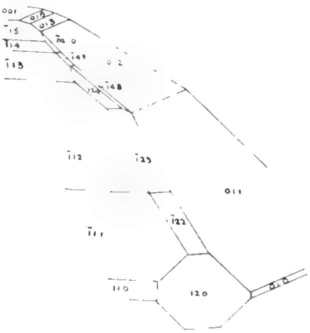

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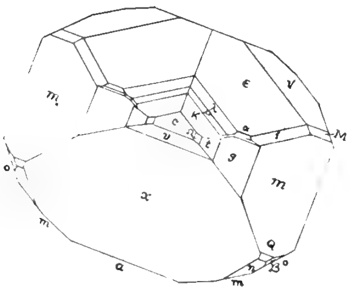

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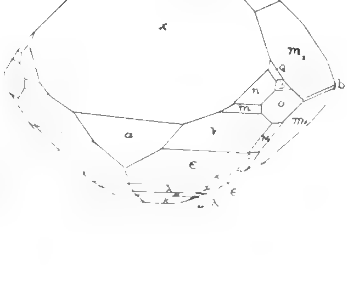

Appendix 4

Paleontology 15, 16

Museum bulletins 99, 101

15 Geologic Map of the Buffalo Quadrangle

16 Geology of the Penn Yan-Hammondsport Quadrangles

Published monthly by the
New York State Education Department

BULLETIN 371 MAY 1906

New York State Museum

JOHN M. CLARKE Director

Bulletin 99

PALEONTOLOGY 15

GEOLOGIC MAP

OF THE

BUFFALO QUADRANGLE

BY

D. D. LUTHER

New York State Education Department
Science Division, May 17, 1905

Hon. Andrew S. Draper
Commissioner of Education

My dear sir: I take pleasure in communicating herewith for publication as a bulletin of the State Museum a *Geologic Map of the Buffalo Quadrangle*, prepared on the scale of 1 mile to the inch and including the region about the city of Buffalo.

In view of the zeal with which geologic science is studied in this important center of population I am convinced that the map and the accompanying explanation thereof will appeal to a large element of our people.

Very respectfully yours
John M. Clarke
Director

Approved for publication May 18, 1905

A. S. Draper

Commissioner of Education.

New York State Education Department

New York State Museum

John M. Clarke Director

Bulletin 99

PALEONTOLOGY 15

GEOLOGIC MAP

OF THE

BUFFALO QUADRANGLE

BY

D. D. LUTHER

PREFACE

The map herewith presented affords accurate data in regard to the surface rocks and succession of strata at and in the immediate neighborhood of the second city of the State in size and importance; over an area where the rocks yield and are eagerly exploited for natural gas, natural cement and other industrial products. Students of geology in Buffalo will find the map and its accompanying text a detailed guide to the rock sections of the region and to the scattered and often obscure outcrops of the formations.

The Buffalo quadrangle embraces geologic formations which extend from the Upper Siluric well into the Upper Devonic. The tracing of the boundaries of these formations here has been beset with special difficulties arising from the essentially level character of most of the region, the absence of creeks flowing across the strike of the beds over much of the area and the presence of an all obscuring mantle of glacial drift. The boundaries are therefore to some degree constructional, but are believed to be as nearly correct as can now be determined from data of every kind.

In approaching this region from the east the Helderberg escarpment traversing the State as a notable topographic feature here becomes lessened and flattened out; again, the northern edge of the Appalachian plateau which enters the southern part of the quadrangle from the east is less pronounced than in the central part of the State. Both of these facts have led to the obscuration of the stratigraphy of the region.

The rocks of Buffalo abound in fossils often of the most interesting character. These have been cited here under their respective formation names, but for fuller accounts of the species with analytic illustrations the student must refer to the volumes of the *Palaeontology of New York.*

In the preparation of this map the territory has been carefully resurveyed by D. Dana Luther, field assistant on the geologist's staff. In this work he has had the assistance of Prof. Irving P. Bishop of Buffalo, who several years ago at the solicitation of the State Paleontologist prepared a map of the quadrangle giving the boundary lines of the formations with their broader and earlier value. Much previous work has been done in the same field. Professor Bishop prepared and published in the 15th Annual Report of the State Geologist a special account with a map of the structural and economic geology of Erie county, at a date when a detailed topographic map was not available. In 1901 Prof. A. W. Grabau prepared and published a map and descriptive account of the northern part of this region in State Museum bulletin 45, *A Guide to the Geology and Paleontology of Niagara Falls and Vicinity*, but it has been possible since then to trace the stratigraphic boundaries in much more refinement of detail. The reader may find it desirable to refer to both of these publications; the latter especially for a summary account of the fossils in the northern formations of the region. Professor Grabau has also published in the 16th Annual Report of the State Geologist and as a bulletin of the Buffalo Society of Natural Sciences, volume 6, a full descriptive account of the formations and fossils in the rocks exposed at Eighteen Mile creek, and Professor Bishop has supplemented his original report on Erie county with more recent notes on the gas wells and production of the region, in the 17th and 19th reports of the State Geologist.

John M. Clarke
State Geologist

The strata composing the surface rocks of this quadrangle as delineated on the map have an aggregate thickness of 804 feet, of which 310 feet are exposed by the difference of elevation between the lowest horizon, 570 feet above tide, where the north line of the quadrangle crosses Niagara river, and the highest land 880 feet above tide in the southeast corner near Orchard Park; 494 feet of this thickness are brought up by the northeastern elevation of the beds which thus show the average dip to be 28 feet a mile.

This dip, however, is variable as the strata roll in broad undulations, and it is also modified by changes in the thickness of the different formations throughout their extent. In the vicinity of Black Rock the dip is about 40 feet a mile toward the south, while in the southern part of the quadrangle it decreases to 25 feet.

In a well put down by the Lackawanna Steel Co. in 1904 on the bank of Smoke's creek in West Seneca, the bottom of the Onondaga limestone was found at the depth of 292 feet or 288 feet above tide, and that horizon appears in the quarry of the Buffalo Cement Co., 10½ miles north of the well at 640 feet above tide, showing a southward dip of 352 feet or an average of nearly 34 feet a mile.

SUCCESSION OF STRATA

The following formations are represented on this quadrangle:

Devonic	Neodevonic	Senecan	Portage	Rhinestreet black shale
				Cashaqua gray shale
				Middlesex black shale
			Genesee	West River shale
				Genundewah limestone
				Genesee black shale
	Mesodevonic	Erian	Hamilton	Moscow shale
				Tichenor limestone
				Ludlowville shale
				Skaneateles shale
			Marcellus	Cardiff shale
				Stafford limestone
				Marcellus black shale
		Ulsterian	Onondaga	Onondaga limestone
	Paleodevonic	Oriskanian	Oriskany	Oriskany sandstone
Siluric		Cayugan	Salina	Cobleskill waterlime
				Bertie waterlime
				Camillus shale

UPPER SILURIC

Salina beds

Camillus shale

The lowest formation exposed within the limits of the quadrangle is the Camillus shale, which is the surface rock over an area of 35 square miles north of Buffalo and Williamsville.

It is entirely covered by drift on the American side of Niagara river excepting a small outcrop at the extreme south end of Grand island. On the Canadian side the upper beds are exposed in the low cliffs along the river from a point opposite Strawberry island almost to the International bridge.

The rock at these exposures is mostly soft, light gray or olive gypseous shale; a few thin layers are harder and more blocky in structure.

About 75 feet of Camillus shale come to the rock surface on this quadrangle but these do not represent the entire formation. Its precise thickness here is not known, but well cores show that beds of gypsum, thinner and less pure toward the bottom, occur at intervals through 150 feet or more of strata.

The Vernon red shales that underlie the Camillus shale in the central part of the State have not been recognized in the deep borings about Buffalo, and if the Camillus formation is to here include all of the strata between the Guelph dolomite of the Niagaran group beneath, and the Bertie waterlime above, its average thickness as shown in 10 wells is 333 feet.

Gypsum and plaster have been mined in the Camillus shale in Genesee, Monroe, Ontario, Seneca, Cayuga and Onondaga counties in very large quantities but thus far no fossils have been found in these beds in the western part of the State. The little brackish water crustacean Leperditia alta occurs below the upper gypsum bed in Onondaga county.

Bertie waterlime

The passage from the Camillus shale to the succeeding formation is a gradual one, the gypsum slowly diminishing in quantity and the rock becoming much harder and, by the addition of alumina and carbonate of magnesia, highly dolomitic. The Bertie waterlime is usually in layers from a few inches to 2 to 3 feet thick, separated by thin seams of carbonaceous matter. Though very dark when fresh the rock weathers to a light brown or buff.

The proportion of calcareous matter varies considerably in the different layers, the composition of many of them being such as to make true hydraulic limestone or "cement rock." A bed of this character, 5 to 6 feet thick, at the top of the formation has been extensively quarried in Buffalo by the Buffalo Cement Co. and also at Williamsville for the production of natural cement. The cement produced at Akron, 12 miles east of the quadrangle, is also from the same stratum.

At the quarry of the Buffalo Cement Co. the Bertie waterlime is 53 feet thick, as shown by the core of a well drilled in 1883, now in the museum of the Buffalo Society of Natural Sciences.

This rock is exposed along the west side of Niagara river, between the International bridge and the stone church; in the bed of Scajaquada creek in Forest Lawn cemetery; very abundantly in the Buffalo Cement Co.'s quarries and at Williamsville, on this quadrangle; also at Falkirk, Indian Falls, Morganville, North Leroy, Garbuttsville, Honeoye Falls, East Victor, Phelps and other places to the east of this quadrangle; and toward the west at Bertie Ont., whence the name of the formation is derived.

This formation is characterized by an abundant and peculiar crustacean fauna; in fact it has long been famous for its strange lobsterlike fossils belonging to the extinct orders, Eurypterida and Phyllocarida and the cement quarries of Buffalo have proved veritable treasure chambers of these odd creatures. The following species have been observed in the vicinity of Buffalo.

The ostracod, Leperditia scalaris Jones, occurs abundantly in the lower part of the formation as exposed along Scajaquada creek in Forest Lawn cemetery.

The cement layer has furnished the following species of fossils:

Ceratiocaris acuminata *Hall* (Ceratiocaris grandis *Pohlman*)
Eurypterus lacustris *Hall*
E. remipes *De Kay*
E. giganteus *Pohlman*
E. pustulosus *Hall*
E. robustus *Hall*
E. pachychirus *Hall*
E. dekayi *Hall*
Dolichopterus macrochirus *Hall*
Eusarcus grandis *Grote & Pitt*
E. scorpionis *Grote & Pitt*
Pterygotus acuticaudatus *Pohlman*
P. bilobus *Huxley & Salter*
P. buffaloensis *Pohlman*
P. cummingsi *Pohlman*
P. macrophthalmus *Hall*
P. quadraticaudatus *Pohlman*
P. globicaudatus *Pohlman*
P. cobbi *Hall*
Leperditia scalaris *Jones*

Besides these crustaceans some brachiopods belonging to the genera Orbiculoidea and Lingula and some seaweeds have been found; among these Bythotrephis lesquereuxi Grote and Pitt.

Cobleskill waterlime

The bed which overlies the Bertie waterlime has lately been properly correlated by Hartnagel[1] with the Cobleskill limestone (formerly Coralline limestone) of eastern New York. Previously it

[1]State Paleontol. An. Rep't 1902. N. Y. State Mus. Bul. 69. 1903.

was referred by Bishop to the "Onondaga limestone" (in distinction from the Corniferous limestone, which in this paper is termed Onondaga limestone) and to the Manlius limestone by Clarke[1] and Grabau.[2]

The Cobleskill waterlime immediately overlies the cement layer, the transition being gradual through 2 or 3 feet of strata, above which the rock is a dark subcrystalline dolomitic limestone in uneven layers, usually but a few inches thick, separated by thin seams of carbonaceous matter. It sometimes has a brecciated appearance and after exposure is usually more or less porous, owing to the dissolving out of calcite crystals and of a small coral Cyathophyllum hydraulicum, which is very common throughout and specially so in the upper part. Though very dark colored when fresh, the rock becomes buff or light brown when exposed and it is locally known to quarrymen as "bullhead" or "pumpkin head."

The formation is 7 to 9 feet in thickness on this quadrangle, the variation being due to erosion of the upper surface and not to irregularity of deposition which the evenness of the bedding planes shows to have taken place in quiet waters.

At Falkirk, Erie co. this formation attains a thickness of 14 feet, but it becomes thinner again toward the east as far as Livingston county; then it increases slowly to 10 feet in Herkimer county, again diminishing to 6 to 8 feet in the Hudson valley. The rock is fairly fossiliferous, the most abundant form being the small coral Cyathophyllum hydraulicum Simpson.

Besides this are found in Erie county:

Nematophytum crassum *Penhallow*
Favosites *sp.*
Orthothetes interstriatus *Hall* (=O. hydraulicus *Whitfield*)
Spirifer eriensis *Grabau*
Whitfieldella sulcata *Vanuxem*
W. nucleolata *Hall* var.
W. *cf.* laevis *Whitfield*
Rhynchonella *sp.*
Loxonema?
Pleurotomaria?
Trochoceras gebhardi *Hall*

There are good exposures of this formation on Scajaquada creek in Forest Lawn cemetery; in the Buffalo Cement Co.'s quarries; in Miller's quarry and at Williamsville on this quadrangle, and at Akron, Falkirk, Indian Falls, Morganville, North Leroy, East Victor, Union Springs, DeWitt, Cobleskill, Rondout and many other places in the central and eastern parts of the State.

[1] N. Y. State Mus. Mem. 3. 1900.
[2] Geol. Soc. Am. Bul. 1900. v. 11.

DEVONIC

The division line between the great Siluric and Devonic systems is well marked here on account of the entire absence of Helderbergian limestones, which in the eastern part of the State represent the earlier stages of Devonic deposition.

Its peculiarities in this area have been fully noted by Clarke,[1] Grabau,[2] and Hartnagel[3] and are briefly stated below.

Oriskany sandstone horizon

The Cobleskill waterlime is the highest Siluric formation represented on the Buffalo quadrangle. The Paleodevonic strata rest unconformably on it, the Rondout waterlime and the Manlius limestone not extending into the western part of the State. The surface of the Cobleskill gives unmistakable evidence of having suffered considerable erosion in the long period during which those formations were being deposited. The most important facts indicating this interval of erosion are the following:

In the Buffalo Cement Co.'s quarries well defined channels and irregular depressions make the surface of the stratum exceedingly rough and hummocky and its line of contact with the superjacent formation as seen in the quarry walls very uneven.

In the bottom of some of these depressions there appear thin masses of dark shale and a conglomerate composed principally of small waterworn fragments of waterlime in a matrix of indurated quartz sand. Because of the extremely slender representation of this formation it is not introduced on the map.

In the quarry wall there are two fissures that extend from the top of the Cobleskill to the bottom of the cement layer. They have been filled with this quartz sand and are covered by a few inches of the conglomerate. This filling of the fissures has been considered as Oriskany sediment by Clarke[1], and the erosion interval as comprising the Helderbergian and part of Oriskanian ages.

At Falkirk, Erie co., and Indian Falls, Genesee co., the character of the deposits in the horizon of this erosion interval is still similar to those on this quadrangle, but farther east the broad lentils of characteristic Oriskany sandstone appear in it.

At Morganville the sandstone is 4 feet thick; in the salt shaft at Livonia, 4 feet, 6 inches; at Honeoye Falls, 1 foot, 2 inches; at North Leroy and Victor only the conglomerate is present; at

[1] N. Y. State Mus. Mem. 3. 1900. p.96–98.
[2] Geol. Soc. Am. Bul. 1900. v.11. p.357–61.
[3] State Paleontol. An. Rep't 1902. N. Y. State Mus. Bul. 69. 1903. p.1138.

Phelps, 4 feet, 2 inches of sandstone. In the central and eastern part of the State this formation is an interrupted deposit having at some exposures the character of an arenaceous limestone 1 to 3 feet thick while at Union Springs, Onondaga Valley, Oriskany Falls and other localities it is a friable, light colored and rather coarse sandstone containing an abundance of fossils. It attains a thickness of more than 20 feet in a lentil in the northeast corner of the town of Skaneateles, Onondaga co.[1]

Onondaga limestone

This important deposit is a compact, dark bluish gray limestone bedded in layers from 3 inches to 2 feet thick and carrying interbedded nodules and nodular layers of chert.

The limestone contains a large amount of carbonaceous matter, which appears in the shaly partings and on the surface of the layers discoloring and giving them a black appearance. This carbonaceous admixture is removed by slow decomposition on exposure and the rock then assumes a very light bluish gray color.

The chert, as a rule, is nearly black and slightly translucent, but sometimes lighter colored and bluish. It is very unevenly distributed in the beds; in some it largely predominates and in others it is entirely absent. It forms nodular layers which are frequently continuous for long distances. Outcrops of these and boulders of the cherty limestone that have been long exposed present a peculiarly ragged and scraggly appearance, owing to the superior resistance to decomposing agencies that the chert possesses over the limestone.

At some outcrops a very small portion of the formation is shaly, but all of the remainder wherever the amount of chert is not too large, is somewhat compact and durable and exceedingly valuable as building stone and for the production of quicklime.

At the base of the formation, filling the depressions in the Cobleskill waterlime and varying greatly in thickness, there occurs a stratum of limestone almost entirely free of chert, and embracing lenses of considerable extent wholly composed of corals.

The latter stratum is but 5 inches thick in the bed of Scajaquada creek at the Main street bridge; 7 feet in an old quarry in Forest Lawn cemetery; 5 feet, 6 inches in the park quarry; 5 feet in the southern part of the Buffalo Cement Co.'s quarry and less than 2 feet in the northern. It is a veritable coral reef, 35 feet

[1]These lentils of sandstone in the strike of the Oriskany formation have been described by Clarke. Amer. Ass'n: Adv. Sci. Proc. 1900; Science. Dec. 28, 1900.

thick in Fogelsonger's quarry at Williamsville and in Quinn's quarry 2 miles farther east, but decreases rapidly to 3 feet a short distance beyond. The bed is recognizable continuously toward the east along the Helderberg escarpment to Albany county, varying in thickness but maintaining the same general character, and is quarried all along this line of outcrop, furnishing a large amount of building and dimension stone of fine quality.

The succeeding beds, which contain a large proportion of chert, are also quarried extensively, furnishing excellent material for road making and concrete. Some layers in the upper beds are again almost free from chert at certain localities.

The lower Onondaga limestone beds are well exposed on the west side of Niagara river at Black Rock and slightly on its east side; also in Forest Lawn cemetery; also extensively in the Buffalo Cement Co.'s quarries and thence northeastward to Fogelsonger's quarry and Williamsville. Larger exposures of the middle and upper part of the formation may be seen in quarries in the region extending on both sides of Fillmore avenue from Leroy avenue to Delevan and from Leroy avenue to Worcester place and along Delevan avenue to Dutton; also in Cutter & Bailey's quarry at the intersection of Bailey avenue and the New York Central Railroad.

Beyond the limits of this quadrangle extensive exposures embracing the entire section of this formation are found in the vicinity of Leroy, Genesee co.; Phelps, Ontario co.; Union Springs, Cayuga co. Marcellus, Onondaga Valley, Jamesville and Manlius, Onondaga co. and at other localities still farther east in the State.

The average thickness of the Onondaga limestone in 12 wells in this vicinity according to driller's records is 168 feet. In the carefully kept record of the Lackawanna Steel Co.'s well on Smoke's creek 1904, it is given as 162 feet. It is somewhat less in the eastern part of the quadrangle. At the Livonia salt shaft in Livingston county it is 136 feet; in the deep well at Ithaca, 78 feet; in Onondaga county, 65 feet; at Clarksville, Albany co., 85 feet and at Countryman hill, 100 feet.

This formation is exceedingly rich in remains of animal life but it is frequently quite difficult to obtain good specimens. There have been found in it 3 species of fish; 39 of crustaceans, mostly trilobites; 13 of cephalopods; 3 of pteropods; 38 of gastropods; 15 of lamellibranchs; 48 of brachiopods; many bryozoans and corals and a few crinoids. Some of the more common fossils are: the trilobites Odontocephalus selenurus and Phacops cristata var. pipa; the cephalopods, Cyrtoceras undulatum and Gyroceras trivolve, and the brachiopods, Atrypa reticularis, Leptaena rhomboidalis, Stropheodonta concava, S. inaequistriata, Spirifer acuminatus and S. divaricatus and others.

Marcellus beds

Marcellus black shale

The term Marcellus shale has been generally applied in New York geology to the series of black and dark blue shales which lie immediately on the Onondaga limestone and at the top pass gradually into the lighter colored Hamilton shales. At Marcellus, Onondaga co., from which place the name is derived, only the lower layers are well exposed and observations in that region and in the western part of the State indicate the desirability of restricting the term to the lower shales, exposed at the type locality, thereby obtaining a more exact basis for correlation.[1]

From Ontario county westward the thin Marcellus black shale is delimited upward by the Stafford limestone. The rock is a densely black and highly bituminous slaty shale with a few thin calcareous layers and rows of spherical concretions.

Neither the lower nor upper contacts with the limestones are exposed on this quadrangle, and the shales nowhere come to the surface. The thickness of the formation can therefore only be estimated or obtained from well records.

The beds are 41 feet thick in the Livonia salt shaft and contain a 5 foot stratum of soft limestone, 27 feet below the top. The most western exposure of the Marcellus shale is in the bed of Plumbottom creek at Lancaster, 6 miles east of the east line of this quadrangle. A layer of limestone 1 foot thick forming there the bottom of the outcrop and separated by 18 to 20 feet of black shale from the Stafford limestone probably represents the five foot stratum of the Livonia salt shaft. Since the contact with the Onondaga limestone is not exposed at this locality it fails to furnish information on the entire thickness of the Marcellus shale. This has been obtained in the well on Smoke's creek, previously mentioned, where a total thickness of 55 feet has been measured.

The fauna of the black shales is small and fossils are rare except

[1] N. Y. State Mus. Bul. 63, p. 14.

at the base of the formation. The limestones are, on the contrary, highly fossiliferous and often entirely composed of shells. The fauna of the Marcellus shales and limestones of Lancaster has been thoroughly studied by Wood,[1] who records as the most common forms of the shale Styliolina fissurella Hall, Chonetes mucronatus Hall, Strophalosia truncata Hall, Pterochaenia fragilis Hall and Liorhynchus limitare Vanuxem. The lowest shale exposed proved to contain abundant ostracod valves, belonging to the species Isochilina (?) fabacea Jones and Primitiopsis punctulifera Hall.

Stafford limestone

On Flint creek in the town of Phelps, Ontario co., the Marcellus shales are capped by a 4 inch layer of dark chocolate limestone which is very hard when fresh but breaks easily into angular fragments after exposure. It is not known farther east but increases westward from 2 feet or more at the Livonia salt shaft to nearly 4 feet at Stafford, where it is well exposed and whence the name is derived, and to 8 feet, 4 inches at Lancaster, Erie co. The record of the Smoke's creek well makes it even 15 feet thick at that point. There are no exposures of the entire formation on this quadrangle but the upper layers outcrop to the thickness of nearly 6 feet in the bed of Buffalo creek opposite the end of the Winchester road, ¾ mile east of South Buffalo and 1½ miles south of the junction with Cayuga creek, at which latter point there is a small exposure of Onondaga limestone.

The Stafford limestone is here a compact bluish gray limestone, mostly in thick layers and bearing a strong resemblance to the Onondaga limestone by the admixture in considerable proportion of dark chert in nodules and nodular layers. It has been found in excavations at several places southwest from this exposure but nowhere comes to the surface and its precise position on the lake shore is not known, the bed being completely buried under heavy drift cover.

Besides the exposures previously mentioned it appears in the east bank of the Oatka river at Leroy and along the outlet of Conesus lake at Littleville near Avon.

Fossils are abundant in the Stafford limestone at Lancaster, specially in the upper part and some layers are entirely made up of

[1] N. Y. State Mus. Bul. 49. 1901, p. 139-81.

shells of Strophalosia truncata and Ambocoelia nana. Miss Wood records a total of 72 species. The more common and characteristic of these are:

Ambocoelia nana *Grabau*
Chonetes mucronatus *Hall*
C. scitulus *Hall*
Liorhynchus limitare (*Vanuxem*)
Strophalosia truncata (*Hall*)
Meristella barrisi *Hall*
Spirifer (Martinia) subumbonus *Hall*
Cypricardinia indenta (*Conrad*)
Orthoceras exile *Hall*
O. marcellense *Vanuxem*
Phacops rana (*Green*)
Primitiopsis punctulifera *Hall*

Cardiff shale

The upper beds usually included in the old term Marcellus, and designated by Vanuxem the "Upper shales of Marcellus" are abundantly exposed about the village of Cardiff, Onondaga co., and recently have been named from that locality.[1]

This division consists of a series of dark calcareous and black slaty shales with thin layers of fossiliferous limestone. Rows of spheric concretions occur in the lower part at some localities. The fossil contents are not essentially different from those below the Stafford limestone, but the shales are more calcareous and weather, specially in the upper beds, to an ashen gray.

The beds immediately above the Stafford limestone are not exposed on this quadrangle but an exposure beginning near the New York Central Railroad bridge over Buffalo creek, ¼ mile west of the outcrop of Stafford limestone previously mentioned and not more than 15 feet above it, extends along the bed of the stream to Gardenville and the east line of the quadrangle. The lower shales outcrop on Cazenovia creek at the park just above Cazenovia street, and the upper beds at the covered bridge, nearly 2 miles farther up the creek.

At West Seneca outcrops occur in the line of Smoke's creek between White's Corners and the western New York and Pennsylvania Railroad and at the north end of the low cliff on the lake shore at Bay View.

The more important exposures of the Cardiff shales toward the east are along Plumbottom creek at Lancaster; along Oatka river at Leroy; Conesus outlet at Littleville near Avon; Flint creek near Orleans, Ontario co. and in the vicinity of Marcellus and Cardiff in Onondaga county.

The thickness of the Cardiff shales on this quadrangle is estimated to be 45 feet. In Ontario county it is 100 feet and at Cardiff, Onondaga co. 175 feet.

[1] N. Y. State Mus. Bul. 63. 1903. p. 16.

In the exposure of the lower and more calcareous beds of the Cardiff shales, immediately overlying the Stafford limestone at Lancaster the following species of fossils were found by Wood:

Ceratopora dichotoma *Grabau*
Chonetes lepidus *Hall*
Liorhynchus limitare (*Vanuxem*)
Atrypa reticularis (*Linné*)
Ambocoelia umbonata (*Conrad*)
Meristella barrisi *Hall*
Pterochaenia fragilis (*Hall*)
Styliolina fissurella (*Hall*)
Orthoceras aegea *Hall*
Phacops rana (*Green*)

Tornoceras uniangulare and Orbiculoidea minuta are common fossils in this horizon in Livingston and Ontario counties.

Hamilton beds

Skaneateles shale

This term was applied by Vanuxem to the beds immediately overlying the upper Marcellus (Cardiff) shale and exposed on both sides of the north end of Skaneateles lake. It subsequently fell into disuse when the term Hamilton group, employed by Vanuxem for certain beds of shales at West Hamilton, Madison co. had been extended to all the formations lying between the Onondaga and Tully limestones. When recently the State survey found itself compelled to adopt more exact and refined classification of the strata than that hitherto in use, the term Skaneateles shale was reapplied in its original meaning and scope. The Skaneateles shale is the lowest division of the Hamilton beds.

At the base the shales are hard, dark bluish or black and calcareous, passing into somewhat lighter and softer beds above, and containing several rows of small concretions. On the lake shore south of Bay View the division is 40 feet thick. It increases toward the east and has a thickness of 125 feet in Ontario county and of 335 feet in the Onondaga valley in Onondaga county.

The entire section of the Skaneateles shale is exposed in the cliff along the lake shore between the Bay View and Athol roads and along the south branch of Smoke's creek, 1 mile east of Blasdell, The Skaneateles shale also outcrops along the north branch of Smoke's creek ½ mile west of Reserve and along Cazenovia creek ½ mile east of Reserve.

At Blossom, 3 miles beyond the eastern boundary of this quadrangle, a bed of hard limestone 4 feet thick at or near the base of the Skaneateles shale contains many cyathophylloid corals and other fossils. The bed becomes softer toward the west and the corals disappear. It is a shaly limestone where it outcrops on the south branch of Smoke's creek a mile below Windom, and a 2 foot band of calcareous shale in the cliff at Bay View.

Outside of this quadrangle the Skaneateles shale is exposed in the bed of Mud creek below Wheeler in Ontario county; in Great gully, 3 miles south of Union Springs, Cayuga county, and in the Bear mountain ravine near Tully valley in Onondaga county.

Fossils are rare except in the lower calcareous shale. The following is a list of fossils reported as obtained from these shales by A. W. Grabau:

Phacops rana (*Green*)
yphaeus boothi (*Green*)
Primitiopsis punctilifera (*Hall*)
Orthoceras *sp.*
Tentaculites gracilistriatus *Hall*
Styliolina fissurella (*Hall*)
Euomphalus (Phanerotinus) laxus *Hall*
Bellerophon leda *Hall*
Pterochaenia fragilis (*Hall*)
Nuculites triqueter *Conrad*
Orthothetes arctostriatus *Hall*
Chonetes mucronatus *Hall*
C. setigerus *Hall*
C. scitulus *Hall*
C. lepidus *Hall*
Productella spinulicosta *Hall*
Strophalosia truncata *Hall*
Spirifer mucronatus (*Conrad*)
Ambocoelia umbonata (*Conrad*)
Liorhynchus limitare (*Vanuxem*)
Tropidoleptus carinatus (*Conrad*)
Crinoid stems

Ludlowville shale

This formation embraces that part of the rock section extending from the base of a 6 inch layer of soft limestone capping the Skaneateles shale and containing Strophalosia truncata abundantly, to the Tichenor limestone. The term applied to this member of the series is one of the earliest in the New York nomenclature and the occasion of its revival is explained in Museum bulletin 63, p. 17–20, 1904.

The shale is mostly fine, soft and evenly bedded, light to dark bluish gray in color and but slightly calcareous. In the lower part there are several thin layers of limestone and calcareous concretions are common. Next above the Strophalosia bed above mentioned, a stratum of concretionary limestone contains Nautilus magister; another, 10 feet higher and 3 feet thick, contains many trilobites; and a thinner one, 8 feet below the top of the formation, contains Athyris spiriferoides in large numbers.

The calcareous layers at some outcrops consist merely of rows of broad flat concretions and their number and relative positions vary greatly in different exposures; one or another may disappear entirely and a new one come in at a higher or lower horizon.

This formation is 60 feet thick in the southwestern corner of this region and increases toward the east at an average rate of about 1 foot a mile to Ontario county, where it is 125 feet thick. Farther east it increases more rapidly and attains a thickness of 350 feet in the Tully valley in Onondaga county.

The extreme western exposure of the Ludlowville shale in New York is at the base of the south shore cliffs, which extend for 1½ miles southwest from the mouth of Eighteen Mile creek, 5½ miles beyond the south line of this quadrangle. The lower beds in the cliffs at Idlewild and nearly all of those exposed in Wanakah cliff belong to the Ludlowville shale.

On this quadrangle good exposures may be seen along Avery's creek where the limestones at the base of the formation produce a small cascade just above the lake shore highway bridge; along Rush creek, near Wosgwah station of the Hamburg Electric Railroad; along the south branch of Smoke's creek near Windom; along its east branch, 1 mile southwest from Reserve and along Cazenovia creek, 1 mile east from Reserve.

There are further large exposures of these beds at several localities east of this quadrangle, some of the best being in Ontario county on Shaffer's creek and in the lower part of the ravines on both sides of Canandaigua lake north of Menteth point; on the shore of Cayuga lake between Aurora and King's Ferry from 10 to 16 miles north of Ludlowville; and in Onondaga county, in the Bear mountain and Fellows falls ravines; in the Tully valley and at Pratt's falls in Pompey.

The Ludlowville shales abound in fossils most everywhere. Dr Grabau's list of those obtained from this horizon in the vicinity of Eighteen Mile creek names 120 species, embracing 6 crustaceans, 4 cephalopods, 4 pteropods, 29 lamellibranchs, 50 brachiopods, 1 crinoid, 8 bryozoans and 7 anthozoans.

Some of the more prominent or abundant forms are:

Phacops rana (*Green*)
Crypheus boothi *Green*
Nautilus magister *Hall*
Orthoceras nuntium *Hall*
Tentaculites gracilistriatus *Hall*
Styliolina fissurella (*Hall*)
Platyceras attenuatum *Hall*
Diaphorostoma lineatum (*Hall*)
Pterinea flabellum (*Conrad*)
Actinopteria decussata *Hall*
Modiomorpha subalata (*Conrad*)
Paleoncilo tenuistriata *Hall*
Cypricardinai indenta *Conrad*
Stropheodonta demissa (*Conrad*)
Leptostrophia perplana (*Conrad*)
Rhipidomella vanuxemi *Hall*
Orthothetes arctostriatus *Hall*
Chonetes lepidus *Hall*
Chonetes scitulus *Hall*
Spirifer mucronatus (*Conrad*)
Sp. granulosus (*Conrad*)
Sp. subumbonatus *Hall*
Sp. fimbriatus (*Conrad*)
Ambocoelia umbonata (*Conrad*)
Athyris spiriferoides (*Eaton*)
Atrypa aspera (*Dalman*)
Camarotoechia dotis *Hall*
Liorhynchus multicostum *Hall*
Tropidoleptus carinatus (*Conrad*)
Stictopora incisurata *Hall*
Pleurodictyum stylopora (*Eaton*)
Streptelasma rectum *Hall*

Tichenor limestone

This name is applied to a stratum of crinoidal limestone 1½ to 2 feet thick that is persistent toward the east for more than a hundred miles, maintaining the same general character and varying but slightly in thickness. It has been commonly known as the Encrinal limestone, a name applied to it by Hall in 1839. Since the latter term, in the Genesee valley and Canandaigua lake sections, has been applied by others to limestone layers of similar character but occurring at distinctly different horizons, confusion had arisen and a more distinctive appellation for this stratum become imperative. It has therefore been designated Tichenor limestone[1] from its typical exposure in the ravine at Tichenor Point on Canandaigua lake and along the shore toward the south.

It is usually a single compact layer, hard and durable, but at some outcrops the upper or lower part is somewhat shaly, and in the cliff on Smoke's creek near Windom it is separated in two layers, the lower one 15 inches and the upper 9 inches thick.

This stratum emerges from the waters of Lake Erie near the mouth of Pike creek, 5½ miles southwest from the southern limit of this quadrangle on the lake shore, and forms a conspicuous band in the stratigraphy of the south shore at Idlewild and Wanakah cliffs.

At Hamburg-on-the-lake it passes half a mile, and at Athol Springs 200 yards east of the railroad; at Big Tree it is exposed at 640 feet above tide in the railroad cutting near Rush creek and on the banks of the stream near the farmhouse above. At Windom it appears at 680 feet above tide in the banks of Smoke's creek for some distance near the station and crosses the bed of the stream ⅛ mile further up.

It is also exposed on the east branch of Smoke's creek, 1 mile southwest from Reserve at the top of a cascade 30 feet high, southeast of Reserve along a small brook that empties into Cazenovia creek.

The Tichenor limestone carries an abundant fauna. Dr Grabau's list contains the names of 60 species occurring in this region, of which the following are the more abundant or striking forms:

Phacops rana (*Green*)
Diaphorostoma lineatum (*Hall*)
Modiomorpha concentrica (*Conrad*)
Rhipidomella vanuxemi *Hall*
R. penelope *Hall*
Spirifer granulosus (*Conrad*)
S. mucronotus *Hall*
Vitulina pustulosa *Hall*
Centronella impressa *Hall*
Cryptonella planirostra *Hall*
Tropidoleptus carinatus (*Conrad*)
Favosites hamiltoniae *Hall*

[1] N. Y. State Mus. Handbook 19. 1903. p. 22.

Moscow shale

This formation rests on the Tichenor limestone and consists of soft, light bluish gray shales that are usually somewhat calcareous and embrace several courses of concretions. The latter become at some exposures continuous concretionary layers crowded with fossils. In the central part of the State, from Ontario to Chenango counties, the Moscow shale is separated from the black Genesee shale above by the Tully limestone. But both the Genesee shale and the Tully limestone fail to extend to this quadrangle as distinct formations. On Canandaigua lake and westward as far as this quadrangle the Tully horizon is marked only by thin lentils of iron pyrites and the Genesee black shale though 90 feet thick in Ontario county thins out toward the west to so great an extent that it barely reaches the eastern part of this quadrangle, being there but a few inches thick. As a lithologic unit it is absent in the exposures on Smoke's creek and Rush creek and along the lake shore, for no black shales appear between the top of the Moscow shale and the Genundewah limestone. Genesee fossils, however, are found a few inches below the Genundewah limestone in beds of light colored shale and soft limestone, that contain also a small number of Tully and Hamilton species.

Including the 12 to 15 inches of transitional beds at the top just mentioned, the Moscow shales are 17 feet thick at Eighteen Mile creek. Increasing rapidly toward the north and east they measure 52 feet on the south branch of Smoke's creek at Windom, where the entire formation is favorably exposed between the two crossings of the electric railroad over the stream. There are also some slight exposures above the Tichenor limestone along the railroad and Rush creek near Big Tree.

The Moscow shales are everywhere exceedingly rich in fossils, but the specimens are, as a rule, not so well preserved as in the Ludlowville shale, and there is little difference between the faunas of the Moscow and Ludlowville shales. Dr Grabau reports 51 species from the latter in the Eighteen Mile creek region and the following are the common forms:

Phacops rana (*Green*)
Tentaculites gracilistriatus *Hall*
Palaeoneilo tenuistriata *Hall*
Pholidops hamiltoniae *Hall*
Spirifer tullius *Hall*
S. consobrinus *d'Orbigny*
Chonetes deflectus *Hall*
C. mucronatus *Hall*
Leptostrophia perplana (*Conrad*)
Ambocoelia umbonata (*Conrad*)
Atrypa reticularis (*Linnè*)
A. aspera (*Dalman*)
Streptelasma rectum *Hall*
Cystiphyllum conifollis *Hall*

Tully horizon

No exposures of the thin lentils of iron pyrites that occur frequently at this horizon from Canandaigua westward to Erie county are found on this quadrangle, but a few species characteristic of the Tully limestone occur in the upper layers of the Moscow shale.

Genesee beds

Genesee black shale

As noted before the Genesee black shale is absent here with the possible exception of a few inches of black shale near the eastern border; on the south shore cliffs at North Evans, however, it is again represented by 1 foot of characteristic shale.

Genundewah limestone

The Genundewah limestone is a member of the Genesee shale series in west central and western New York. While the Genesee black shale disappears toward the west from the Genesee river, this limestone intercalation persists to the shore of Lake Erie. It is an irregular stratum of concretionary limestone 1 to 2 feet thick, extending across the quadrangle and finely exposed on the south branch of Smoke's creek on the south side of the upper railroad bridge at Windom. It continues beyond the quadrangle toward the southwest to a mile south of the mouth of Pike creek where it dips under the water of the lake and toward the east to the vicinity of Seneca lake, having its highest development at Genundewah point on Canandaigua lake.

Other good exposures besides those at Genundewah point and the ravines toward the north, may be found in the ravine at Bristol Centre and in Mill gull on Honeoye lake in Ontario county; at Eagle point on Conesus lake; on the Genesee river at Mt Morris, Livingston co.; in a small ravine 2 miles north of Wyoming, Wyoming co. and at Griswold station, 6 miles west of Attica.

In the Genesee valley and Canandaigua lake sections the formation has a thickness of 6 to 8 feet and is composed of several thin nodular or compact limestones separated by black shales.

The Genundewah limestone is in many places composed almost entirely of the shells of the minute pteropod Styliolina fissurella, and from that fact has been also designated the Styliola limestone. But this peculiar pteropod ooze has also furnished an exceedingly interesting fauna of other forms. Goniatites, lamellibranchs and gastropods appeared in great numbers and in species characteristic of the later Naples fauna. Dr Clarke has for this reason designated the fauna of the Genundewah limestone as a prenuncial fauna.[1] Among the most interesting members of this fauna are the following:

Dinichthys newberryi *Clarke*
Spathiocaris emersoni *Clarke*
Tentaculites gracilistriatus *Hall*
Protospirialis minutissima *Clarke*
Manticoceras pattersoni *var.* styliophilum *Clarke*
M. contractum *Clarke*
M. fasciculatum *Clarke*
M. nodiferum *Clarke*
Gephyroceras genundewa *Clarke*
Tornoceras uniangulare (*Conrad*)
Loxonema noe *Clarke*
Pleurotomaria genundewa *Clarke*
Protocalyptraea styliophila *Clarke*
Phragmostoma natator *Hall*
P. incisum *Clarke*
Bellerophon koeneni *Clarke*
B. denckmanni *Clarke*
Macrochilina pygmaea *Clarke*
M. seneca *Clarke*
Lunulicardium hemicardioides *Clarke*
L. encrinitum *Clarke*
Honeoyea styliophila *Clarke*
Pterochaenia fragilis *Hall*
P. sinuosa *Clarke*
Buchiola? livoniae *Clarke*
B. scabrosa *Clarke*
Paracardium doris *Hall*
P. delicatulum *Clarke*
Melocrinus clarkii (*Hall*) *Williams*
Aulopora annectens *Clarke*

West river shale

Professor Hall separated the Genesee slate in order to indicate its bituminous character by a distinct name. Subsequently the formation here described as West River shale was incorporated into the Genesee shale as upper Genesee shale, but the different lithologic characters of the two, the absence of the bituminous character in the upper shales and the intercalation of a distinct limestone between the two have demonstrated the necessity of subdivision and of separate designations. The term West River shale has been proposed for these lighter shales, overlying the Genundewah limestone [*see* N. Y. State Mus. Bul. 63. 1904. p. 59].

This formation consists mainly of fine dark gray or bluish black shales, thinly laminated and highly fissile. They are slightly calcareous and become lighter colored on exposure. Layers of bituminous black shale and thin limestone occur in the lower part. Concretions and the septaria known as "turtle stones" are common in these beds farther east and also thin sandy flags occur, though rarely.

The West River shale is 12 feet thick, where exposed on the south branch of Smoke's creek above the upper railroad bridge at Windom.

[1]State Geol. An. Rep't 1896. 1899. p. 38; N. Y. State Mus. Mem. 6. 1904. p. 203.

It is 65 feet thick at the mouth of the Genesee river gorge at Mt Morris and 90 feet in Ontario county. There are large exposures of these beds at Mt Morris, on the shores of Conesus and Honeoye lakes, in the Bristol valley, at the head of Canandaigua lake and in the West River valley in Yates county.

Pterochaenia fragilis is abundant in thin layers of this shale at the exposure on Smoke's creek south of Windom. Other fossils are exceedingly rare.

Portage beds

Middlesex black shale

As in the case of the Hamilton beds and other larger divisions it has also become necessary to recognize the distinct component units of the Portage division by separate terms. The Middlesex black shale is the lowest of the subdivisions of the former Portage group. It is abundantly exposed in the Middlesex valley in Yates county, whence the name [*see* N. Y. State Mus. Mem. 6 and Handbook 19]. It appears as a bed of densely black slaty shale 6 feet thick superjacent to the West River shale at Windom; is found on Eighteen Mile creek and the south shore cliffs and well exposed on Pike creek.

It may be easily distinguished at nearly all of the outcrops from the West River shale by its darker color and more bituminous character. Like all the preceding divisions, it increases slowly in thickness toward the east and is 35 feet thick in Ontario county, where a few thin sandstone slabs and hard blue shales are interstratified at the bottom and near the top.

The Middlesex shale contains very few fossils, but Lingula ligea is common in this horizon on Pike creek, North Evans; and it occasionally carries in the central part of the State Sandbergeroceras syngonum, Pterochaenia fragilis and Spathiocaris emersoni, together with plant and fish remains.

Cashaqua shale

The Cashaqua shale is another well characterized subdivision of the Portage beds, for which the original name given by the early geologists has been revived. The type locality of this formation is along Cashaqua creek, a confluent of the Genesee river. The formation is composed of light blue-gray or olive soft shales in which are interbedded at frequent intervals concretionary calcareous layers 2 to 4 inches thick. Layers of dark or black shale occur, but these are quite rare and very thin, and also rows of spheric or oblong and flattened concretions. Eight feet of the shales at the top of the beds are somewhat darker and harder than those below.

The Cashaqua beds are 32 feet thick in the exposure at the south shore cliffs and in the bed of Pike creek at North Evans. They extend in long flat outcrops in the bed and banks of Smoke's creek, ½ mile south of the upper electric railroad bridge at Windom, and are slightly exposed along the roadside on the hill above the schoolhouse 1 mile south of Big Tree.

The average thickness of the formation on this quadrangle is 45 feet. The thickness increases toward the east and is 165 feet in the Genesee river gorge at Mt Morris and along Cashaqua creek above Sonyea; and at Naples, in Ontario county, it even attains 230 feet.

Nearly all of the northward flowing streams in the eastern part of Erie county and in Wyoming, Livingston and Ontario counties have excavated ravines in the Cashaqua shales, producing large and favorable exposures. Among the best of these are: the ravine of Murder creek at Griswold on the Erie Railroad 6 miles west of Attica; in the Oatka river valley in the vicinity of Wyoming; in the Genesee river gorge between Mt Morris and Smoky Hollow; along Cashaqua creek between Sonyea and Tuscarora; in the ravines along the sides of Conesus and Honeoye lakes and in the southern part of the Bristol valley and in Parrish gully and other ravines at Naples.

Fossils are fairly common in the shales and also in the concretions and they increase in frequency from the lower to the upper beds. The more abundant forms in this vicinity are:

the goniatites

Probeloceras lutheri *Clarke*
Gephyroceras holzapfeli *Clarke*
G. *cf.* domanicense *Holzapfel*

the lamellibranchs

Lunulicardium pilosum *Clarke*
Pterochaenia fragilis (*Hall*)
P. elmensis *Clarke*
Buchiola retrostriata (*v. Buch*)
B. lupina *Clarke*
Paleoneilo petila *Clarke*

the gastropod

Loxonema noe *Clarke*

Rhinestreet black shale

This shale consists of a heavy mass of black, bituminous, slaty shale, in which there are a few thin bands of dark bluish, rather hard shale, usually from 2 to 5 feet thick. The latter contain large symmetric concretions and septaria, some of which attain a diameter of 6 to 8 feet. The formation has a total thickness of about 200 feet on the lake shore in the town of Evans and is 165 feet thick in the southeast corner of this quadrangle. Its lower beds appear along Smoke's creek, 1½ miles south of Windom and some of the shales and concretions near the middle along a branch of the same stream ½ mile west of Orchard Park.

Unlike every other formation represented on this quadrangle except the Bertie waterlime, it becomes thinner toward the east, diminishing at the rate of 1½ feet a mile to Naples, Ontario co., where it measures 21 feet. It may be seen at nearly all of the exposures of the Cashaqua shale at and above cascades produced by its superior resistance to the erosive power of the streams.

Common Portage fossils occur but sparingly in the lighter bands in the western part of the State, and the black shales have been found to contain very few fossils except plant and fish remains and a few conodont teeth.

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New York State Education Department

New York State Museum

PUBLICATIONS

Postage or express to places outside of New York State must be paid in addition to the price given. On 10 or more copies of any one publication 20% discount will be given, the buyer to pay transportation. Editions printed are only large enough to meet special claims and probable sales. When the sale copies are exhausted, the price for the few reserve copies is advanced to that charged by secondhand booksellers, in order to limit their distribution to cases of special need. Such prices are inclosed in [ ]. All publications are in paper covers, unless binding is specified.

Museum annual reports 1847–date. *All in print to 1892, 50c a volume, 75c in cloth; 1892–date, 75c, cloth.*

These reports are made up of the reports of the Director, Geologist, Paleontologist, Botanist and Entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Director's annual reports 1904–date.

These reports cover the reports of the State Geologist and of the State Paleontologist. Bound also with the Museum reports of which they form a part.
Report for 1904. 138p. *20c.* Report for 1905 in press.

Geologist's annual reports 1881–date. Rep'ts 1, 3–13, 17–date, O; 2, 14–16, Q.

In 1898 the paleontologic work of the State was made distinct from the geologic and was reported separately from 1899–1903. The two departments were reunited in 1904, and are now reported in the Director's report.

The annual reports of the original Natural History Survey, 1837–41, are out of print.

Reports 1–4, 1881–84, were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

Report	*Price*	*Report*	*Price*	*Report*	*Price*
12 (1892)	$.50	17	$.75	21	$.40
14	.75	18	.75	22	.40
15, 2v.	2	19	.40	23	.45
16	1	20	.50	[*See* Director's annual reports]	

Paleontologist's annual reports 1899–date

See first note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Those for 1901–3 were issued as bulletins. In 1904 combined with the Director's report.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882–date.

Reports 3–20 bound also with museum reports 40–46, 48–58 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3–4, 17 are out of print, other reports with prices are:

Report	*Price*	*Report*	*Price*	*Report*	*Price*
1	$.50	9	$.25	15 (En 9)	$.15
2	.30	10	.35	16 (" 10)	.25
5	.25	11	.25	17 (" 14)	.30
6	.15	12	.25	18 (" 17)	.20
7	.20	13	.10	19 (" 21)	.15
8	.25	14 (En 5)	.20	20 (" 24)	.40
				21 *In press*	

Reports 2, 8–12 may also be obtained bound separately in cloth at 25c in addition to the price given above.

Botanist's annual reports 1867–date.

Bound also with museum reports 21–date of which they form a part; the first Botanist's report appeared in the 21st museum report and is numbered 21. Reports 21–24, 29, 31–41 were not published separately.

Separate reports for 1871–74, 1876, 1888–96 and 1898 (Botany 3) are out of print. Report for 1897 may be had for 40c; 1899 for 20c; 1900 for 50c. Since 1901 these reports have been issued as bulletins [*see* Bo 5–8].

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have also been published in volumes 1 and 3 of the 48th (1894) museum report and in volume 1 of the 49th (1895), 51st (1897), 52d (1898), 54th (1900), 55th (1901), 56th (1902), 57th (1903) and 58th (1904) reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared, constitute Museum memoir 4.

Published monthly by the
New York State Education Department

BULLETIN 380 JULY 1906

New York State Museum

JOHN M. CLARKE Director

Bulletin 101

PALEONTOLOGY 16

GEOLOGY OF THE PENN YAN-HAMMONDSPORT QUADRANGLES

BY

D. D. LUTHER

New York State Education Department
Science Division, November 25, 1905

Hon. Andrew S. Draper
Commissioner of Education

DEAR SIR: I beg to communicate for publication as a bulletin of the State Museum the accompanying manuscript, entitled, *The Geology of the Penn Yan-Hammondsport Quadrangles*, with geologic maps of these areas on the topographic map scale.

Very respectfully yours

JOHN M. CLARKE
Director

Approved for publication November 28, 1905

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Commissioner of Education

New York State Museum

John M. Clarke Director

Bulletin 101

PALEONTOLOGY 16

GEOLOGY OF THE PENN YAN-HAMMONDSPORT QUADRANGLES

BY

D. D. LUTHER

All the formations represented on the area here considered belong to the Devonic system and except for a very minor part to the upper or Neodevonic division.

The following formations are present:

Neodevonic	Chautauquan	Chemung sandstone and shale
		Prattsburg shale
	Senecan	High Point (Portage) sandstone
		West Hill flags and shale
		Grimes sandstone
		Hatch shale and flags
		Rhinestreet black shale
		Cashaqua shale (including the Parrish limestone)
		Middlesex black shale
		Standish shale
		West River black shale
		Genundewa limestone
		Genesee black shale
		Tully limestone
Mesodevonic	Erian	Moscow shale

These are considered in order from bottom to top.

The old group terms commonly employed in combining the units represented in the above table have now entirely lost their value and hence do not appear here. In this and a previous paper the precise value of the geologic term *Chemung* is demonstrated and it now becomes a unit term in accordance with its original usage. Hence there is no place in the nomenclature for the expression *Chemung group*, and its use involves an objectionable duplication of terms. On previous occasions also it has been shown that the High Point sandstones of the area next west are continuous with the original Portage sandstones of the Genesee valley; hence we can not wisely employ the term *Portage group*. Likewise the Genesee shales have been restricted to the lower measures of the group passing under this name and in accordance with the original intention the term becomes a unit name. Study of the typical sections of the Hamilton shale in Madison county makes it equally clear that the name *Hamilton* will not be advisedly employed except as a unit and not as a group term.

Under the former grouping, the units here embraced under the term *Senecan* would be divided as follows from above down.

Portage	High Point sandstones	contain Chemung fossils in Ontario county
	West Hill flags	
	Grimes sandstone	
	Hatch shale	
	Rhinestreet shale	
	Cashaqua shale	
	Middlesex shale	
	Standish shale	
Genesee	West River shale	
	Genundewa limestone	
	Genesee shale	
Tully	Tully limestone	

MESODEVONIC

Moscow shale

The lowest formation exposed within the limits of these quadrangles is the Moscow shale, of which there are a few small outcrops of its upper beds along the Keuka lake outlet between the Seneca paper mills and the east line of the quadrangle, half a mile below.

In Bruce's gully, a mile farther east, 40 to 50 feet of the upper part, capped by the Tully limestone, at the top of the falls, are finely exposed in the sides and bottom of the ravine.

A vertical section of this entire formation is well shown in the gorge of Kershong creek at Bellona near the northeast corner of this quadrangle.

It is composed of a mass of mostly soft, light bluish, gray calcareous shales becoming darker toward the upper part. Thin layers of limestone usually extending but a few rods and irregular calcareous lenses, consisting principally of fossils, are of frequent occurrence.

Normally the Moscow shale rests upon a stratum of limestone formerly called the Encrinal limestone but now known as the Tichenor limestone from its favorable exposure at and near Tichenor point, Canandaigua lake. In Ontario county the shale formation has a total thickness of 150 to 165 feet and the Menteth limestone, a stratum somewhat similar in character to the Tichenor and which has been sometimes mistaken for it, is interstratified 75 feet above the base. There are numerous exposures of the Moscow shale in central and western New York, among the most favorable of which eastward from this quadrangle are: along the east shore of Cayuga lake for 10 miles north of Ludlowville; in ravines and cliffs at the south end of Skaneateles lake and Otisco lake; in the Fellows Falls ravine 2 miles west of Tully, and at Tinker's falls near Fabius; and toward the west, in several ravines along both sides of Canandaigua lake between Tichenor point and Black point; along Little Beard's creek at Moscow; along Murder creek and Ellicot creek near Darien; along Smoke creek at Windom, Erie co., and on Eighteen Mile creek and the Idlewild and South Shore cliffs on Lake Erie at North Evans.

The characteristic fossils of the Moscow shale are listed in New York State Museum bulletin 63 to which the reader is referred.

NEODEVONIC

Tully limestone

The Tully limestone is a bed of hard, dark bluish limestone that on exposure is inclined to separate into small angular blocks. It overlies the Moscow shale from Gorham, Ontario co. on the west to Smyrna, Chenango co. on the east and is exposed on the Penn Yan quadrangle at Seneca Mills on the Keuka lake outlet at 600 A. T., where it produces a cascade 14 feet high.

Here it occurs in several heavy layers that aggregate 12 feet in thickness. Some are compact and durable, but a large portion of the limestone, throughout the entire line of outcrop, has a sharp, brittle texture and, after exposure, breaks easily into small angular fragments. The extreme western outcrop of the formation is on Gage's creek, 5 miles southwest of Gorham, Ontario co., and about 1 mile from Canandaigua lake. It is here 31 inches thick. It increases toward the east slowly to 28 feet at Tully, Onondaga co., and is not known east of Smyrna, Chenango co., where it consists of several thin layers separated by shales. It is abundantly exposed along both sides of Cayuga lake in the vicinity of Ludlowville and northward to King's Ferry and also on the east side of Seneca lake from Lodi Landing to Ovid.

It appears in two small undulations on the west side of Seneca lake and finally emerges from the water on the north side of Plum point. It is well exposed on the Keuka outlet, a mile below the outcrop at the Seneca mill, previously mentioned, and it forms the crest of the fall at Bellona. Fossils are usually found abundantly in one or more layers at nearly all outcrops but the fossiliferous layers are not the same at all localities, and a large portion of the rock is almost barren.

At Bellona the two upper layers are to a large extent made up of corals, many of them of great size.

The characteristic fossils of the horizon are: Hypothyris cuboides Sowerby and Schizophoria tulliensis Hall, with many species from the lower beds [*see* Mus. bul. 63].

Genesee black shale

Lying next above the Tully limestone is a mass of densely black bituminous shale that on exposure becomes very fissile and splits into thin flat plates.

Owing to their rigidity these shales are traversed by parallel series of joints from an inch to 3 feet apart intersecting each other at different angles and producing in cliff exposures striking effects like buttresses and bastions, and on surface exposures tessellations, triangles, rhomboids, diamonds and kindred forms.

Rows of spheric concretions and thin calcareous layers occur, specially in the lower beds, and nodular masses of iron pyrites are common throughout the formation. Thin flags of sandstone appear in the upper part at some localities but they are not continuous.

The Genesee shale is abundantly exposed in the cliffs along the Keuka outlet between Keuka Mills and Seneca Mills and along the south branch of Kershong creek in the northeast corner of the Penn Yan quadrangle.

On these quadrangles this formation is about 100 feet thick. It diminishes gradually toward the east and disappears near Smyrna, Chenango co., and also toward the west, running out entirely in the town of East Hamburg, Erie co. It however reappears and is 12 inches thick on the shore of Lake Erie, 13 miles farther southwest at the mouth of Pike creek.

The entire formation is exposed in numerous ravines and cliffs along the shores of Canandaigua, Seneca and Cayuga lakes and in the Genesee valley in Fall Creek ravine and in the ravine of Little Beard's creek at Moscow, but not directly upon the banks of the Genesee river.

Fossils are rare and poorly preserved in this shale. Lignites and conodont teeth occur very sparingly in the densely black beds and the lighter shales carry a few specimens of Styliolina fissurella Hall; Liorhynchus quadricostatum Hall; Pterochaenia fragilis Hall; Probeloceras lutheri Clarke; Lingula spatulata Vanuxem; Bactrites aciculum Hall; Orbiculoidea lodensis Hall; Pleurotomaria rugulata Hall.

Genundewa limestone

On the next quadrangle at the west and thence continuously to Lake Erie the Genesee black shale is overlain by a band of thin limestone composed almost entirely of the shells of a minute pteropod, Styliolina fissurella and designated the Genundewa limestone from its favorable exposure at Genundewa Point on Canandaigua lake. The horizon of this limestone is entirely covered by drift in the western part of the Penn Yan quadrangle and in the eastern part the limestones are not found although there are a few exposures of the horizon.

There is, however, a small outcrop of this rock in a small ravine on the east side of the Potter swamp, 1½ miles north of the north line of this quadrangle and another 1 mile south of Fir Tree point on the west side of Seneca lake, 6 miles north of Watkins. On the west side of Seneca lake the horizon is plainly marked by a band of light gray calcareous shale 6 to 8 feet thick in which large flat concretions are common and near Fir Tree point form a continuous layer. The representative fossils of the Genundewa limestone are abundant in the concretions and they also contain a number of additional species. The latter are in strong contrast to those of the preceding rocks and mark an invasion of an entirely new congeries of organisms into this region.

This gray band may also be traced along the east side of Seneca lake and on both sides of Cayuga lake. It is finely displayed in the west bank of Salmon creek near the forks 2 miles south of Genoa. This formation is described and its interesting fauna cited in full in Museum memoir 6.

West River black shale

The West River shale, formerly known as the Upper Genesee shale, is composed of fine bluish black or dark gray shale with a thin layer of black slaty shale at intervals of a few feet. Spheric and oblong concretions, many of which are septaria, are common throughout the beds singly or in rows and thin sandy flags occur specially in the upper part.

These shales are contrasted with the Genesee shales below by their lighter color and less bituminous character, being mostly highly fissile and breaking into thin sharp laminae.

The concretions are highly characteristic of these beds and in the region of their outcrop have been collected extensively on account of their curious shapes suggestive of turtle backs, human skulls and other rounded objects. Fossils are common but nowhere abundant. Fine specimens are occasionally found in the concretions.

The following species occur in the beds:

Bactrites aciculum *Hall*
Gephyroceras *sp.*
Pleurotomaria rugulata *Hall*
Buchiola retrostriata *v. Buch.*
Panenka *sp.*
Pterochaenia fragilis *Hall*
Lunulicardium curtum *Hall*
Lingula spatulata *Vanuxem*
Orbiculoidea lodensis *Vanuxem*

The West River shale is exposed on the Penn Yan quadrangle at the mouth of the Sartwell ravine 1 mile south of Penn Yan; also in a small ravine on the north side of the Keuka outlet 1 mile east of Penn Yan and on the east side of the Potter swamp along the road leading eastward to Voak.

Other good exposures may be found in the ravine of Plum creek below Himrods; along the shore of Seneca lake at Smith's point in the town of Starkey, and at Faucetts point 1 mile farther north on the east side; in the Goodrich and other ravines in West River valley in the town of Middlesex; in several larger ravines on the sides of Canandaigua lake from Seneca point southward; in ravines along the sides of Conesus lake; in the cliffs at the mouth of the Genesee River gorge at Mt Morris; in the ravine at Griswold 6 miles west of Attica and on the shores of Lake Erie near the mouth of Pike creek in the town of Evans, Erie co.

On the western border of this quadrangle the West River shale has a thickness of 110 feet and is overlain by a lighter colored and somewhat arenaceous band known as the Standish shales and flags, which are succeeded by a heavy bed of black shales called the Middlesex shales.

By a gradual change in the character of the sedimentation the identity of these formations is lost before reaching the exposures of their horizons in the northeastern part of this quadrangle, the Standish flags being eliminated from the rock section and the Middlesex black shale appearing, if at all, only as a few feet of darker and more bituminous shale at the top of the West River shales not separate from the latter formation, and the upper limit of the West River shale is not well defined.

On the map a thickness of 100 feet is assigned to this formation. It is 65 feet thick on the Genesee river and 11 feet on Lake Erie.

In the cliffs on the eastern shore of Cayuga lake, 4 miles north of Ithaca, the beds of this horizon are dark to black barren shales, next below the heavy sandstone that is in that locality the lowest member of the Portage group and about 35 feet thick.

The Standish flags and shales, 15 feet thick, at the base of the Portage beds along Canandaigua lake and in the Middlesex valley are not accessible on this quadrangle. The formation is described in Museum bulletin 63.

Middlesex black shale

This is a well defined band of bituminous black shale overlying the West River shale and exposed in many outcrops in the Middlesex valley 2 to 5 miles west of this quadrangle, and farther west to Lake Erie. It is 35 feet thick in the Middlesex valley and diminishes to 6 feet on Lake Erie in the town of Evans, Erie co.

There are no favorable exposures of this formation on this quadrangle. It can be recognized in a few small outcrops on the east side of the Potter swamp in the vicinity of Voak, and at the mouth of the Belknap gully at Guyanoga.

The formation is fully described in Museum bulletin 63.

Cashaqua shale

The Cashaqua shale is a heavy mass of light bluish gray or olive shales and sandstone appearing as the surface rock over a large area in the north part of the Penn Yan quadrangle and outcropping in the ravines and cliffs along the sides of both branches of Keuka lake and as far south as 1 mile north of Hammondsport on the west side and to a point opposite the village on the east side. At the base in the western part of the quadrangle there are 75 feet of laminated, rather sandy shales and thin flaggy sandstones that are succeeded by alternating beds of heavier, more compact sandstones and soft argillaceous shales containing calcareous concretions, and, toward the south, more or less continuous concretionary calcareous layers. The entire formation becomes more arenaceous and less calcareous from west to east, but the upper beds on this quadrangle retain to a large degree the character and appearance of the beds in this horizon exposed along Cashaqua creek in Livingston county, the type locality of the formation, except that the sandstones are much heavier. One of the lowest of these compact layers has been quarried extensively in Cornwells gully, in the north part of Penn Yan and along the upper part of the Sartwell ravine 1 mile south of that village.

These sandstones are broad lentils, usually becoming thinner and pinching out entirely in one direction and in the opposite after extending a considerable distance of perhaps several miles losing thickness by becoming shaly in the upper or lower part.

They are the most prominent features in the stratigraphy of the formation and by their superior resistance to the eroding power of the streams as contrasted with the soft shales in the ravines have produced the numerous cascades and waterfalls that contribute so largely to the beauty of the scenery in the region about Keuka lake.

In the Cashaqua shale is the

Parrish limestone

This limestone is interstratified in the Cashaqua shales 25 feet below the top in the western part of the Penn Yan quadrangle, but the shale intervening between it and the overlying Rhinestreet shale thins out rapidly toward the south and east and disappears entirely a few miles beyond the east line of the Hammondsport quadrangle.

This peculiar formation is an impure concretionary limestone which, in the Parrish gully near Naples, is 4 inches thick and is rich in goniatites and other cephalopods. It does not extend west of the Naples valley but increases toward the east and south and reaches its greatest development, so far as exposed, about the head of Keuka lake. It is 6 inches thick in the gully at Friend, 10 inches in the Belknap gully at Guyanoga and in Wagener gully near Pulteney 1 foot, 6 inches. In the ravine at Gibson Landing at 290 feet above the lake it is in four layers aggregating 2 feet, 6 inches. It dips under the water on the west side of the lake 50 rods south of Oak point and on the east side a mile farther south and directly opposite Hammondsport. In the small ravine on the east side at Rye point it is 100 feet above the lake, in the large ravine opposite Glen Grove 165 feet and in another, opposite Urbana, it is 6 inches thick and forms the crest of a 25 foot fall 211 feet above the lake level. It doubtless extends some distance farther north and east but changes in character to a calcareous nodular shale that does not resist erosion and rarely appears in outcrops. In Hewitts glen, 5 miles south of Penn Yan, it occurs as a shaly and lumpy limestone at 1000 A. T.

It is exposed in the Big Stream gorge west of the Northern Central Railroad bridge, where it is a band of thin limestones and shales 5 feet thick overlain by the Rhinestreet black shale, the intervening light shales having thinned out and disappeared. Fossils are much less common in the Parrish limestone, on this quadrangle than in the Naples valley.

Manticoceras pattersoni Hall, Tornoceras uniangulare Conrad, Probeloceras lutheri Hall and Orthoceras pacator Hall are the more common cephalopods and Styliolina fissurella Hall is abundant.

The Cashaqua beds are 230 feet thick on the Naples quadrangle. They are increased toward the north and east by the assimilation of the upper part of the Middlesex shales and lose by the thinning out of the soft shales between the Parrish limestone and the Rhinestreet shale. The formation reaches its greatest thickness, 250 feet, in the region northwest of Penn Yan, and, decreasing gradually toward the southeast, is 207 feet thick in the vicinity of Watkins. Fossils are rare in the lower part of the Cashaqua beds, but occur in considerable numbers in a few layers, mostly in the upper part, of soft light colored shales. The fauna in this vicinity consists of species of 4 crustaceans, 16 cephalopods, 5 pteropods, 12 gastropods, 25 lamellibranchs, 4 brachiopods, 1 coral, 1 crinoid, 3 plants.

The more common of these fossils are:

Spathiocaris emersoni *Clarke*
Manticoceras pattersoni *Hall*
Probeloceras lutheri *Clarke*
Tornoceras uniangulare *Conrad*
Hyolithus neapolis *Clarke*
Phragmostoma natator *Hall*
Loxonema noe *Clarke*
Paleotrochus praecursor *Clarke*
Pterochaenia fragilis *Hall*
Buchiola retrostriata *v. Buch.*
Ontaria suborbicularis *Hall*
O. clarkei *Beushausen*
Lunulicardium acutirostrum *Hall*
L. ornatum *Hall*
L. hemicardioides *Clarke*
Honeoyea major *Clarke*
H. erinacea *Clarke*
Aulopora annectens *Clarke*

Plumalina plumaria is common in a 5 inch layer of shaly sandstone exposed in a small ravine west of the rock cut of the Northern Central Railroad 2½ miles southeast from Penn Yan. See Museum bulletin 63 for full list of fossils.

Rhinestreet shale

This formation is a bed of black shale that overlies the Cashaqua shale from the Seneca lake valley where it is but 1 foot thick to the shore of Lake Erie in the town of Evans, Erie co., where it attains a thickness of 185 feet. It is 3 feet thick on the east line of these quadrangles and 15 feet on the western. In the exposure of this horizon in the Big Stream ravine it rests directly upon the Parrish limestone, but westward across these quadrangles a rapidly thickening bed of light shales intervenes and on the west side of Keuka lake it is 20 to 25 feet above that limestone and in the Naples valley 50 feet above it.

East of the Genesee valley this formation is composed almost entirely of densely black bituminous shales, but farther west it includes several layers of lighter shales that contain a few of the fossils of the Cashaqua shales and rows of large spheric concretions. Fossils are exceedingly rare in the black shales but beds of land plants forming thin seams of lignitic coal are seen occasionally.

The following species have been identified from the Rhinestreet shale in this vicinity.

Paleoniscus devonicus *Clarke*
Acanthodes pristis *Clarke*
Polygnathus dubius *Hinde*
Prioniodus spicatus *Hinde*
P. erraticus *Hinde*
Spathiocaris emersoni *Clarke*
Lunulicardium velatum *Clarke*
Pterochaenia fragilis *Hall*
Leptodomus multiplex *Clarke*
Lingula ligea *Hall*

The Rhinestreet shale is well exposed in the ravine at Friend; in the Belknap gully at Guyanoga; in the Wagener ravine at Pulteney; at 1000 feet A. T. in the small ravine 1 mile east of South Pulteney; in the Urbana ravine; along the lake shore south of Oak point and along the east side of the lake opposite Hammondsport, also in the Rye Point and other ravines farther north to Grove Springs.

In the region between Grove Springs and Crosby the Cashaqua shales and the lower beds of the Hatch flags and shales have an unusually large proportion of bituminous matter and the Parrish limestone does not appear. This condition together with considerable undulations of the strata makes identification of the horizon of the Rhinestreet bed somewhat uncertain, but its position is, approximately at least, as indicated on the map.

Some of the best exposures of the Rhinestreet shale west of these quadrangles are along Rhinestreet and in Parrish gully at Naples; in Buck Run ravine at Mt Morris and in the Genesee River gorge in Smoky Hollow; in the ravine at Griswold 6 miles west of Attica; in the Eighteen Mile Creek gorge at North Evans; and along Big Sister creek below Angola, Erie county.

The limits of the remaining formations shown on this map, though well defined on the Naples quadrangle, are very obscurely so on the Hammondsport and Penn Yan quadrangles.

Lithologically they all have the same general character and appearance except as to the proportion of sandy sediments to the argillaceous and this is nowhere constant even in the same horizon. Very little assistance can be obtained in the determination of horizons from the fossils of these beds, specially in the Hatch shales and flags, for this is in the region, though on its western border, where extensions of the Naples fauna from the west and the Ithaca fauna from the east succeed each other, or are intermingled in a few thin layers. Correlation is therefore more a labor of careful tracing of formations from the type localities in the Naples valley than of detailed study of vertical sections.

Undulations of the strata cause frequent changes in the dip and make accurate measurements of the thickness of formations well-nigh impossible. The figures given for these upper divisions are therefore estimates or arbitrarily assigned.

Hatch shale and flags

This formation is composed principally of shales, mostly soft and light blue or olive in color, but with frequent intercalations of layers of black shale from a fraction of an inch to 4 feet in thickness. Flags and thin sandstones are liberally though very irregularly distributed throughout the beds but appear more frequently in the middle and upper parts. These sandstones vary from an inch to 2 feet thick and are usually compact and hard on the lower surface but become shaly on the upper side. Some of them are laminated and on exposure separate into thin plates. Layers of this character occur in the Cashaqua shale and in all the formations on these quadrangles above the Rhinestreet shale.

The lower beds of the Hatch shale and flags are very much like the Cashaqua beds in appearance but in the upper part the changes from dark to light and hard to soft are more pronounced and in many old exposures the frequent flags projecting beyond the softer shales produce a coarsely stratified appearance.

The proportion of sandstones is much greater at some outcrops than at others in the same horizon. The formation is 300 feet thick on the western border of these quadrangles and increases slowly toward the southeast. It is the surface rock over a large area in the Penn Yan quadrangle but appears to be somewhat thinner and softer in the more northern exposures. It is well exposed in the upper part of the ravines at Friend; the Belknap gully at Guyanoga; the Wagener gully at Pulteney. The upper beds may be seen in the large ravine in the western part of Hammondsport and at that half a mile south of the village, also in the side of the dugway road on the east side of the lake and in the Rye point and other ravines farther north.

It outcrops in the road ½ mile southwest of Wayne and along the Bailey Gully stream and the highway a mile farther southwest. The drift sheet is thin over the large area where this is the surface formation, and small exposures are frequent along the sides of the roads and in the numerous small gullies on the hillsides.

The Hatch shale and flags are abundantly exposed along the foot of Hatch hill at Naples, resting upon the Rhinestreet shale and capped by the Grimes sandstones, also in the Genesee River gorge from Smoky Hollow to the mouth of Wolf creek. They are softer and more calcareous in the vicinity of Lake Erie where they may be seen to good advantage in the ravine of Big Sister creek between Angola and Pontiac, and along the lake shore near Silver creek. On the Naples quadrangle the fossils occurring in the Hatch shale are all representations of the Cashaqua shale or Naples fauna, but much less in numbers. The following species may be found in the lower beds on this quadrangle:

Manticoceras pattersoni *Hall*
Probeloceras lutheri *Clarke*
Bactrites
Paleotrochus praecursor *Clarke*
Lunulicardium ornatum *Hall*
Honeoyea desmata *Clarke*
Buchiola retrostriata *v. Buch.*

On the Watkins quadrangle, adjoining on the east, a few representatives of the Ithaca fauna are found in the Hatch shale and flags. They are exceedingly rare here, though broken fragments of brachiopods too small for identification appear in some of the more calcareous sandstones.

At 1250 A. T. in the Belknap gully a 6 inch sandstone contains:

Spirifer mucronatus *Conrad var.* posterus *Hall & Clarke*
Schizophoria impressa *Hall*
Productella lachrymosa *Hall*
Crinoid stems

Grimes sandstone

This formation is lithologically distinguished from the Hatch shale and flags only by the much larger proportion of arenaceous matter and consists of light blue-gray sandstones in layers from an inch to 3 feet thick separated by thin layers of hard, blue shale. The change in the proportion of sandstone and shale is very gradual at the bottom and also at the top of the formation, consequently its limits are very obscurely defined. This condition obtains throughout the entire extension of this formation across the western part of the State and is much emphasized east of the Naples quadrangle. The estimated thickness of the Grimes sandstones on these quadrangles is 75 feet. It is not of great importance here except as a bench mark but at Naples it is a prominent feature in the stratigraphy of the Portage rocks, producing high falls in the Grimes, Tannery and Parrish gullies, and escarpments on the hillsides. It is important there also as marking the close of the period during which sediments carrying the Naples fauna were laid down, and containing the earliest representatives of the Ithaca fauna in that locality.

On the Watkins and Elmira quadrangles those faunas are intermingled in these beds, and it is probable that the same condition obtains here.

The following species have been found in the horizon of the Grimes sandstones in the western part of the Penn Yan quadrangle or at Naples:

Protonympha devonica *Clarke*
Schizophoria impressa *Hall*
Productella spinulicosta *Hall*
P. lachrymosa *Hall*
Spirifer mesacostalis *Hall*
Atrypa spinosa *Hall*
Liorhynchus mesacostale *Hall*
L. quadricostatum *Hall*
Leptostrophia mucronata *Vanuxem*
Chonetes lepidus *Hall*
Ambocoelia umbonata *Conrad*
Dictyospongia haplea *Hall & Clarke*
Orbiculoidea *sp.*
Paropsonema cryptophyum *Clarke*

The horizon is exposed on the Watkins quadrangle along the Johnson Hollow creek, 1 mile west of Lower Pine valley and there contains: Manticoceras pattersoni Hall; Orthoceras sp.; Buchiola retrostriata von Buch; Phragmostoma natator Hall; Paleoneilo filosa Conrad; Nuculites oblongatus Conrad; Grammysia sp., together with Orthis tioga Hall; Chonetes scitulus Hall; Schizophoria impressa Hall and Productella spinulicosta Hall.

There are good exposures of the Grimes sandstones in the ravine in the western part of Hammondsport and that 1 mile south of the village; also in the upper part of the Wagener ravine.

Besides the exposures mentioned at Naples the Grimes sandstones may be seen in the cliffs at St Helena and at the mouth of Wolf creek in the Genesee River gorge and along the shore of Lake Erie between Silver Creek and Dunkirk.

West Hill flags and shales

The rock of this division consists of numerous thin, uneven flags, 2 to 4 inches thick and occasionally compact, even, blue sandstones

1 to 2 feet in thickness, separated by blue or olive shales. Layers of black shale from an inch to 2 or 3 feet thick also occur.

The proportion of sandstone decreases toward the east and south.

Fossils are common in several of the heavier layers of sandstones lying 100 to 150 feet above the Grimes sandstones. In a small ravine that crosses the road leading to North Urbana 1 mile east of Hammondsport, there is exposed 40 rods above the crossing a calcareous lens 1 foot, 6 inches thick and several rods long almost entirely composed of brachiopods and crinoid segments, and several sandstones in the same horizon in the ravine 1 mile south of Hammondsport contain the same species. The more common are:

Goniatites
Orthoceras *sp.*
Leptodesma *sp.*
Orthis tioga *Hall*
Schizophoria impressa *Hall*
Stropheodonta cayuta *Hall*
Leptostrophia perplana *Conrad var.* nervosa *Hall*
Atrypa spinosa *Hall*
Productella lachrymosa *Hall*
Ambocoelia umbonata *Conrad*
Spirifer mesacostalis *Hall*
Cyrtina hamiltonensis *Hall*
Orbiculoidea *sp.*
Crinoids

On the Hammondsport and Naples quadrangles the fossils of the West Hill flags and shales are mostly brachiopods, but in the Genesee river section and westward the fauna of the Naples beds prevails and brachiopods are absent.

The West Hill flags and shales are exposed at the upper end of the ravine ¼ mile south of Friend; the Belknap gully and the Wagener gully; and in field and roadside outcrops on the hill north of Hammondsport. The fossiliferous sandstones of this formation produce a series of low cascades in the ravine 1 mile south of Hammondsport at 1150 to 1200 A. T., and an exposure of the same horizon in the ravine near the corner of the Urbana road 1 mile east of Hammondsport includes the calcareous lens previously mentioned. There are frequent small outcrops of the West Hill flags at North Urbana and along the road to Wayne and the ravine at Bradford is in the softer beds in the middle of this division. There are extensive exposures of this formation on West hill at Naples and on East hill at Dansville. It is the upper part of the Gardeau flags in the Genesee river section and includes the strata displayed in the cliffs between the mouth of Wolf creek at St Helena and the high bridge of the Erie Railroad at the top of the Upper Portage falls.

It appears in the cliffs along the shore of Lake Erie between Dunkirk and Barcelona. It is softer here and includes some heavy beds of black shale.

High Point sandstone

In structure and appearance the formation designated the High Point sandstone is on these quadrangles a repetition of the Grimes sandstone on a slightly enlarged scale. It is an arenaceous band about 100 feet thick, in which the sandy layers are from 1 inch to 3 or 4 feet thick and the separating shales have the same range as to thickness and vary from light blue to black. The sandstones are somewhat lighter colored than those below and weather to a light gray except some calcareous layers that become rotten and rusty on exposure.

The proportion of sandstone increases toward the west to the Genesee river where the formation is 185 feet thick and the proportion of shale is very slight. In the Genesee river section and westward to Lake Erie where it has gradually diminished to a few feet in thickness it is almost barren of fossils and no brachiopods have been found in it.

At Naples, the typical exposure, the sandstones project from near the top of the formidable cliff at High Point and include a large calcareous lens composed of Chemung brachiopods and crinoids. The formation has been traced from Naples eastward and across these quadrangles to the vicinity of Elmira where lenses of similar character and appearance to the one at High Point are of frequent occurrence in it. The fossil contents of these lenses are exceedingly variable, no two of them being composed of the same species.

The High Point sandstones are exposed in a small ravine $1\frac{1}{4}$ miles northeast of Italy Hill and a calcareous lens outcrops three quarters of a mile north of that village. Small outcrops and a thin lens occur near the east and west road over the hill 2 miles north of Hammondsport. The sandstones outcrop at North Urbana and at Wayne Four Corners, also in a ravine and along the roadside 2 miles north of Sonora; near the mouth of the ravine 1 mile east of Savona and along a small stream that flows into Mead creek 1 mile north of Monterey.

They are exposed in the quarries on East hill at Elmira and show an extensive calcareous lens.

West of the Genesee river they outcrop near Rock Glen in the Oatka valley and in Chautauqua county at Forestville, Laona and Brocton. The horizon, with the sandstones almost entirely eliminated, dips under the water of Lake Erie 3 miles north of the State line. Fossils are not very abundant on these quadrangles except in the calcareous masses.

The following are the more common species:

Lyriopecten tricostatus *Vanuxem*
Grammysia *sp.*
Spirifer mesastrialis *Hall*
Sp. mesacostalis *Hall*
Atrypa reticularis *Linné*
Productella lachrymosa *Hall*
P. speciosa *Hall*
P. boydi *Hall*
Orthis tioga *Hall*
O. carinata *Hall*
Schizophoria impressa *Hall*
Stropheodonta cayuta *Hall*
Leptostrophia perplana *Conrad var.* nervosa *Hall*
Orthothetes chemungensis *Conrad*
Tropidoleptus carinatus *Conrad*
Liorhynchus mesacostale *Hall*
Chonetes scitulus *Hall*
Lingula *cf.* melie

Prattsburg shales and flags

Above the High Point sandstones there is a partial return to argillaceous conditions and for about 250 feet the beds are mostly shales or thin, uneven, blocky or shaly sandstones. A few of the sandy layers are compact and hard and others are schistose or straticulate.

In the Genesee river section at Wiscoy and vicinity these beds are soft, shaly and somewhat calcareous and contain only Portage fossils but eastward from that point they are harder and in the town of Prattsburg and on these quadrangles they contain many Chemung and very few Portage fossils. Toward the southeast they become softer again and at Elmira there is an approach to the conditions at Wiscoy.

Although this formation is the surface rock over large areas on these quadrangles, outcrops that show more than a very few feet of the strata are rare owing to its elevation above the more deeply excavated parts of the ravines, except near the southern border where the drift mantle is quite heavy.

It is partly exposed in the ravine 1 mile east of Savona and in another 2½ miles south of that village, also in a ravine and along the roadside 2 miles north of Sonora.

The more common fossils of the Prattsburg shales and sandstones are:

Paleoneilo filosa (*Conrad*) *Hall*
P. constricta (*Conrad*) *Hall*
Lyriopecten tricostatus *Vanuxem*
Pterinopecten imbecilis *Hall*
Macrodon chemungensis *Hall*
Mytilarca carinata *Hall*
Grammysia circularis *Hall*
Leptodesma potens *Hall*
L. maclurii *Hall*
L. spinigerum *Conrad*
L. robustum *Hall*
L. interplicatum
Spirifer mesastrialis *Hall*
S. mesacostalis *Hall*
Productella lachrymosa *Conrad*
P. hirsuta *Hall*
P. speciosa *Hall*
Liorhynchus mesacostale *Hall*

L. multicosta *Hall*
Atrypa reticularis *Linné*
A. hystrix *Hall*
Schizophoria impressa *Hall*
Orthis tioga *Hall*
O. carinata *Hall*
Stropheodonta cayuta *Hall*
Leptostrophia perplana *Conrad var.* nervosa *Hall*
Stropheodonta demissa *Conrad*
Orthothetes chemungensis *Conrad*
Camarotoechia eximia *Hall*
Ambocoelia umbonata *Conrad*
Lingula spatulata *Hall*

Chemung sandstones

The Chemung sandstones and shales as defined in Museum bulletin 81 are the surface rocks over the high lands in the southern part of the Hammondsport quadrangle, attaining in the extreme southeast corner in the town of Hornby a thickness of 560 feet.

They are almost entirely covered by a thin mantle of drift or disintegrated shale and sandstone, the few exposures being mostly the results of grading the highways. They are, however, uncovered sufficiently to show that, structurally, the formation is an aggregation of light and dark shales and blue gray sandstones, much like the West Hill flags and shales, except that many of the sandstones are laminated or schistose and light gray or almost white in color. Calcareous lenses like those previously mentioned are more frequent and usually more extensive than those below.

Fossils are abundant at all horizons and in nearly all outcrops of these beds, the more common species in this region being:

Leptodesma longispinum *Hall*
L. billingsi *Hall*
L. shumardi *Hall*
L. spiniger (*Conrad*) *Hall*
L. disparile *Hall*
L. matheri *Hall*
Paleoneilo filosa (*Conrad*) *Hall*
P. constricta (*Conrad*) *Hall*
P. emarginata (*Conrad*) *Hall*
Lyriopecten tricostatus *Vanuxem*
Microdon *sp.*
Liopteria chemungensis *Vanuxem*
Mytilarca simplex *Hall*
Grammysia *sp.*
Pterinea chemungensis (*Conrad*) *Hall*
Spirifer mesacostalis *Hall*
S. marcyi *Hall*
S. disjunctus *Sowerby*
S. mucronatus *var.* posterus *Clarke*
Productella lachrymosa *Hall*
P. onusta
P. hystricula
Liorhynchus mesacostale *Hall*
L. globuliforme *Vanuxem*
Atrypa reticularis *Linné*
A. spinosa *Hall*
Orthis tioga *Hall*
O. carinata *Hall*
Schizophoria impressa *Hall*
Stropheodonta cayuta *Hall*
Leptostrophia perplana *Conrad var.* nervosa *Hall*
Leptostrophia mucronata *Vanuxem*
Athyris polita *Hall*
Orthothetes chemungensis *Conrad*
Camarotoechia eximia *Hall*
C. contracta *Hall*
Ambocoelia umbonata *Conrad*

UNDULATIONS OF THE STRATA

The aggregate thickness of the geologic formations and parts of formations represented on the map of the Penn Yan and Hammondsport quadrangles is approximately 2187 feet, of which 1535 feet are surface rocks by reason of the difference in elevation between the point where the east line of the Penn Yan quadrangle crosses Keuka outlet 525 feet A. T. and the extreme southeast corner of the Hammondsport quadrangle which is 2065 feet A. T. The total amount of the southward dip in the 34 miles across the two quadrangles from north to south is about 652 feet, an average of a fraction less than 20 feet a mile.

The inclination of the strata is not constant in any direction except for short distances, and there are evidences of more or less disturbance throughout the whole of the area covered by the map.

The sandstones of the beds that cover the southern part of the Hammondsport quadrangle are not reliable as bases for accurate determination of the size, shape and direction of the folds and undulations except in a general way. In the rock cut along the Northern Central Railroad 2½ miles southeast of Penn Yan a compact sandstone 2 feet thick is exposed that is probably synchronous but not continuous with a stratum of similar character that appears at the mouth of Watkins Glen and the one assumed as the base of the Portage beds at Ithaca.

In this cut the sandstone shows a strong dip toward the west, but at the west end it is 840 feet A. T. and in the Sartwell gully 2 miles farther west it appears at 880 feet A. T., 40 feet higher. It descends between this point and the quarry in the Cornwall ravine, 1½ miles northwest, 35 feet and in the quarry dips northwestward at the rate of 52 feet a mile.

The Tully limestone, from its outcrop at Seneca Mills, dips southeastward to Plum point on Seneca lake at the average rate of 26 feet a mile and rises toward the north to Bellona at the rate of 16 feet a mile. Estimates based on other outcrops of the Tully 1 mile east of that at Seneca Mills, where there is evidence of a considerable fault or very sharp fold, would give altogether different results.

The strata show more disturbance in the region about Penn Yan than elsewhere on these quadrangles, and small anticlines or downthrusts may be seen in nearly every ravine or outcrop in the vicinity. In a ravine on the west side of the lake 3 miles southwest from Penn Yan at about 100 feet above the lake, a 4 foot sandstone that crosses the ravine is much broken and shows a diagonal fault or downthrow toward the southeast of 9 feet. In the ravine at Crosby the sandstones dip toward the southwest at the rate of 100 feet a mile.

The western side of the high ridge that separates Keuka lake and Seneca lake shows at all exposures a strong dip toward the west, that reaches in the north part of the quadrangles as far as the Naples valley. The dip is reversed in part at least on the Seneca lake side of the ridge as may be seen in the lower part of the Plum Creek ravine below Himrods where the strata dip toward the east for nearly a mile at the rate of 100 to 200 feet a mile. The Parrish limestone is exposed in a series of outcrops on the west side of the Keuka lake valley between Friend and Hammondsport, a distance of 13 miles on a nearly north and south line. In the ravine at Friend the limestone outcrops at 1095 feet A. T. and descends southward 45 feet or 18 feet a mile to the Belknap gully where it is 1050 feet A. T. This latter exposure is 11 miles directly east of the one in the Lincoln gully at Naples and 300 feet higher, an average descent toward the west of 27 feet a mile.

From Belknap gully to the road leading west from Gibson Landing, which it crosses at 1005 feet A. T., the limestone descends 45 feet in 9 miles, a southward dip of 5 feet a mile, and from this outcrop south and a little west to Oak point, where it disappears under the lake, it descends 296 feet in 6 miles, an average of 49 feet a mile. Owing to the western dip it is above the water about 1¼ miles farther south on the east side than on the west.

From the place of its emergence on the east side of the lake to its outcrop in the ravine on the east side opposite Urbana, the distance is 4 miles and the direction northeast. Between these points the limestone rises 165 feet or 41 feet a mile. The place where the limestone dips under the water opposite Hammondsport is 10½ miles east and 14 miles south of the place where it is at the same elevation, 709 feet A. T. at Naples.

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Published monthly by the
New York State Education Department

BULLETIN 379 [illegible]

New York State Museum

JOHN M. CLARKE Director

EPHRAIM PORTER FELT State Entomologist

Bulletin 103

ENTOMOLOGY 25

THE GIPSY AND BROWN TAIL MOTHS

BY

EPHRAIM PORTER FELT D. Sc.

New York State Education Department
Science Division, February 16, 1906

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

SIR: I beg to transmit herewith, for publication as a bulletin of the State Museum, a brief manuscript treating of the gipsy and brown tail moths. It seems advisable, in view of the great danger of these insects being brought into this State, that information relating to them should be made immediately accessible to the people.

Respectfully yours
JOHN M. CLARKE
Director

Approved for publication, February 16, 1906

A. S. Draper
Commissioner of Education

New York State Education Department

New York State Museum

John M. Clarke Director
Ephraim Porter Felt State Entomologist

Bulletin 103

ENTOMOLOGY 25

THE GYPSY AND BROWN TAIL MOTHS

BY

EPHRAIM PORTER FELT D. Sc.

These two ravenous leaf feeders, as it is well known, are thoroughly established in eastern Massachusetts and have amply demonstrated their pernicious natures. The gipsy moth caterpillar, remarkable because of its omnivorous tastes and voracity, is an exceedingly injurious form. It feeds, when present in large numbers, on almost every tree and shrub besides herbaceous plants. Its operations are particularly fatal to pine, hemlocks and other evergreens, since one defoliation of these trees is inevitably followed by death. Three strippings in successive years kill our more common deciduous trees such as oaks, maples, elms etc. It is difficult for one not conversant with the situation to gain an adequate idea of conditions in the infested region. Thousands of acres of deciduous trees have been killed as a result of the work of this insect. For example, one 40 acre woodland park was entirely defoliated in 1905. One tree in this infested tract was banded so that the insects could not ascend, and three wheelbarrow loads of caterpillars were removed from around its base. This gives a little idea of the hordes present in badly infested territory.

The more recently imported brown tail moth is especially destructive to fruit trees and has a marked fondness for wild cherry, white oaks, maples and elms. It has become so numerous in many sections of eastern Massachusetts as to strip thousands of these trees, and it has proved itself an efficient ally of the gipsy moth in the work of destruction. The ravages of these insects have become so serious that in some places owners of woodlands, rather than undertake the enormously expensive work of checking the pests, have sacrificed their forests to the woodman's axe, even within a few miles of the city of Boston.

It will be seen at once that these insects have inflicted serious financial loss in the infested sections and in addition thereto there has been great personal discomfort accompanied in some instances by physical suffering. The young caterpillars, easily dislodged during active feeding, spin down on a web when somewhat disturbed and adhere to the clothing of passers. This annoyance is very great and many carry umbrellas for the purpose of keeping the hairy pests at a little distance. The hordes of caterpillars living in adjacent forest or fruit trees desert the same when nearly mature or after their food supply is exhausted, and wander in all directions. They frequently become so abundant in localities where no effort has been made to check them, as to swarm on the sides of houses, literally covering square yards of buildings, and unless removed are very likely to make their way into the dwellings, to the horror of the housewife. Residents of the infested section during caterpillar time may be observed both morning and evening with brush and dustpan, removing the invaders from the buildings. The sidewalks become so thickly covered with the creatures that it is almost impossible to walk without crushing them, and the mangled remains of victims make footing very disagreeable if not insecure.

Worse than this, the stiff hairs of the brown tail moth caterpillar are barbed and, falling from their bodies or blowing from the empty cocoons in midsummer, may cause a very annoying rash, the brown tail itch, which is said by some to cause more suffering than that accompanying ivy or dogwood poisoning, the sting of bees or hornets, or other similar painful injuries. This irritation is so great in the case of persons with a somewhat delicate cuticle, as to cause serious illness. The trouble is so prevalent that salves or emollients for its allayment are for sale by most local druggists. It has been estimated that the rental value of property in the worst infested sections about Boston has been reduced from 20% to 50% on account of the caterpillar plague. Furthermore, the better class of people obliged to live in such districts, go to the country or seashore as soon as possible in the spring, and remain there till after the caterpillar season has passed, thus depriving the community of money which would otherwise be spent in infested districts.

The female gipsy moth does not fly and, unaided, the pest spreads slowly. The spinning down habits of the caterpillars facilitate its distribution by persons and vehicles, among the most efficient of which may be mentioned automobiles. The brown tail moth flies readily and has already extended its range greatly

There is grave danger of both of these insects being brought into New York State at almost any time, and the following brief descriptive accounts have been prepared so that our citizens may be able to recognize these two species upon their appearance in any locality.

Gipsy moth

Porthetria dispar Linn.

This notorious pest, widely and thoroughly established in eastern Massachusetts, has been known by reputation to residents of New York State for some years. The caterpillars are exceedingly voracious feeders, readily devouring the foliage of most trees and shrubs. There was practically no attempt made to control the gipsy moth in Massachusetts from 1900 to 1905 and as a consequence, its range has become greatly extended. According to Superintendent Kirkland, the pest has been found in 120 cities and towns and the infested area in Massachusetts is over 2000 square miles, nearly six times as great as that at the time work against this insect ceased. It has made its way nearly 30 miles west, occurring in such outlying towns and cities as Maynard, Stowe and Marlboro. A recent communication from Prof. E. D. Sanderson of Durham informs us that the pest has been found in southeastern New Hampshire, and the presence of a colony in Providence, R. I. has been known for some years. This pest has also become established at Stonington, Ct.

Destructiveness. It is very difficult for one not conversant with the situation to appreciate the destructiveness of this pest, which is greatly increased by its omnivorous nature. Its injuries are further emphasized by the gregarious habits of the caterpillars and the female's inability to fly. The result is that caterpillars abound upon individual trees; groups of trees or in extended woodland areas, and if not abundant enough to defoliate the trees one season, attain maturity and the parent insects deposit thousands of egg masses which another summer may produce millions of caterpillars that will entirely strip the foliage from infested sections and, spreading to adjacent fields, continue the work of destruction. The operations of this insect are particularly fatal to pines, hemlocks and other evergreens, since one defoliation of these trees is followed by death. The first serious outbreak in Massachusetts in 1889 and following years was comparatively limited though the injury in infested sections was severe. The depredations of this caterpillar have been much extended in recent years, owing to the cessation of active control methods on the part of the state in 1900. The result is that many fruit, ornamental and shade trees have been seriously injured and the damage has been especially severe in the vicinity of infested woodlands. The cost of fighting the pest on unimproved lands is so great as to be beyond the means of the average individual. Those unfortunate enough to live in the vicinity of infested woods are not only obliged to control the caterpillars upon their own grounds, but are frequently seriously discommoded by those swarming on their premises from adjacent defoliated woodlands [pl. 3, 4]. A partial investigation in September of this year showed that large areas were very seriously infested by the caterpillars of both the gipsy and brown tail moths. Dead pines were familiar objects in infested woodlands and in not a few instances considerable forest areas were conspicuous because of the dead standing timber, mostly deciduous trees, which had been repeatedly defoliated by these voracious pests.

Danger of spreading into New York. The greatly increased area occupied by the gipsy moth, coupled with its excessive abundance in a number of localities, has materially increased the danger of this pest being brought into New York State. The known spread, as previously pointed out, is somewhat slow, it having made its way west only about 25 or 30 miles, and its northward extension is presumably about the same. Fortunately the female gipsy moth does not fly and as a consequence the spread of this species is slow, because it must rely for dissemination upon the ability of the caterpillars to crawl, their being carried by other agents, and the distribution of eggs. These latter are deposited on almost any object and have even been found on freight cars, so that no one can predict where this species may appear within the next few years. Freight cars are not, in our opinion, such dangerous carriers of this insect as some other agencies, because it is only occasionally that they stand in the vicinity of adequate food for the caterpillars, a necessity at the time the eggs hatch if the young are to survive. Street cars, automobiles, carriages and even individuals may serve as carriers. The street cars are restricted to comparatively narrow limits, which is not true of automobiles. These latter, during caterpillar time, may easily make a run of 100 miles from a badly infested section, carrying about the vehicle several caterpillars, which are thus readily established in the new location. The possibilities of spread in this manner are very great and numbers of these vehicles undoubtedly make long runs either through or from the infested section. It is only necessary to cite in this connection an instance which illustrates what might take place. An acquaintance stated that on returning to New York city last summer from a visit to the infested region during caterpillar time, he brushed from his person a gipsy moth larva which, it is needless to add, was promptly destroyed. There is no guaranty that others were not brought and it is somewhat disquieting to think of the possibilities in the case of others proceeding directly from infested areas to localities where this pest is still unknown.

The insect can be conveyed long distances in the egg and it is rather surprising that such has not occurred more frequently. Any hard object remaining near an infested tree during July, while oviposition is in progress, is very likely to bear one or more clusters of eggs. There is great danger of the pest being carried with household effects to most distant points, specially if packed in boxes and barrels which have been allowed to lie where the females could deposit eggs upon them. The danger of the insect being spread in this way is, in our opinion, much greater than of its being carried by egg masses deposited on freight cars as mentioned above.

Description. The great danger of this insect being brought into New York State makes it advisable for all to be on the lookout for this pest, and for this reason we have prepared a rather careful notice of the species, giving particular attention to descriptive details in order that the insect may be recognized and checked before it has caused serious injuries. We further counsel great moderation on the part of amateurs in attempting to identify this species. A false statement regarding its occurrence may cause serious injury to local interests, whereas the delay of a few days necessary to secure an authentic determination will ordinarily be of but little moment.

The eggs of this insect, occurring from midsummer to the following spring, appear very much like a small section of sponge. They are deposited usually in round or oval masses [pl. 1, fig. 8; pl. 7] on a piece of bark and then covered with buff colored scales from the underside of the female's abdomen. These egg masses 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 particularly likely to occur on the undersurface of limbs, fence rails, moldings, cornices etc., on houses. The nearly globular, pale yellowish or salmon-colored eggs are about $\frac{1}{20}$ inch in diameter [pl. 1, fig. 9, 10] and there are usually 400 to 500 in a cluster, though occasionally 1000 may be found in an egg mass.

The young caterpillar is slightly over $\frac{1}{10}$ inch long just after it emerges from the egg. It has a black head, the body is brownish yellow and 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. The markings become plainer as it increases in size and when full grown it is from 2 to 2½ inches long. The caterpillar then 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 12 remaining red. Similar tubercles occur on the side. Two nearly full grown caterpillars are represented on plate 1, figures 6, 7. These caterpillars, like the well known forest tent caterpillar, Malacosoma disstria Hübn., assemble in masses on the trunks [pl. 5] and underside of limbs, sometimes covering large areas.

The somewhat conical, dark brown pupa [pl. 1, fig. 5], ranges from ¾ to 1½ inches long and is usually found in numbers [pl. 6] lying among a few threads and securely attached to them by its terminal spine.

The male and female moths differ widely. The former is a slender, olive-brown, black marked insect with featherlike antennae and has a wing spread of about 1½ inches. It is represented with wings expanded at figure 3 and in a resting position at figure 4 on plate 1. It flies in the late afternoon and early evening. The female is much heavier and ligher colored. She has a wing spread of about 2 inches and is white or buff-white with more or less distinct black markings. The abdomen is tipped with black. She is represented with the wings spread and in the characteristic resting position at figures 1 and 2 respectively, on plate 1 and on plate 7. The female moth does not fly though she apparently has well developed wings.

History in America. This pest was introduced into Medford, Mass. in 1868 or 1869 and, escaping from its introducer, attracted little notice for about 10 years. Then the caterpillers became somewhat abundant and in 1889 Medford and vicinity were literally overrun with the pests, the infestation bordering closely on a plague. An act, passed in the winter of 1890, provided for the appointment of a special commission and placed at its disposal $25,000, which sum was subsequently increased by an equal amount. An appropriation of $50,000 was made in 1891 and from then to 1899, appropriations ranged from $75,000 to $190,000 annually. The total amount expended by the commonwealth of Massachusetts during a decade, amounted to $1,155,000. The work was so sucsessful that in many sections badly infested in 1890, gipsy moth caterpillars were remarkable for their scarcity in 1898 and following years. Residents of the infested sections almost forgot that there had ever been such a pest, and made light of the close exterminative methods then in vogue. Unfortunately the work was abandoned at this stage and the insect has had an opportunity of multiplying almost without restriction during the past five years, greatly extending its range and causing serious depredations as described in a previous paragraph.

Life history. The winter is passed in an egg mass remarkably resistant to atmospheric and other changes. Experiments have shown that even when egg clusters were broken up and freely exposed to the elements, their contents were apparently unharmed and a normal proportion of caterpillars appeared at the usual time, which, in the vicinity of Boston, is from the last of April to the middle of June. The feeding period extends from the first of May to about the middle of July, the caterpillar requiring from about 9 to 11 weeks to complete its growth and enter the pupal stage. The recently hatched caterpillars remain on the egg clusters from one to five or more days and then commence feeding on the leaf hairs. Soon they eat out small holes in the foliage and after the third or fourth molt about as many feed on the edge of the leaf as eat out holes. The caterpillars are largely nocturnal, remaining in clusters on limb or trunk or hiding in some crevice during the day, beginning between 7 and 8 o'clock in the evening leisurely to ascend the tree, where they feed on the foliage at intervals during the night, descending about 3 o'clock in the morning. The gipsy moth caterpillars assemble in just such masses as those formed by our native forest tent caterpillar, Malacosoma disstria Hübn., so abundant in sections of New York State about 1900. This imported species is just as destructive as our native form and much more dangerous because of its feeding upon a large variety of plants.

The caterpillars transform to pupae during the month of June, moths appearing from the latter part of June to the latter part of July, and belated individuals may even be found in September. Males emerge in advance of the opposite sex and shortly after females appear, pairing takes place and eggs are laid. The embryos or very young caterpillers are frequently well developed within the eggs in two or three weeks after oviposition and as a rule they do not emerge till the next spring. One case is on record of eggs hatching in early September 1895, at Woburn, Mass., but the round of life was not completed and in this northern latitude there need be little fear of two generations annually.

Food plants. These caterpillars are quite destructive because of the very large number of plants on which they can thrive. They will eat, without hesitation, almost all our native shrubs and trees, and when hard pushed can subsist for a time at least on a number of herbaceous plants. The common fruit trees, the elms, maples and oaks are all eaten readily and even with the list no greater, the pest would be a most serious one to control. It is particularly destructive to pine, hemlock and other evergreen trees because a single defoliation destroys them. It feeds on many other plants, as the list of 536 species given in the exhaustive report of 1896 on this insect attests. It is true that the caterpillar feeds on some of these only when compelled by starvation and that it can not be considered an enemy of a number of others, but after making most liberal allowance for these, the list is still a very formidable one.

Natural enemies. This insect has a number of natural enemies in this country, though unfortunately none of them are aggressive enough to warrant placing much dependence on them. They should, however, be encouraged by all possible means. About a dozen native song birds, as recorded by Mr Forbush, are very useful in devouring one stage or another of this moth, and about 29 other species feed on it to a slight extent or more largely when their usual food supply is somewhat scarce. The most useful birds are the yellow and black billed cuckoos, Baltimore oriole, catbird, chickadee, blue jay, chipping sparrow, robin, red-eyed and yellow-throated vireos and crow.

A number of predaceous and parasitic insects have either been reared from this species or observed preying on it, but none of them are of sufficient importance to warrant special mention in this connection. A determined effort is being made by Superintendent Kirkland in cooperation with Dr Howard of the Federal Bureau of Entomology, to bring into this country natural enemies of this very destructive pest, in the hope that some forms will prove of considerable value in keeping this leaf feeder in subjection. Nothing can be promised in the way of results, yet this line of effort is sufficiently promising to warrant its being followed so far as possible.

Recommendations. Investigate anything that arouses a suspicion that it may be the gipsy moth, but be in no undue haste to identify the insect. There have already been some false alarms occasioned by persons with more enthusiasm than discretion, who have attempted to identify an insect with which they are unfamiliar. It is much more satisfactory to submit the specimens to an entomologist than to arouse unnecessary fears.

It would undoubtedly pay to exterminate a small colony, but in the course of time this will be impractical. We must learn to control it on our own land. The inability of the female to fly and the conspicuous character of the egg masses make this task relatively easy upon cultivated land. The private individual can hardly cope with this insect in forest lands. The point of establishment in this State is almost bound to be near some dwelling and therefore the species need not be allowed to establish itself in wild lands at least for some years, and by that time it is most sincerely hoped that some adequate check, natural or otherwise, may be found which can be employed to advantage in forest lands.

The larva is quite resistant to arsenical poisons and it requires a large dose to kill it, specially when the caterpillar is nearly grown. There is probably no better poison for this insect than arsenate of lead, using at least 5 pounds to 50 gallons. The application should be made as soon as the young leaves are well grown in order to destroy the caterpillars if possible while they are young and therefore most susceptible to the insecticide. Ordinarily thorough and timely spraying with an arsenical poison should be sufficient to keep this pest in subjection on fruit and shade trees.

One of the most effective methods of keeping this pest under control is by the destruction of the egg masses. Creosote oil applied to the egg mass will soak in and kill the eggs. The following preparation has been extensively used in work against the gipsy moth. Creosote oil 50%, carbolic acid 20%, spirits of turpentine 20%, and 10% of coal tar. The latter is added to color the compound and thus show at a glance what clusters have been treated. It is usually best for two men to work together, one standing upon the ground to point out the egg clusters and the other applying the mixture. No ordinary fire running over the ground can be relied upon to kill egg masses attached to stumps, foliage, stones or similar places. They must either be removed and burned in a stove or furnace or touched with the creosote oil preparation as described above.

The caterpillars prefer to hide during the daytime. Advantage may be taken of this habit by tying burlap bands in the middle around the tree trunks and dropping the upper portion of the burlap down over the string. The bands can be lifted daily and the caterpillars assembled beneath killed. This method proved of so great value in the exterminative work against the gipsy moth, that thousands of trees were banded during the latter part of the caterpillar season. The trouble with the two last named methods is that they are quite expensive though very efficient, and on that account their employment will be restricted largely to shade trees and ornamentals in parks, where expense is a question of minor importance.

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A few only of the more important and valuable works relating to this insect are cited. The first named, by Messrs Forbush and Fernald, is by far the most comprehensive volume and includes everything of value relating to this insect up to the time of its publication.

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Brown tail moth

Euproctis chrysorrhoea Linn.

This species, a more recent introduction than the gipsy moth, has already attained a much wider distribution and promises to develop into a serious pest of fruit, shade and certain forest trees. It will prove exceedingly difficult to control this pest in forest areas if it becomes at all abundant and destructive. This insect is not only injurious to the foliage of trees, but the barbed hairs of the caterpillar, falling upon human flesh, may produce a severe and occasionally dangerous irritation. This latter phase of the trouble has been so serious as to cause the board of health of the city of Boston to give a public hearing on the subject in 1901.

Destructiveness. The caterpillars are very voracious, feeding by preference on the foliage of both apple and pear [pl. 8, 9], wild cherry and white oak, though they thrive on both soft and hard maples and also elm. They are exceedingly abundant in the Middlesex Fells and other extensive wooded areas north or northwest of Boston, and last spring defoliated large tracts of white oaks. The numerous nests of young caterpillars, visible in these wooded sections last September, gave every indication that the injuries next season would be more extensive than were those during the spring of 1905. The nests of this insect were very abundant on hard and soft maples in and about Saugus and there is every probability that unless active steps are taken these trees will be defoliated another year. The nests were less apparent on the elm. Numerous apple and pear trees throughout the infested region were in a dead or dying condition and bore striking testimony to the voracity of this insect, while others supported many nests containing caterpillars destined to continue the work of devastation another season.

The serious effects upon property values, caused by the abundance of gipsy moth caterpillars, applies with double force to those of this pest, since the caterpillars are not only extremely annoying when abundant, but their irritating barbed hairs, blowing from the nests or cocoons, are constant reminders of the insect's presence aside from the serious discomfort inflicted.

Distribution. This species, unlike the gipsy moth, spreads readily with the wind, as the female moths fly without difficulty. This has been an important factor in extending the distribution of the insect. It was brought into this country in the early 90's and in 1901 it had made its way 30 miles west to Hudson, Mass. It has been reported from the Connecticut valley, has spread half or two thirds the length of the state of New Hampshire, occurs at Kittery, Me., and has been found at St John, New Brunswick.

Brown tail moth caterpillars, like those of the gipsy moth, may be carried considerable distances on vehicles or persons, though favorable winds at the time the moths fly seem to be the most important factor in distributing the pest. There is some danger that automobiles passing through infested sections during the time the moths are in flight may carry gravid females long distances and correspondingly hasten the spread of the insect. One of the agents connected with the work of suppressing this pest and the gipsy moth states that a considerable number of moths were found last summer among the cushions of an automobile in the infested section. The long runs made by these vehicles render it very possible that uninjured adults have been carried beyond the limits of the present known infested area. These facts indicate a strong probability of this pest becoming established shortly within the bounds of New York State, if it has not already obtained a foothold.

Description. The male moths have a wing spread of about 1¼ inches, are pure white with a satiny luster on the fore wings and have a conspicuous reddish brown tuft at the tip of the abdomen [pl. 2, fig. 5, 6]. Sometimes there are a few black spots on the fore wings. The antennae are white and fringed with pale yellowish hairs. The females are the same size and color as the males except that they have no black spots on the wings and the anal tuft is larger and blacker in color while the antennae are shorter and with shorter fringes.

The eggs, laid in July in masses of 200 to 300, are usually placed on the underside of the leaves [pl. 2, fig. 1], where they are covered with brown hairs from the tip of the abdomen. They hatch in a short time and the young feed during the rest of the season on the surface of the leaves, a few days only being required to skeletonize them. The caterpillars begin at once to make a nest [pl. 2, fig. 7] in which they hibernate while still young. It is constructed on the twigs and is made by drawing together a few leaves, lining them with silk and inclosing them with a mass of silken threads [pl. 10]. These tents are so firmly secured to the twigs that they can be removed only with considerable force.

The young or overwintering caterpillar is easily recognized by its black head, dark color and particularly, by the two conspicuous tufts on the anterior two abdominal segments, and the two circular papillate reddish elevations on the dorsum of the sixth and seventh segments. The hibernating caterpillars are found in silk-lined pockets within dense firm webs, which are torn open with difficulty.

Hibernating larva. It is sparsely clothed with long, brownish, barbed hairs, about ¼ inch long, and with the head and body dark brown or black. There are two conspicuous reddish dorsal tufts on the first and second abdominal segments, rather pale, median, sublateral, reddish lines on the dorsum of third, fourth and fifth abdominal segments and a conspicuous, oval, reddish, tubercular process on the dorsum each of the seventh and eighth abdominal segments. Labrum pale whitish. The anterior margin of the thoracic shield with a pair of sublateral, oval, pale orange markings, and with a large, paler, lateral tubercle below. The second and third thoracic segments are thickly studded with black tipped tubercles, the sides and intervening space being pale yellowish. There is a sublateral line of pale yellowish white, the dorsal margin of a row of conspicuous lateral tubercles, each bearing a spreading fascicle of long hairs. There is a stigmatal row of large, dark brown tubercles lying in a broad band of pale yellowish white. The true legs are dark brown, the prolegs brown with golden-yellow tips.

The full grown caterpillars [pl. 2, fig. 3], range from 1 inch to 1½ inches long. The pale brown head is mottled with dark brown and has reddish brown hairs scattered over its surface. The body is dark brown or black with numerous fine, dull orange or gray spots over the surface, which are most pronounced on the second, third and fourth segments. Long, reddish brown, finely barbed hairs arise from all the tubercles, and white branching hairs from the upper side of the lateral tubercles on segments 4 to 12 inclusive. These white hairs form elongated white spots along each side and are one of the most striking characteristics of the full grown caterpillar. The subdorsal and lateral tubercles on segments 4 to 12 inclusive are covered with fine, short spines of uniform length. The bright red retractile tubercles on the top of the 10th and 11th segments are also visible as described above.

The pupa is ⅝ inch long, dark brown in color and with fine, yellowish brown hairs [pl. 2, fig. 4] scattered over the surface.

The close, firm webs [pl. 2, fig. 7; pl. 10] of this species are also very characteristic. They are 4 to 6 inches long and occur on the tips of the smaller twigs, remaining there throughout the winter.

Life history. The winter is passed by partly grown caterpillars in the peculiar webs on the terminal twigs. They begin work in the spring, feeding downward from the tip of the branches, leaving the naked twigs and the gray apex at their extremities, conspicuous evidence of their presence. All the leaf but the midrib is devoured except that in the case of trees like the sycamore maple, the larger ribs also are untouched. The caterpillars when numerous attack not only buds, leaves and blossoms, but even green fruit. They are gregarious till nearly full grown, when they disperse to some extent, and this spreading is more marked when the food supply on the tree becomes exhausted. Several caterpillars frequently pupate in a common cocoon within the leaves at the tip of the branches and sometimes in masses under fences, clapboards or on the trunks and larger branches of trees. The webs of the brown tail moth may be easily distinguished from those of the tent caterpillar, Malacosoma americana Fabr., or the fall webworm, Hyphantria textor Harr., both common native species, since the tent caterpillar makes its web in the forks of the branches, whereas those of the brown tail moth occur at the tips. The fall webworm rarely attacks pear or hard maple, both of which are more or less favorites of the brown tail moth. The former makes a much larger, more open web than the latter. Moreover it is never firmly attached to the twig by bands of silk as is the case with this introduced species. The snow-white brown tail moths are attracted to light and in infested regions may be very numerous in July.

Food plants. This species has been recorded on a considerable number of food plants. Apple and pear appear to be favorites in the infested region, and the same is true of wild cherry and white oak. The pests are nearly as abundant on both hard and soft maples and apparently to a less extent on elm. It also occurs on quince, plum, cherry, peach, rose and grape, some of which are seriously injured. Messrs Fernald and Kirkland give a list of 81 trees and shrubs upon which the caterpillars have been observed feeding.

Irritation caused by the hairs. Investigations have shown that this trouble is entirely a mechanical one and is not, as it was at first supposed, due to any poisonous irritating substance in the hairs. The nettling of the skin may be caused by contact with either old or young caterpillars or cocoons, though in the latter case contact is not necessary, since hairs from them are blown about by the winds. Professor Fernald cites the statement of an English journal that travelers are often affected when the wind blows strongly from infested hedges along the road. This severe irritation may be allayed by applying vaseline and sweet oil to the affected parts. Alcohol has been employed with some success, and the trouble is so prevalent in the Metropolitan district that druggists have special lotions for this brown tail itch, many of which are valuable.

Natural enemies. A number of parasites have been reared from pupae in this country. Professor Fernald records the breeding of Phaeogenes hebe Cress., Diglochis omnivora Walker, Euphorocera claripennis Macq. and a large number of unnamed dipterous parasites from this insect. He states that the work of Diglochis is specially valuable and he also records the destruction of many caterpillars by the soldier bug, Podisus serieventris Uhl., P. placidus Uhl., Milyas cinctus Fabr. and Liotropis humeralis Uhl. assist in this good work. A serious effort is being made by Superintendent Kirkland to obtain European parasites of this species, and in view of its extended depredations upon forest trees it is most sincerely hoped that the quest will prove entirely satisfactory.

A number of native birds prey upon this species. Professor Fernald states that the Baltimore oriole, black-billed and yellow-billed cuckoos, crow, bluebird and English sparrow have also been observed feeding on these insects, and quotes Mr Kirkland to the effect that the birds eat not only the moths, but their young. Messrs Fernald and Kirkland state that the notorious English sparrow has a strong redeeming trait in its fondness for the moths, it ranking as their most formidable bird enemy. In addition to the above mentioned birds, Mr E. H. Forbush has recorded the robin, blue jay, black and white warbler, the rose-breasted grosbeak, the chestnut-sided warbler, the scarlet tanager, redstart, chickadees, red-eyed vireos and yellow-throated vireos and the male indigo bird as feeding on the caterpillars. The blue jay and the yellow-throated vireo are specially valuable. The records given by Mr Forbush include the number of larvae eaten by each bird and the time occupied. None ate less than nine, and one as many as 57 caterpillars, the latter operation occupying 20 minutes. These observations show that our native birds will undoubtedly prove very efficient aids in checking this pest. Professor Fernald has also recorded bats as feeding on the moths at night, and he states that toads devour the caterpillars during the early summer and the moths later in the season.

Remedial measures. The conspicuous hibernating nests [pl. 2, fig. 7] of this species are easily detected at any time when the foliage is off the trees, and one of the most effective methods of checking this pest is to cut them off and burn them. This can be very easily done with the aid of long handled pruning shears and ladders. The insect is also readily controlled with arsenical poisons; and Professor Fernald reports experiments in spraying with arsenate of lead, in which 1 pound to 150 gallons killed 50% of the caterpillars in four days, 90% in seven days and all in 13 days. Treatment with the same insecticide, 2 pounds to 150 gallons, gave similar results, and when 5 pounds were used to 150 gallons 80% were dead within four days and all in nine days. The use of 10 pounds to 150 gallons resulted in the destruction of all the caterpillars in six days.

Spraying with paris green, 1 pound to 150 gallons, killed 4% in four days, 70% in six days and 90% in nine days, all being dead in 12 days.

The methods described above, while applicable to the more valued fruit and shade trees, can hardly be employed to advantage in forest areas. This species it is feared may become a serious pest in oak and maple timber unless natural enemies, either native or introduced, prevent its becoming unduly abundant. It is difficult at the present time to see how, with our present methods, it can be fought successfully in extensive forest areas.

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EXPLANATION OF PLATES

PLATE I[1]

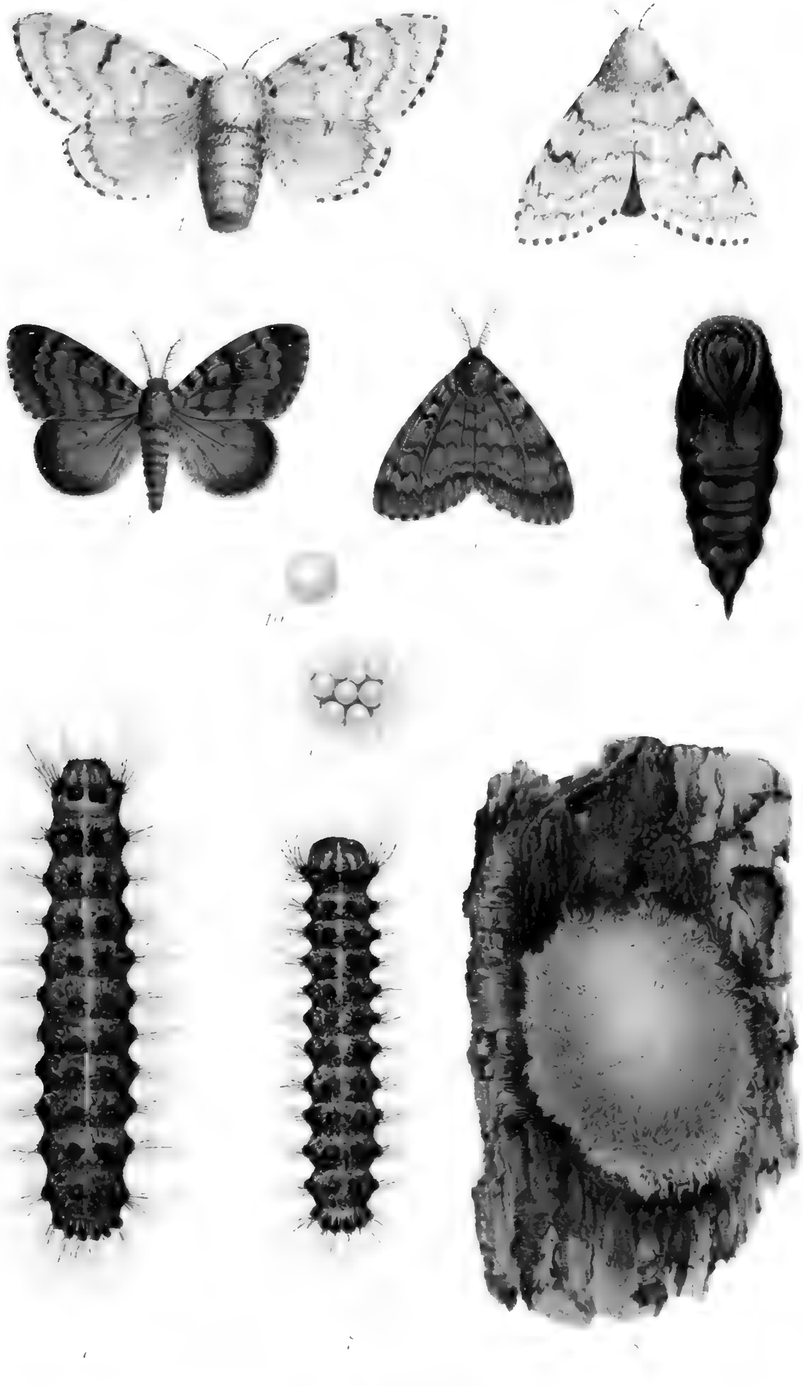
[1]Reproduced through the courtesy of the secretary of the Massachusetts State Board of Agriculture.

Gipsy moth

Porthetria dispar Linn.

1 Female with wings expanded
2 Female in resting position
3 Male with wings expanded
4 Male in resting position
5 Pupa
6 Dorsal view of one of the larger caterpillars, presumably a female
7 Dorsal view of one of the smaller full grown caterpillars, presumably a male
8 Egg cluster on a piece of bark
9 A few eggs greatly enlarged
10 One egg still more enlarged

Plate 1



GIPSY MOTH

After Massachusetts State Board of Agriculture

PLATE 2[1]

[1]Executed from nature under the author's direction by L. H. Joutel, and reprinted from N. Y. State Mus. Bul. 64.

Brown tail moth

Euproctis chrysorrhoea Linn.

1 Egg mass on the underside of a pear leaf and also on twig
2 Young caterpillars or larvae as they appear in early spring
3 Half grown and full grown caterpillars
4 Pupae in portion of a web mass, also a few cast larval skins
5 Male moth at rest
6 Female moth with wings partly extended
7 Hibernating tents in which the winter is passed

PLATE 3

Forest trees stripped by gipsy moth caterpillars. Malden, Mass., July 1905. From unpublished photograph loaned by Kirkland

Plate 3

Work of gipsy moth caterpillars

PLATE 4

Pine and other trees attacked by gipsy moth caterpillars at Melrose, Mass. Photo June 1905. From unpublished photograph loaned by Kirkland

Plate 4

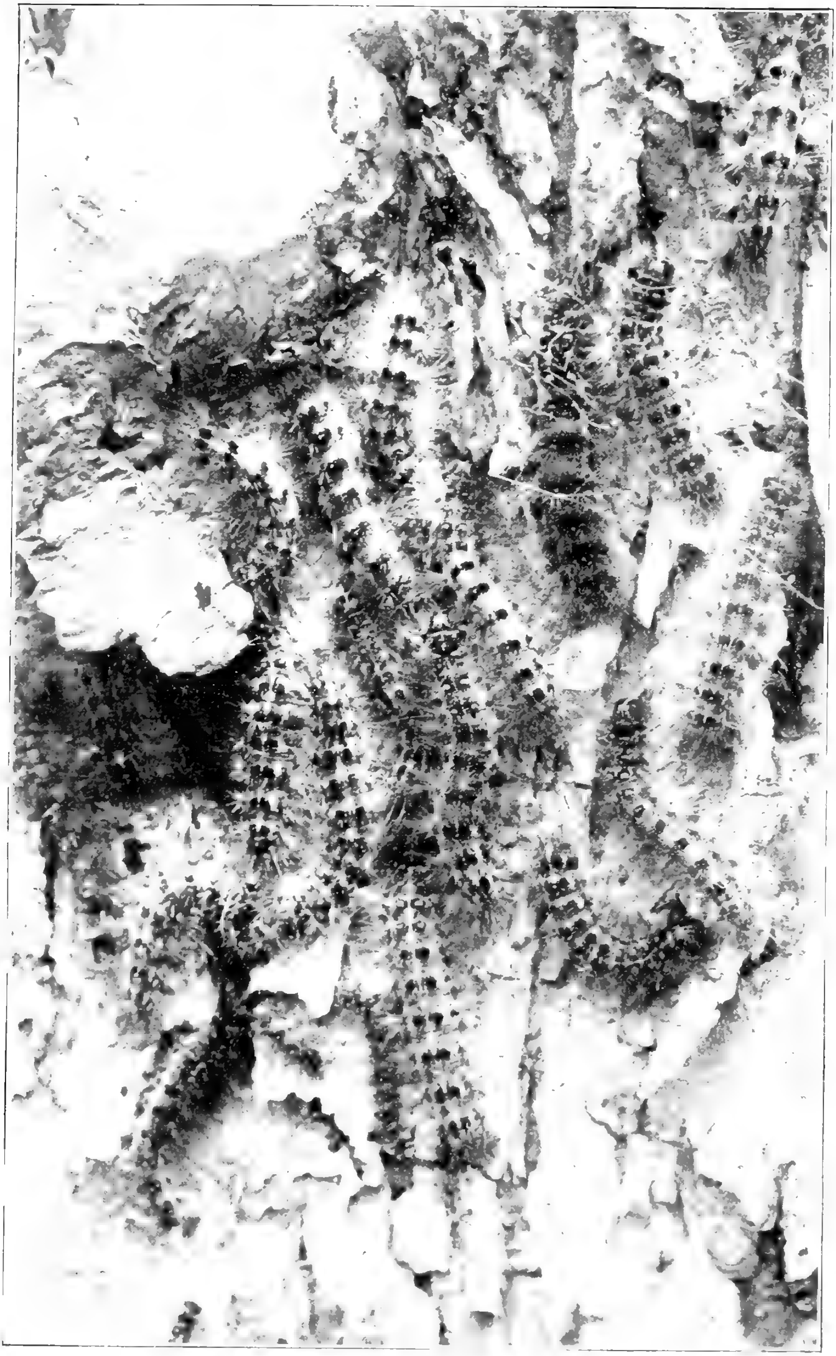
Pines killed by gipsy moth caterpillars

PLATE 5[1]

[1]Plates 5–7 reprinted from *The Gypsy Moth*, Mass. State Bd Agric. 1896.

Full grown gipsy moth caterpillars about to pupate on the trunk of a walnut tree. Arlington, Mass., July 9, 1891

Plate 5



Cluster of gipsy moth caterpillars

PLATE 6

A large stone has been removed from the ledge, exposing a mass of gipsy moth pupae. Arlington, Mass., July 9, 1891

Plate 6

Masses of gipsy moth pupae

PLATE 7

Female gipsy moths depositing egg clusters on the trunk of an oak tree Saugus, Mass., 1895

Gipsy moths depositing eggs

PLATE 8

Peartree defoliated by brown tail moth caterpillars. The webs on the trees in the background were destroyed during the previous winter. Winchester, Mass. Photo June 9, 1905. From unpublished photograph loaned by Kirkland

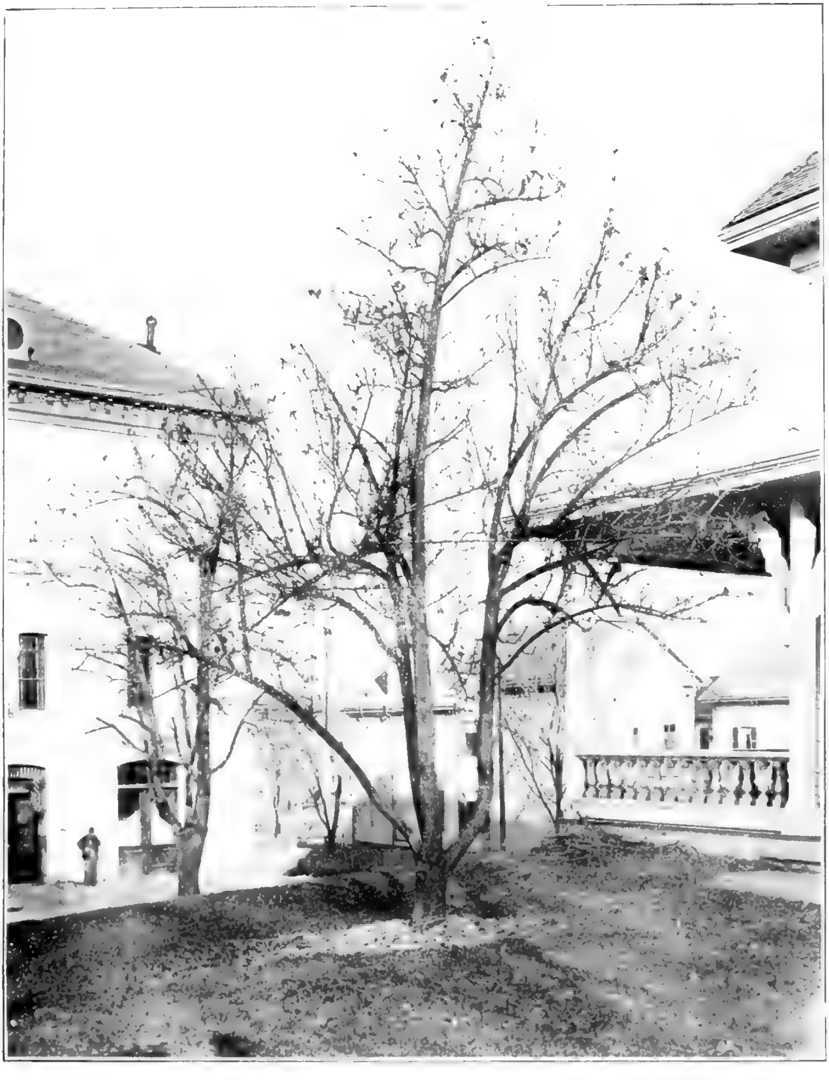
Plate 8

Pear trees defoliated by brown tail moth caterpillars

PLATE 9

Web of brown tail moth caterpillars on pear. Melrose, Mass., March 1906. From unpublished photograph loaned by Kirkland

Plate 9



Webs of brown tail moth caterpillars

PLATE 10[1]

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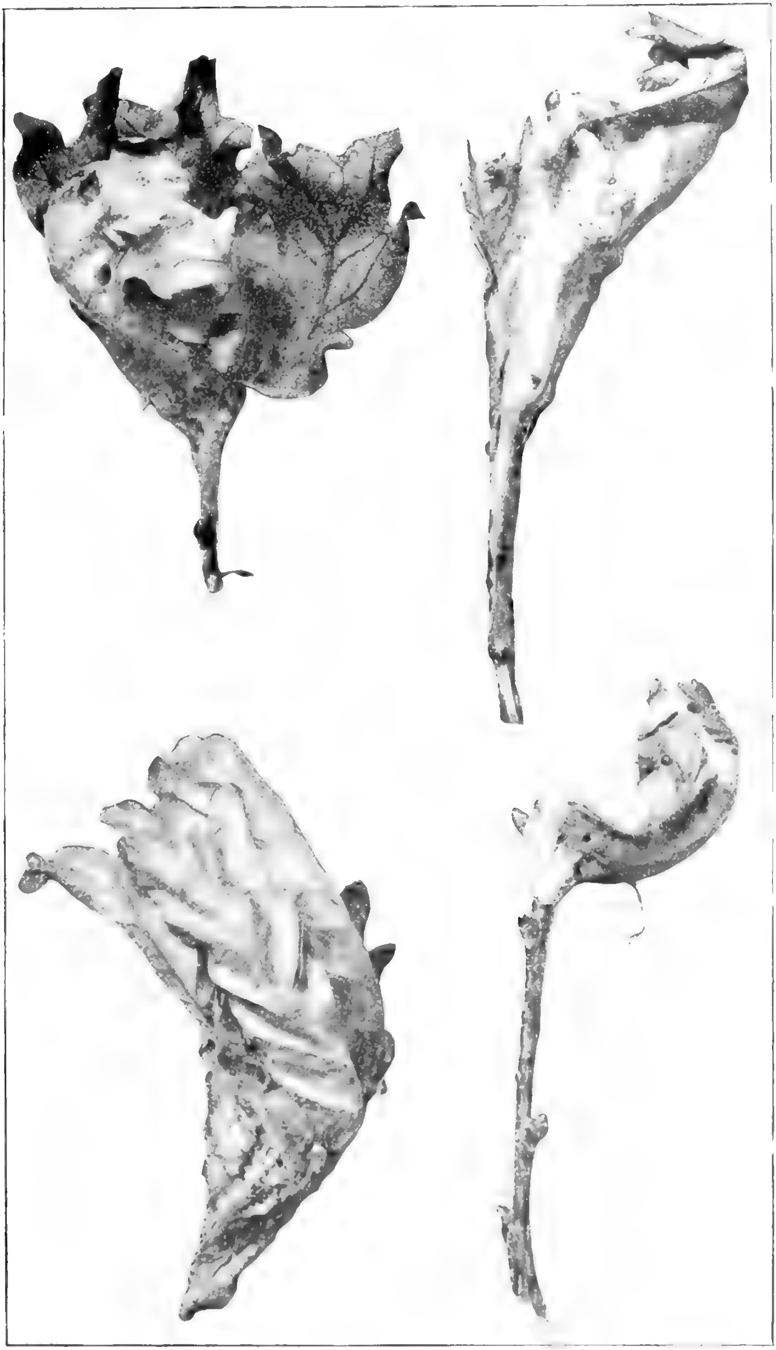
[1]Plate 10 reprinted from *The Brown Tail Moth*, Mass. State Bd Agric. 1903

Winter webs of brown tail moth on English oak. Photo by Charles Bradley, Sup't Farm School, Thompson's island



Winter webs of brown tail moth

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Published monthly by the
New York State Education Department

BULLETIN 382 AUGUST 1906

New York State Museum

JOHN M. CLARKE Director

EPHRAIM PORTER FELT State Entomologist

Bulletin 104

ENTOMOLOGY 26

21st Report of the State Entomologist

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1905

New York State Education Department
Science Division, February 16, 1906

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 Entomologist for the year 1905.

Very respectfully
JOHN M. CLARKE
Director

Approved for publication February 17, 1906

A. S. Draper

Commissioner of Education

New York State Education Department

New York State Museum

JOHN M. CLARKE Director
EPHRAIM PORTER FELT State Entomologist

Bulletin 104

ENTOMOLOGY 26

21st REPORT OF THE STATE ENTOMOLOGIST

1905

To 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 October 14, 1905.

General entomologic features. The season of 1905 was marked by the appearance of two destructive grass pests. Grass webworms (Crambidae) were very abundant and somewhat injurious to grass lands in Rensselaer and Albany counties in early spring, and in midsummer the army worm, Heliophila unipuncta Haw., aroused considerable anxiety by appearing in numbers in limited portions of Chautauqua and Erie counties. Fortunately this latter attack was not extensive and the injury did not approximate that inflicted by this species in 1896. The second brood of the codling moth, Carpocapsa pomonella Linn., was unusually abundant and caused serious losses, because the fruit crop was light and prices for first quality fruit correspondingly high. The rose beetle, Macrodactylus subspinosus Fabr., was very abundant and injurious in some sections of the State, appearing in swarms and nearly defoliating many fruit trees. The San José scale, Aspidiotus perniciosus Comst., continues to spread in fruit-growing sections though it has not been so prolific as last year. Shade trees in some of the principal cities of the State were seriously injured by caterpillars of the white marked tussock moth, Hemerocampa leucostigma Abb. & Sm., the pests being so numerous as to defoliate thousands of trees.

San José scale. The control of this destructive insect is still a problem of considerable importance to the horticulturist. The experiments with various insecticides against this species were continued in 1905 and our recent results confirmed in a very gratifying manner. The lime-sulfur wash is fully as effective as any other material which has been employed against this insect in the East, and it is a pleasure to state that our earlier studies in the method of preparing this wash have been fruitful of good results, since experience shows that the prolonged boiling originally insisted upon is unnecessary. We have also demonstrated the possibility of making a reliable wash with lime and sulfur by employing only a little hot water together with a small amount of sal soda, a substance that is both cheap and easily obtained. This preparation is particularly valuable where but a few trees are to be treated.

Grape root worm. This pernicious enemy of the vineyardist is generally distributed throughout the Chautauqua grape region and has been under observation during 1905 for the purpose of corroborating in a general way the results of our earlier studies given in Museum bulletins 59 and 72, special attention being paid to the danger of its suddenly invading a vineyard in immense numbers and inflicting serious injury. Certain vineyards were severely damaged in earlier years and these have been carefully watched for the purpose of obtaining accurate data as to the practicability of restoring them. This can undoubtedly be done to advantage where there is serious injury of but one year's standing provided relief measures are prompt, though it is doubtful whether this is true where hosts of grubs are allowed to work two seasons in succession.

Gipsy and brown tail moths. These two imported insects have become well established in Massachusetts. The gipsy moth is now well known as an extremely voracious enemy of fruit and forest trees. Its spread is slow, as this species, on account of the female's inability to fly, must rely very largely for dissemination upon the eggs or caterpillars being carried from place to place by the movement of animals and the usual means of transportation, by such vehicles as automobiles, electric and steam cars, etc. In spite of this, there is grave danger of its being brought into New York State at almost any time. The brown tail moth, a more recent introduction, flies readily and has already made its way to the Connecticut valley. Like its associate, it is a greedy leaf feeder, living by preference upon our more valuable fruit trees and at the same time displaying a fondness for the foliage of such shade trees as maples and elms. These two insects are so destructive that a close watch has been kept upon developments in the infested territory so that our citizens may not be taken unawares. In addition, a comprehensive bulletin giving illustrated accounts of these two insects has been prepared.

Shade and forest tree insects. This constitutes an exceedingly important group, particularly as insect depredations on shade trees appear to increase in severity from year to year, strikingly illustrated by the extensive injuries inflicted by tussock moth larvae on the shade trees of many of our cities and villages in 1905. So many trees were defoliated by the pest that the Entomologist judged it timely to make an appeal for their more adequate protection. Good shade trees are surely worth $10 each. Our estimates show that the total value of these trees in the cities and villages of the State is at least $18,000,000 and probably much more. It is a short-sighted policy that allows this vast wealth which can be replaced only by great expenditure of both time and money to be destroyed for the want of a little protection, and we have therefore deemed it fitting to urge through the public press that every city of 50,000 or more should make provision for the adequate care of its shade trees by putting them under the control of a properly qualified forester or entomologist connected with either the park or city departments. We have further suggested that most villages would find it advantageous to make some provision for the welfare of their shade trees.

The investigations of shade and forest tree insects, begun by the writer in 1895, have been continued in connection with the extended memoir on *Insects Affecting Park and Woodland Trees*, soon to appear. A series of illustrations necessary for the identification of the very destructive bark borers was an outcome of these studies, a unique feature of the work being the demonstration of specific morphologic differences existing in the proventriculi of these small, dull colored apparently similar forms. Another result of our investigations has been the rearing of a number of gall gnats, known previously only by the vegetable malformations produced. These forms have been characterized in the adult and immature stages and form an excellent basis for further studies of this exceedingly interesting group.

Mosquitos. This group is extremely important economically and very interesting morphologically. Our work has been largely of a fundamental character, since it is absolutely necessary to define species before any precise statements can be made as to their life history and habits. Several allied forms have been carefully studied in all stages and satisfactory diagnostic characters worked out. Morphologic studies are very important because they reveal natural relationships, something of considerable moment when studying disease-bearing forms, since it is well recognized that closely allied species are very likely to have similar habits. The efficiency of ordinary repressive work also depends largely on a correct knowledge of the species involved. It was extremely difficult to identify either larvae or adults of our native forms previous to the appearance of Museum bulletin 79, a work which contains a series of illustrations very nearly essential to their identification. A material addition to our knowledge of these insects is given in Museum bulletin 97, which contains a revised key for the separation of a large proportion of American Culicid larvae and is of special interest because of the morphologic study of the terminal abdominal appendages, particularly those of the male. We have succeeded in homologizing these structures, have bestowed thereupon a set of appropriate names and our studies have demonstrated that these organs are of great importance to the systematist. Careful morphologic studies have already been made of a number of exotic forms, new material is constantly being received and we should soon be in position to make another important addition to the study of this group. Mr J. R. Gillett, a medical student, has been employed for six months in rearing mosquitos and making microscopic preparations. Some idea of the character and extent of our work may be gained from the following statistics: The State collection of Culicidae now comprises about 4600 pinned specimens, many of them bred, over 1600 microscopic preparations and numerous vials containing alcoholic specimens of larvae, a total of nearly 140 species being represented in the adult or larval stages, many of them in both. It is proposed eventually to bring together the results of our biologic and morphologic studies in a thoroughly comprehensive treatise on the mosquitos of New York State.

Aquatic insects. Dr James G. Needham and Cornelius Betten spent the summer in investigating the aquatic insect fauna of Old Forge and its immediate vicinity. This work resulted in large additions to the State collections, particularly in the Syrphidae and Caddis flies. Dr Needham is now engaged on a monographic account of the stone flies (Plecoptera) of New York State, which should be completed by the end of the calendar year. Mr Betten has in preparation a comprehensive account of our Caddis flies (Trichoptera), which may be expected in 1907.

The investigation of this hitherto much neglected group was planned on comprehensive lines though its extent was necessarily restricted because of the limited funds available for the purpose. The work already accomplished or in hand constitutes an unrivaled basis for more extended studies, which should not only result in large acquisitions of original knowledge but should also prove of immense service to the fish culturist. An idea of the possibilities may be obtained from the following statistics culled from related lines of effort: A number of years ago the shellfish industry of this State was at a very low ebb and now, as a result of the application of scientific methods, the products amount to over two million ($2,309,758) dollars. The fresh-water fish products of the Hudson valley and Long Island amounted in 1900 to over one million ($1,192,544) dollars and that coming into the State from the Great Lakes in 1901 to nearly one fourth million dollars ($241,916). These returns were obtained with very little or no effort toward improving the available amount of fish food, and there seems to be no reason why our numerous fresh-water lakes, ponds and streams can not be made much more productive. The mere stocking with valuable fish is not sufficient, provision must be made for an adequate food supply. It is very probable that careful studies of water insects and the conditions necessary to their existence would result in ascertaining practical means whereby the amount of available fish food might be immensely increased and the productivity of waters correspondingly influenced. The possible results from further investigations are sufficiently promising to warrant continuing this work so far as available funds will permit.

Publications. The Entomologist has made numerous contributions of a practical nature to the agricultural press. Two important bulletins, entitled *Mosquitos or Culicidae of New York State*, Entomology 22 [N. Y. State Mus. Bul. 79] and *May Flies and Midges of New York*, Entomology 23 [N. Y. State Mus. Bul. 86], have been issued. Owing to unexpected delays, the report of the State Entomologist for 1904 was not issued till after the close of the official year. The stone flies (Plecoptera) of New York State are being monographed by Dr James G. Needham. This work should be completed by the end of the calendar year. The memoir on

Insects Affecting Park and Woodland Trees is going through the press and should appear early in 1906.

Collections. Large and exceedingly valuable additions have been made to the State collection during the past season. The total is about 15,000 pinned specimens besides a great amount of very desirable biologic material. Messrs Needham and Betten secured a large number of valuable specimens at Old Forge, and their work was admirably supplemented by Assistant Entomologist Young, who spent a month collecting in the Adirondacks, specializing in the Hymenoptera and Diptera. Collections have been further enriched by Mr Young's donating some 3000 Coleoptera, many of them rare and a considerable proportion new to the State collection. The general condition of the collection has been much improved during the year. Mr Young has devoted a large share of his time to classifying the Hymenoptera and Diptera, while assistant Nixon has given most of his attention to the Coleoptera.

Office work. The general work of the office has been conducted about as in preceding years, aside from somewhat serious interruptions due to the protracted sickness of Assistant I. L. Nixon and a shorter illness of Assistant Entomologist D. B. Young. Continued and gratifying interest in our work is indicated by the correspondence. 2035 letters, 784 postals, 490 circulars and 1109 packages were sent through the mails, and 439 packages were shipped by express.

Nursery certificates. Indorsing of nursery certificates issued by the State Commissioner of Agriculture has been continued as formerly whenever the same was requested, which has been the uniform practice of the Virginia authorities for several years. The following is a list of firms to whom these nursery certificates were issued in the summer and fall of 1905: Nelson Bogue, Batavia; George W. Whitney & Co., Bryart Bros., George A. Sweet, Morey & Son, Stark Bros., Rogers Nurseries and Sheerins Wholesale Nurseries, all of Dansville; T. S. Hubbard & Co., George S. Josselyn, Wheeler & Clark, L. Roesch, Foster & Griffith and T. E. Schifferli, all of Fredonia; W. & T. Smith, R. G. Chase Co. and Sears, Henry & Co., all of Geneva; E. A. Barnes, Middle Hope; Mrs L. S. Peterson, Montrose; Jackson & Perkins Co., Newark; Eugene Willett, North Collins; M. F. Tiger, Patchogue; Stark Bros., Portland; Chase Bros. Co., Irving Rouse, Hawk Nursery Co., T. W. Bowman & Son Nursery Co., Perry Nursery Co., Ellwanger & Barry, Western N. Y. Nursery Co. and Brown Bros. Co., all of Rochester; Lake View Nursery Co., Sheridan.

Voluntary observers. The voluntary observers have continued to send reports throughout the growing season and a number of valuable facts were brought to our notice in this way. These reports, with the advance of years, will constitute a unique record of the abundance and destructiveness of various pests in New York State, which should prove of great service to all those interested in securing data on insect outbreaks and causes controlling the same.

Historical. It is 50 years since the first report on injurious and beneficial insects was published by Dr Asa Fitch, then entomologist to the State Agricultural Society and practically State Entomologist. This document, unique as the first report on injurious insects in this country by a salaried State official, was the precursor of a magnificent series, 14 in all, consisting of over 1100 pages of largely original matter. These publications deal with insects affecting the agriculturist, special attention being paid to those depredating on grain and garden crops, fruit and forest trees, and constitute invaluable records to which economic entomologists must frequently refer. A decade elapsed between the appearance of the last report prepared by Dr Fitch and the first written by Dr Joseph A. Lintner, State Entomologist, though the latter published a number of practical entomologic articles and did considerable work along economic lines during this period.

Dr Lintner was first appointed State Entomologist in 1880, and the quarter century since elapsing has been very prolific. During his term of office he prepared 13 important reports beside several minor ones and contributed over 900 independent articles to the agricultural and horticultural press. His studies and investigations were devoted chiefly to insects of prime economic importance, such grass pests as the army worm receiving careful attention, while species depredating on fruit and forest trees were by no means neglected. His official publications, extending over a period of 18 years, comprise a very valuable addition to economic literature and rank high in the estimation of all practical entomologists.

Later work of the office has been greatly facilitated by that done in previous years, the earlier records and collections proving exceedingly valuable. Large collections, particularly along special lines, have been characteristic of this recent work. Important exhibits of injurious insects have been prepared and maintained and interesting collections sent to the large expositions held at Buffalo, N. Y. and St Louis, Mo., all aiding in bringing the work of the office to public notice. The more destructive insects have received attention from year to year, and in addition a serious attempt has been made to conduct special investigations with the idea of making more valuable additions to our knowledge of injurious species.

The San José scale became established in the east in the early 90's, resulting in an urgent demand for information concerning this insect and its allies. A special study was made of this species and its more important congeners, and the results presented in a comprehensive bulletin on scale insects [N. Y. State Mus. Bul. 46]. This work was supplemented by experiments from year to year with a number of remedial washes, the details being given in annual reports for the last five years. The very destructive grape root worm of the Chautauqua region was carefully studied and many exceedingly important facts learned regarding the pest and the feasibility of controlling it demonstrated. The details are given in Museum bulletins 59 and 72.

Serious injuries to shade trees in the late 90's led to an investigation of the destructive forms, and the results were presented in several reports and bulletins, and summarized accounts given in the fourth and fifth reports of the Forest, Fish and Game Commission. These studies were introductory to work on forest insects, part of which appeared in the seventh report of the Forest, Fish and Game Commission. Field investigations of this group have been continued through a series of years and the general results brought together in a comprehensive memoir on *Insects Affecting Park and Woodland Trees.*

Aquatic insects constitute an important and hitherto much neglected group. Studies of these forms were begun in 1900 and continued to date with remarkable additions to our knowledge. The credit for this is due largely to Dr James G. Needham of Lake Forest College and his collaborators, Messrs Betten and Johannsen. These investigations resulted in a monograph of our dragon flies, special attention being given to the much neglected immature stages, to an as nearly complete account of our May flies, to important additions to our knowledge concerning the Caddis flies, and a portion of the true Neuroptera, Sialidae. The midges, Chironomidae and Simuliidae, exceeding important groups, have been the subject of extended and comprehensive studies by Mr Johannsen, the results being given in Museum bulletins 68 and 86. A monographic account of our stone flies is nearly completed, and a similar work on the Caddis flies in preparation. Many new forms have been discovered and characterized in the progress of this work, and the Museum publications treating of aquatic insects are essential to the library of every student interested in this important group.

Original studies of mosquitos, a group of unquestioned economic importance, have been prosecuted for several years, the preliminary results appearing in Museum bulletin 79, the first American publication to present a large number of reproductions from photomicrographs of both adult and larval structures. These illustrations are of utmost service, being very nearly essential to the identification of many species. Furthermore, this bulletin presents for the first time an excellent series illustrating the male genitalia, structures possessing a systematic value previously ignored and more fully expounded in an important morphologic paper contained in Museum bulletin 97.

Acknowledgments. The office is indebted to Dr L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture and to members of his staff for kindly determining various insects submitted for name throughout the year. Through the courtesy of Forest, Fish and Game Com'r James S. Whipple, the facilities of Fulton Chain hatchery at Old Forge, N. Y. were placed at the disposal of the office during the time field investigations of aquatic insects were in progress.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

Office of the State Entomologist Albany, October 14, 1905

INJURIOUS INSECTS

Grape root worm

Fidia viticida Walsh

This species must be considered a serious enemy of the vineyardist, though its injuries in the Chautauqua grape region have not been so great during the last two seasons as they were a few years earlier. It is now generally distributed throughout this grape section and a significant development of the last year or two is the extension of its operations to vineyards on the hills back from the lake. Two and three years ago the beetles were very scarce in these vineyards, while last summer both adults and larvae were more prevalent than they had been for some years and in one case at least, decidedly abundant.

Life history and habits. The life history and habits of this species have received much attention in the last three or four years, and considerable data bearing on periods of transformation, the habits of the grubs, beetles, oviposition etc., have been presented in State Museum bulletins 59 and 72, to which the reader is referred for details of much importance in controlling this destructive pest. The latter publication comprises practically everything given in the former together with many additional facts.

Root worm control. The investigations of the last three or four years have shown beyond doubt the practicability of controlling this insect, even in badly infested vineyards. The observations have been continued for the purpose of ascertaining the behavior of the pest through a series of years, in order to obtain a more adequate conception of its destructiveness and the conditions favorable to its multiplication with the resulting injury. The best idea of this insect's work can be gained by reference to a particular case where conditions are known. A very thrifty, well kept vineyard belonging to D. K. Falvay of Westfield was found to be abundantly infested with root worms in the spring of 1903. Most vineyardists know in a general way the results of our experiments. A horse collecting machine was made and as a result of three catchings at intervals of about five days in early July, over 150,000 beetles were taken from the experimental area of about 5 acres, or an average of 59 insects were secured from each vine, in spite of the fact that a considerable proportion of the area had been previously cultivated for the special purpose of killing the pupae, this latter operation undoubtedly destroying from 50 to 75% of the latter. Bearing this in mind, these figures give some idea of the immense number of root worms which must have been at work in the vineyard before operations commenced. An examination in 1903 showed that the grape roots were very badly scored, and there was a question whether the vitality of the vines was sufficient to outgrow the injury. The vineyard has, as is well known, received excellent cultivation and care, and the following spring collections with the bettle catcher resulted in taking about 6% of the number captured the preceding July; in other words, the numbers of the pest had been reduced by cultivation for the destruction of pupae and the collection of beetles by about 94%, if we make no allowance for the normal increase of those surviving the operations of the previous season. This vigorous action in connection with excellent cultivation and fertilization gave the vines an opportunity to recuperate, and while they grew well throughout the season in 1903 there was still a chance that the root worm injury had made such a draft upon the reserve vitality of the vines as to make it impossible for them to eventually recover. It is very gratifying to state that the observations of 1904 and 1905 show that these fears were groundless. The vines, in spite of the severe damage inflicted in the fall of 1902, and probably to some extent in the early spring of 1903, have been able to overcome the serious injury and the vineyard is now in most excellent condition in every respect. These experiments and their subsequent results should prove of great value to every grower, since they show that a vineyard may suffer considerable injury from such a pest as the root worm and yet be brought back to its normal condition, provided remedial measures are adopted promptly and the vines given an opportunity to recover through excellent cultivation supplemented by judicious fertilization.

The above bit of history is a marked contrast to that of certain vineyards in the same section, some of which have been practically ruined by the root worm, with very little effort on the part of the owner to avert disaster. We know of one at least which was seriously infested by root worms two or three years earlier than that belonging to Mr Falvay and which is still in a very poor condition, owing largely, we believe, to continued and unchecked root worm depredations. Other causes such as extremely light soil, undrained land, etc. may produce weak, unthrifty vines in restricted localities or even over extended areas. These latter by no means explain some of the losses in Chautauqua vineyards. The grape root worm is undoubtedly causing a great deal of damage and here and there it has multiplied so freely as to nearly destroy the vines.

Experiments with arsenical poisons. The results obtained with these substances last year are given in detail in our report for 1904. The work of 1905 in this direction has consisted largely in making supplemental observations upon the areas sprayed last year. A somewhat peculiar and anomalous condition was found to prevail about the middle of June in our experimental area in E. W. Skinner's vineyard at Portland. It was found that the grubs were then decidedly more numerous under sprayed vines than they were under those which were untreated last year and employed as checks. This condition was exactly the reverse of what was found the preceding fall and may be explained in one or two ways. The application of arsenate of lead protects the vines to a considerable extent, not only from insect injury but from fungous troubles and as a result there was fully as good leaf development on the sprayed vines as elsewhere. The well known preference the beetles exhibit for a thick shelter might naturally lead them to oviposit more largely on the sprayed vines and, owing to the fact that the last of June and early July the foliage was pretty well protected by poison, it may be that a considerable proportion of the eggs were deposited in this area later, and this was borne out by our examinations for egg clusters in 1904. A reference to our report for that year will show that a high percentage of eggs were laid on the sprayed areas late in the season. Grubs from these late deposited eggs are not likely to attain full growth in the fall and as a consequence are much more easily overlooked, so that the apparent discrepancy between conditions found in the fall of 1904 and the spring of 1905 may have been due in part to the better development of foliage attracting more beetles, and in part to the failure of the grubs to attain full size before final counts were made in October 1904. It is at least a peculiar condition, and there is a possibility that some of the grubs found under the vines sprayed the preceding year may have come from eggs deposited by inflying beetles since we know that such migrations occur.

Further evidence on this point, though not entirely of a satisfactory character, was obtained by examining a vineyard near Prospect Station where the beetles, in spite of four sprayings with poisoned bordeaux mixture in which ¼ pound of paris green was used for each 50 gallons, had done considerable eating. This vineyard was treated primarily to prevent rot. The first application was made just before and the second just after blossoming, the others following at intervals of about a week or 10 days. It was stated that the spraying was thorough, though examination leads one to believe that the treatment was concentrated about the middle of the vines for the special purpose of covering the fruit, the lower and upper leaves escaping the application to a considerable extent. The finding of numerous beetles in this vineyard shows that the insects can thrive on sprayed vines and emphasizes the necessity of very thorough work in case one attempts to control them in this manner. The adaptability of beetles to this condition is further demonstrated by finding grubs late in the fall rather abundant under the vines, showing that these insects will select their food whenever there is an opportunity and that they can thrive where other species might succumb readily.

General summary. The observations of the last few years have brought out certain facts rather conspicuously.

They have shown first of all that vines growing on heavy clay soils can withstand greater injuries by root worm than those upon light sandy soils.

They have demonstrated that root worms display a marked preference for the lighter soils, and when vigorous vines are growing thereon the chances of injury are greatly increased.

Our investigations have shown that this insect is to a considerable extent a local species; that is, it may breed in very large numbers in one vineyard or even in a portion of a vineyard and be almost absent from other parts. The reason for this is sometimes seen in greater thrift of badly infested vines and in other cases no ready explanation can be found for the difference.

It has been shown that the beetles fly more or less freely, sometimes entering a vineyard in large swarms and depositing a great many eggs. This fact is of considerable importance because a vineyard free from the pest one season may be very badly infested another. These peculiarities in the behavior of the insect render constant watchfulness necessary on the part of the grower.

Our experiments with arsenical poisons have not been so successful as we had hoped, and though the insect is undoubtedly checked thereby to some extent, we doubt the wisdom of relying wholly thereupon. Experience and investigations show that the applications must be exceedingly thorough in order to obtain even a moderate amount of protection in this manner.

Recommendations. The peculiar and somewhat erratic habits of this insect lead us to emphasize the advisability of watchfulness on the part of every grower if he would avoid serious injury by root worms.

There is no doubt as to the value of cultivation for the destruction of pupae, and wherever the beetles are at all abundant we would advise as heretofore, that vineyardists plan if possible to have a ridge of firm earth at the base of the vines either in the fall or early spring (preferably the former), and to remove the same with a horse hoe or other implement when the great majority of the insects are in the "turtle" or pupal stage, which is normally from the first to the middle of June.

This measure may well be supplemented by destroying beetles, either by the employment of a beetle catcher or with an arsenical spray. The use of the former is preferable in all vineyards where the insects are very abundant and especially where the vines are growing vigorously. The latter may be employed with safety wherever the vineyard is not badly infested, and particularly on vines not growing rapidly. The employment of an insecticide is most advisable where the berry moth is at all prevalent, because there is no doubt but that the poison kills over half of these insects, and this benefit should be taken into account when deciding on the method of destroying the beetles. It should be remembered that if poisons are used the application should be most thorough, and it is probable that an outfit capable of developing a high pressure and delivering an extremely fine, mistlike spray would give better results than one where the spray is coarser and consequently does not drift in among the leaves to so great an extent.

Our observations show that it is much better to fight this insect at the outset and prevent serious injury to a vineyard, rather than to take chances and spend three to five years in getting the vines back into fairly good condition.

Army worm

Heliophila unipunctata Haw.

This species occurred in large numbers in limited areas of Chautauqua and Erie counties last July. Mr Eugene Merry of Derby informed us that army worms were quite destructive on 17 acres, largely of oats, in the town of Evans, Erie co. The pests appeared July 1 and were abundant about 10 days. No natural enemies were observed. Fortunately the outbreak was not an extensive one and so far as we can learn no serious injuries were inflicted in other sections of the State.

Early history. The widespread depredations of 1896, at which time this pest inflicted its maximum injury, are still fresh in mind. The numbers of this species fluctuate widely at irregular intervals. The first authentic report of injury in New York so far as known occurred in 1817, when many meadows and pastures in the northern towns of Rensselaer county and the eastern portions of Saratoga county were rendered as "barren as heath." Some injury was recorded in 1842 from the western part of the State and severe ravages were committed in 1861 in the vicinity of Buffalo, near the head of Seneca lake and at several other points in the southern and western counties. Depredations by this species were reported from Tioga county in 1871, and four years later it attracted notice the latter part of July and the middle of August on Long Island. It was again destructive in 1880, caterpillars appearing in June on Long Island where they caused much alarm.

Description. This insect is one of our common grass-feeding species, which is present in greater or less numbers in grass fields from year to year. Its habits are such that it is ordinarily observed only when conditions allow it to become abnormally abundant and destructive.

The eggs are smooth, white when first laid, turning gradually to a pale straw color before hatching and are about $\frac{1}{50}$ inch in diameter. They are usually deposited in adhesive masses and may be found between the leaf sheath and the stem of grass, the toughest stalks in the thickest clumps being a favorite place of deposit. They are also laid on herbs, dead stems, stalks and in less favorable places when the moths are abundant.

The young caterpillars, rarely seen, are about $\frac{1}{16}$ inch long, of a dull, translucent color with brownish black or yellowish head with dark eyes. These recently hatched caterpillars walk in a looping manner, somewhat like measuring worms. After the first molt the young caterpillars are $\frac{1}{5}$ inch long, the head is darker and the striping observed in full grown individuals is becoming apparent. The general color of the body is yellowish green with three more or less well defined brownish lines on each side of the body. The looping habit is still continued.

The full grown caterpillar has the head light brown with variable dark brown markings, there being more or less indistinct, broken, oblique, sublateral stripes of dark brown. Thoracic shield light brown with distinct median and sublateral white lines. Body a variable greenish with fuscous markings and with more or less distinct median, sublateral, lateral and substigmatal, narrow, white lines, the sublateral and lateral separated by a broad, yellowish, brown or reddish mottled stripe and the stigmatal bordering a broad, yellowish brown or reddish mottled stripe, below, which in turn margins the greenish yellow, fuscous mottled ventral surface. The area between the median and narrow sublateral white line is a variable greenish with fuscous markings, there being in some specimens more or less of a fuscous spot on the anterior portion of each segment just above the lateral line. The lateral white line is separated from the stigmatal line by a broad, variable dark band. True legs pale yellowish; prolegs mostly pale yellowish with a more or less distinct fuscous patch externally.

The above represents the more normal type of coloration. Darker individuals are to be found with almost no trace of the narrow median white line. The sublateral, yellowish brown mottled stripe bordered by two white lines appears to be more constant and the same is true of the narrow, stigmatal, white line and its ventral margining, yellowish brown mottled band. Occasional specimens have the sublateral lines nearly obsolete.

The mahogany-brown pupa is about ¾ inch long, rather stout and bearing at the posterior extremity a pair of slightly converging spines, and on each side thereof two fine, curved hooks.

The adult is a very modest, reddish gray or fawn-colored moth with a wing spread of about 1½ inch. It may be recognized by the small, rather conspicuous, somewhat triangular white spot in the middle of each forewing, which latter bears at its outer margin in particular a variable series of small black spots.

Life history. The winter is normally passed in the pupal stage, the moths appearing in early spring and depositing their eggs as a rule on coarse vegetation. The caterpillars hatching therefrom feed upon various grasses or grains, increase in size rapidly and in turn transform to moths early in June. These latter deposit eggs as did their predecessors, and the caterpillars hatching therefrom constitute a second brood which is the one that caused the principal injury this season and also in 1896, though occasionally the third brood is destructive in September.

The caterpillars are very retiring in habit, remaining under shelter most of the time. The feeding is done largely during cloudy weather or at night. The young caterpillars eat away the lower epidermis of the leaf much in the same way as do Crambid larvae, beginning to eat holes in the sides of the leaves when about a week old. There is considerable difference in the rate of development, which is caused largely by the abundance and condition of the food.

Indications of injury. The signs of this insect's presence are not very striking till serious damage has been inflicted. Oats for example appear to be abnormally thinner and on examination it may be found that most of the leaves have been eaten away. An unusually early ripening should arouse suspicion. The characteristic black droppings on the surface of the ground should lead to scrutiny. Light patches in the field should be examined for signs of this insect's work, and a search under stalks, stones or any adjacent shelter may result in exposing the caterpillars.

Natural enemies. This pest has a large number of natural enemies, which are undoubtedly very serviceable in controlling this species. Unfavorable weather conditions destroy many of the hibernating insects and at times a deadly bacterial disease cuts off thousands of caterpillars. Vertebrate enemies such as swine, shrews, skunks, weasels, domestic fowls, specially ducks and geese and various insectivorous birds devour large numbers of the caterpillars whenever they are numerous. Predaceous insects such as the ground beetles and the tiger beetles also aid in the good work, one of the most efficient of the former being the fiery ground beetle, Calosoma calidum Fabr.

Native parasites play an exceedingly important part in checking this species. The red-tailed Tachinid Winthemia quadripustulata Fabr., sometimes occurs in swarms in an infested field, and its rather large, whitish eggs are frequently observed just behind the head of unfortunate caterpillars. An almost equally abundant and efficient enemy is found in the closely allied yellow-tailed Tachina fly, Belvoisia unifasciata Desv. A number of allied species assist in this work and their efforts are supplemented by those of several minute four winged flies, one of the best known of these latter being the so called military microgaster, Apanteles militaris Walsh. The rather large, reddish, flattened, wasplike parasite, Eniscopilus purgatus Say, is another valuable check upon this species.

Preventive and remedial measures. The most important thing to be borne in mind in connection with this insect is that the moths deposit their eggs by preference on coarse vegetation of one kind or another and as a result army worm outbreaks are likely to occur in the vicinity of rank weed growths such as neglected spots about stones, untrimmed strips beside fences and similar localities. Farms where clean culture prevails are much less likely to suffer injury than those presenting conditions attractive to the moths, as described above.

The caterpillars of this pest are usually so abundant in an infested field that nothing but heroic and prompt measures will stop their work. Grain badly infested throughout with these insects can be saved only by cutting it at once and drying, because the caterpillars will cease eating as soon as the stalks have become somewhat hard. Usually army worms are very abundant in patches here and there, and advantage may be taken of this and their spreading to comparatively uninfested portions prevented by the use of a series of furrows, bands of tar, narrow boards set on edge and with the face next the pests covered with tar, or other obstacles. The furrows, if they be employed, should be turned away from the portion to be protected, and they can be made more efficient by excavating holes in the bottom at intervals of a rod or two, in which the army worms will drop as they crawl along the furrows seeking a place to escape. The pests can easily be destroyed in such places by pouring on kerosene or even covering with earth and crushing. A strip of tar several inches wide, preferably spread upon a board, will turn the caterpillars aside and it may likewise be made more effective by digging holes close beside it, into which the worms may be trapped as described above. A narrow, smooth board set on edge, tipping a little toward the pests, will also be of value in diverting the insects from the field to be protected.

The caterpillars can be destroyed by spraying crops on which they are feeding with paris green, london purple or other arsenical poison, making a very heavy application with the idea of destroying them at once. A poisoned strip should prove of considerable service in protecting areas beyond and its efficacy may be enhanced by the employment of a poisoned bran mash, using enough paris green or other arsenical poison to give a distinct coloring to the mixture and spreading it liberally in thickly infested sections. Better results will follow the use of this latter if the mash be distributed in the late afternoon, as it would remain moist and attractive to the caterpillars for a longer period. Many army worms may be destroyed by spraying them with kerosene, a strong kerosene emulsion or other contact insecticide. These measures will destroy the caterpillars and are not so dangerous to live stock as though poison was employed.

The essential is to avoid presenting conditions attractive to these insects and lacking that, to detect the presence of the enemy early and then adopt vigorous measures to prevent further injury.

Bibliography

A detailed account of this species is given by the late Dr J. A. Lintner in the 12th Report of the State Entomologist for 1896, pages 190-214.

Grass webworms

Crambus species

The latter part of May 1905 was noteworthy because of the appearance of many purplish, brown headed caterpillars about ¾ inch long in grass fields. These webworms were so abundant in portions of Rensselaer, Columbia and Albany counties as to eat practically all the grass within limited areas, producing conspicuous brown patches, which gave rise to considerable apprehension lest the depredations become more extensive and result in great losses. An examination the latter part of May and early in June led us to estimate that in portions of the town of Schodack fully 100 acres had been denuded of almost every green leaf.

Early history. The most severe, widespread injuries by these insects in New York State were recorded by Dr Lintner in his first report for the year 1881. The depredations were confined largely to St Lawrence county. Dr Lintner states that in the town of Potsdam hundreds of acres of pasturage had been destroyed and not one farm, it was believed, had escaped. Some idea of the outbreak may be gained from Dr Lintner's observations which follow: "An upland pasture containing 50 acres, which, 10 days previous to my visit, had afforded good pasturage, was now entirely brown. No grass could be seen in glancing over its whole extent, except over a very narrow strip which had been used as a roadway when farming purposes necessitated occasionally passing from one field to another." On returning, Dr Lintner readily detected the ravages of the caterpillar "at various other places in St Lawrence, Jefferson and Oswego counties, by the brown patches, usually of small extent, on knolls and in the more elevated portions of the pastures bordering the road. Near Richville, several large infested patches were seen. None were noticed at Keen's Station. At about a mile south of Sanford's Corners, in Jefferson county, and continuing for some distance farther, traces of the attack were visible in small brown spots in pastures. Within about 2 miles of

Watertown, it became quite noticeable, and for a few miles beyond, several pastures showed the higher portions infested, and a grain field was also believed to be suffering from it. It was again noticed as we approached Adam's Center and after leaving Sandy Creek, in Oswego county."

A few years later Dr S. A. Forbes, state entomologist of Illinois, recorded severe injuries to corn by the so called corn root worm or better, corn webworm, Crambus zeëllus Fern., and in 1891 Prof. Lawrence Bruner reported the same insect as damaging corn in Nebraska and several other states. The latter year the sooty Crambus, C. caliginosellus Clem. was destructive to corn in Delaware, and similar work was noticed as early as 1886 at Bennings, Md. Injuries by webworms to corn planted on sod were reported by Dr Smith for the year 1893 and in 1894 the garden Crambus, C. hortuellus Hübn. was recorded by Mr Scudder as a destructive pest of cranberries. Crambids were very injurious to grass lands in Ohio in 1896. Professor Webster states: "I witnessed more widespread, severe injury from these webworms than ever before. Not only have whole fields of corn been swept out of existence, but fields of oats have been as completely destroyed, and on being resown have again been as utterly ruined a second time. In some portions of the State, almost without exception, oats or corn sown or planted on sod lands was entirely destroyed, and in one or two cases even on ground that was the previous year devoted to wheat, these crops have suffered also." These insects have also been more or less injurious to corn and tobacco, particularly in Maryland, specific cases being recorded by Professor Johnson for the years 1897 to 1900 inclusive. The damage was in each case attributed to the sooty Crambus, C. caliginosellus Clem., and invariably occurred on land which the previous year had been in grass.

Life history and habits. There are about 20 native species of close-wings or Crambids, parents of grass webworms. They are all, so far as known, grass feeders by preference and closely resemble each other in life history and habits. The moths are easily recognized by their peculiar position in connection with their limited flight. . They invariably occur in grass lands and when flushed fly but a rod or two, alighting on a stem or blade of grass with the body parallel thereto, the wings wrapped closely about the abdomen and the conspicuous palpi extending directly forward. The peculiar manner of holding the wings has led the English to bestow upon them the common name of close-wings. A series of trap lanterns were run at Cornell University in 1889 and the material therefrom shows that different species of Crambids fly from the latter part of May throughout October, the greater number being abroad in July, fewer in June and August and only one or two species in May and September. This variation in the period of flight probably indicates a corresponding difference between the time the caterpillars of the several species attain maturity. This is of considerable importance because most caterpillars feed much more heartily just as they are completing growth, and were this destructive period in the various species distributed over a series of weeks the caterpillars would obtain a maximum amount of food with a minimum injury to the grass. This is very probably what occurs in nature.

The life history of these forms, so far as known, may be summarized briefly as follows: The adults fly as described above and drop their pearly white or yellowish, strongly ribbed eggs at random in the grass, caterpillars hatching therefrom in about a week. The young larvae obtain shelter at the base of grass stalks and at first eat only the underside of the leaf, leaving the upper epidermis. They soon construct a cylindric, web-lined retreat to which they retire during the day. As they attain a little size, portions of the leaf are eaten away and soon the young caterpillar is strong enough to cut off a blade of grass, drag it to its nest and even end it up and draw the end down into its web-lined shelter. This is evidently a provision so that the little creature can feed during the day without exposing itself to attacks from various natural enemies. The partly grown webworms pass the winter in their web-lined retreats and in the spring renew their feeding, those of the vagabond Crambus, C. vulgivagellus Clem., completing their growth the latter part of May or early in June, at which time the cocoon is spun. The caterpillars, however, remain unchanged in their shelters for about two months or through June and July, and the moths appear in the case of this species during the latter part of August and may be observed throughout September.

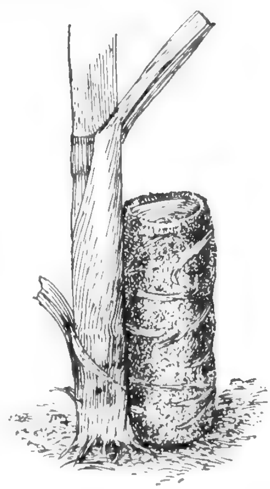
Fig. 1 Crambus trisectus, tube of older larva at base of grass stem, enlarged (Redrawn from author's illustration)

Natural enemies. Webworms are subject to attack by a number of natural enemies, which are undoubtedly of much service in keeping the pests within bounds. A minute four winged fly, Lampronota frigida Cress., was reared from the caterpillars by Dr Lintner in 1881, and Dr Riley obtained another form, Cryptus mundus Prov. A small Tachanid, allied to the one which is so efficient in checking army worm outbreaks, was bred from larvae by Dr Lintner, who observed in the infested fields a well known caterpillar hunter, the fiery ground beetle, Calosoma calidum Fabr. This latter insect is undoubtedly a valuable ally in checking grass webworms. We would expect in addition that many of the smaller ground-feeding birds would destroy a large number of these grass pests.

Fig. 2 Crambus albellus, larval tube or nest in grass, the lower portion exposed by the removal of a little humus (Redrawn from author's illustration)

Remedies. Grass webworms, as has been pointed out above, live by preference on members of the grass family and ordinarily abound only in grass lands. Their invasion of corn fields, tobacco fields and cranberry bogs must be considered more or less accidental, particularly as their depredations in these latter are usually much more marked on the borders of fields adjacent to grass than elsewhere. This naturally suggests the advisability of keeping crops likely to suffer injury from these pests as distant from grass lands as practical. Corn and tobacco fields and possibly cranberry bogs could be surrounded by several rows of potatoes, for example, in localities where these pests are likely to cause trouble.

Another condition leading to injury is when grass sod badly infested with these webworms is plowed and then planted with some crop upon which the caterpillars can feed. This is the usual explanation where there is extensive and serious damage to either corn or tobacco, and the obvious remedy is so to arrange operations when practical as to render such an outbreak impossible. Plowing of the infested land in late summer or early fall, in August or early in September, should result in most of the caterpillars perishing before the following spring. This can not always be done, and danger of injury by those species of webworms which feed in 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 some other crop appears. Early spring plowing of such fields may only aggravate the injury by retarding the development of the caterpillars, with the result that when corn or some other crop begins to appear it is speedily devoured by hordes of half starved webworms. The destruction of a crop under these conditions may be avoided to some extent by putting in from one half to double the usual amount of seed, thus increasing at the outset the chances of securing a fair stand.

Nothing can be done to prevent injury by these pests to badly infested grass lands after the characteristic brown patches have begun to appear, because the labor involved would amount to more than the value of the crop to be protected. Ordinarily such an outbreak means simply the loss of a considerable proportion of the grass for that season, as the webworms rarely feed on grass roots to any extent. There is therefore no necessity of plowing such lands unless one be desirous of obtaining a green crop of some kind, and as pointed out above, the sowing should be delayed a little in order to enable the webworms to complete their growth before the new crop begins to develop.

Literature. Literature relating to these insects is somewhat scarce and consists for the most part of brief records of injury to grass or grain crops. An economic account of these insects is given by the author in bulletin 64 of the Cornell University Agricultural Experiment Station, and Prof. C. H. Fernald has monographed the entire family in the 33d annual report of the Massachusetts Agricultural College, 1896, pages 77 to 160, to which the reader is referred for additional information concerning these insects.

Important species. There are several of these forms which have caused more injury than others and it is of some importance to be able to recognize them, consequently the following brief descriptive accounts have been prepared.

Vagabond Crambus

Crambus vulgivagellus Clem.

The adult is a very ordinary appearing moth having a wing spread of ¾ to 1¼ inches. The general color is a yellowish gray though the forewings are flecked with black and with black dots on the vein tips. The very long, black flecked labial palpi are most characteristic of the insect. It is the form which was largely responsible for the extensive outbreak in the St Lawrence valley recorded above and is probably fully as destructive to grass in this section as any Crambid.

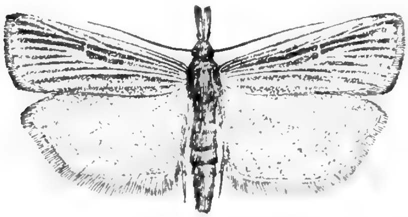

Fig. 3 Crambus vulgivagellus, enlarged (Original)

Description of early stages. The moths fly about dusk during the latter part of August and the first half of September and are attracted to light in large numbers, though a considerable proportion of the captures are males.

The pale straw-colored eggs turn to a reddish buff color before hatching. The very young larva is only about $\frac{1}{25}$ inch long and has a dark brown head, an olive-colored thoracic shield and a straw-yellow body. Late in the fall the young caterpillar may be nearly ⅛ inch long. The head is then jet-black, the thoracic shield a deep brown and the brown body ornamented with dark brown hairy tubercles. The full grown larva (presumably this species) is about ¾ inch long with a very dark brown almost jet-black head. The thoracic shield is dark brown, shining and the body a dull reddish brown or olivaceous with well developed, dark brown tubercles, each bearing a moderately long, stiff, brown hair. The thorax and abdomen are a little wider than the head, the latter being broadest near the middle, tapering somewhat toward the posterior extremity. Anal shield well developed, variably dark brown. True legs dark brown, prolegs dark brown, olivaceous. Ventral surface light yellowish brown.

Life history. The moths fly more or less during the day, particularly in shady places. The females are quite prolific, one depositing 320 eggs after capture, which is probably about the normal number. The young larvae remain for a time coiled up on a leaf in plain sight when not feeding, and if disturbed lie quiet for a minute and then try to escape, or they may drop at once by a silken thread. The larvae feed mostly during the day as cold weather comes on and occasionally may be seen eating in the early morning. They devour the soft parenchyma at first and later the whole leaf is consumed. This species feeds mostly on grass though it eats small grains, and winters as an immature larva which resumes feeding in the spring, completes its growth the latter part of May or in early June, spins a cocoon and some two months later pupates, the moths appearing in August and September.

Dried Crambus

Crambus trisectus Walk.

This species is a rather large, ashy gray moth having a wing spread of 7/8 to 1 1/4 inches. The forewings are ornamented with two irregular, oblique characteristic black markings. The moths fly mostly at or just after dark and are attracted to light in large numbers, being on the wing throughout June and July, though individuals have been taken the latter part of September. This species, as recorded by Dr Lintner, was associated with the vagabond Crambus in the unprecedented outbreak observed in the St Lawrence valley. Our collections at Ithaca show that it is about as abundant as the preceding species, and like it should be regarded as a serious pest in grass lands.

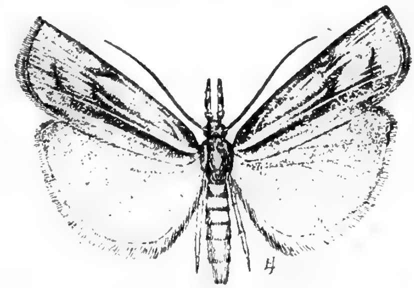

Fig. 4 Crambus trisectus, enlarged (Original)

Description of early stages. The eggs are a cream-yellow when first laid, gradually turning to an orange-buff color before hatching. The very young larva has a black head, a dark brown thoracic shield and the body is a translucent white with numerous small black tubercles, each bearing one or more light colored hairs. The larva in late fall is about 1/12 inch long with the head and tubercles black, while the body is a mottled chocolate-brown with a dark stripe along the dorsal line. In early spring the head and thoracic shield are a dark amber, the tubercles of the same color and there is a dull pinkish line along the middle of the back, and irregular dark wavy subdorsal and lateral lines, the body being a pale straw color.

The oval cocoon is just below the surface and composed of a thick layer of bits of grass with particles of soil adhering. Within it is smoothly and thinly lined with silk.

Life history. This species appears to be moderately prolific, as one female deposited 150 eggs after capture and it is estimated that between three and four hundred may be produced. The newly hatched larvae show a marked preference for the axle of a leaf.

where they eat the soft paranchyma, feeding most voraciously. They begin to spin webs in these retreats when about a week old and frequently several leaves are fastened together, in the midst of which the caterpillars feed. They will also subsist on sheep sorrel if grass is not available. The last of September, about a month after hatching, the young caterpillars construct near the surface of the ground cylindric perpendicular nests which are usually attached to one or more stalks of grass. The outside of this retreat is covered with finely chewed bits of grass, while the inside is smoothly lined with silk. The nests are about ¼ inch long and $\frac{1}{16}$ in diameter. They are strengthened as necessities demand by the addition of more grass to the outside and occasionally a large piece is attached to the side of the nest, though usually the pieces are small and of nearly the same size. The larvae retire for the winter about the first of November, closing the free end with a bit of grass. Some nests have an underground chamber and a passage which probably allows the exit of the larvae during mild days and gives them access to the roots of grass. The larvae come forth in the spring and according to Dr Lintner complete their growth and pupate in June, the insects appearing 15 days later.

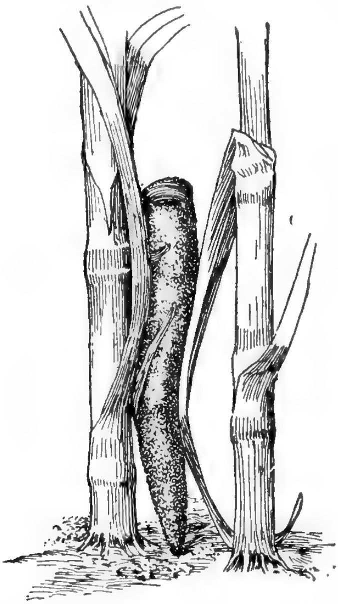

Fig. 5 Crambus trisectus, larval tube at base of grass stem, enlarged (Redrawn from author's illustration)

Dark-spotted Crambus

Crambus mutabilis Clem.

This species, with a wing spread of about ⅞ inch, may be recognized by the dark spot near the middle of the slaty forewing. There is also a dark subterminal line which is usually rubbed so as to give the appearance of a second dark spot. It is a larger species than the sooty Crambus, C. caliginosellus Clem., which it resembles somewhat. The moths fly the latter part of the afternoon and early evening during June, July and even in August and September. This close-wing seems to be confined to low or damp land and is easily attracted to lights. The species is a very common one at Ithaca and is undoubtedly an important grass pest. It is one of several found by Professor Webster causing serious injuries to the grass and grain lands of Ohio in 1896.

Description of early stages. The eggs are creamy white when first laid, gradually turning to an orange-red color before hatching. The young larva has a pale yellowish head flecked with sooty specks and the body is dark, semitransparent, white with irregular reddish blotches along the dorsum. Scattered dark colored hairs occur on the head and body.

Life history. This species appears to have an exceptionally long breeding season, as adults may be observed from June to September and possibly there are two generations annually. The period of oviposition lasts a week or more. One female deposited 200 eggs the day after being captured, 200 the next day and 100 the third, and at the end of the week had produced 727 eggs.

Yellow Crambus

Crambus luteolellus Clem.

This rather uniform, yellow Crambid with a wing spread of ¾ to 1 inch, appears to be confined to low, wet lands, the moths being abroad at dusk during the latter part of June and July. It was a rare species at Ithaca, though Professor Webster lists it as one of the five species responsible for extensive injuries to the grass and grain lands of Ohio in 1896. Practically nothing is known of its early stages except that the eggs are a light reddish color when first laid and ornamented with 14 prominent longitudinal ribs. It is closely related to the following species.

Sooty Crambus

Crambus caliginosellus Clem.

This small, dark colored moth with obscure markings has a wing spread of from ½ to 1 inch. The adults are abroad in early evening during the latter part of July and the first week of August, very few being attracted to lights.

This insect is best known because of its injuries in the corn and tobacco fields of Maryland. It does not appear to be an abundant or destructive form in New York State.

Description of early stages. The eggs are creamy white when first laid, gradually turning to an orange red color. The young larva has a pale amber head and is a dirty, translucent white with irregular, reddish spots on the middle line of the back. Scattered light colored hairs occur on both the head and body.

Life history and habits. This species appears to be moderately prolific, as one female deposited 275 eggs. The habits of the larva have been described by Professor Beckwith practically as follows: The caterpillars remain feeding on the tender inner portions of the corn, working just beneath the surface of the soil. Some stalks are nearly girdled and the worms are frequently imbedded in cavities they have excavated. Sometimes as many as 30 caterpillars were found in a hill, some stalks of which were entirely destroyed and in others the stalks were small, yellow and sickly. The greatest injury was inflicted in the portion of the field adjoining a small strip of timothy sod. It is probable that the moths flew into the field from the adjacent grass, dropped their eggs and the young larvae hatching therefrom caused the trouble above described.

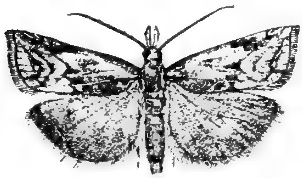

Fig. 6 Crambus caliginosellus, enlarged (Original)

Corn root worm

Crambus zeëllus Fern.

This is a dull, leaden gray, yellowish marked moth with a wing spread of from ¾ to nearly 1 inch. It appears to be rare in New York State, though it has been recorded from Maine, Pennsylvania, West Virginia, Illinois and Missouri and has been reported as a serious pest of corn. It is one of five species which Professor Webster considers responsible for extensive injuries to the grass and grain lands of Ohio in 1896.

Description of early stages. The larva has been described by Dr Forbes as follows:

Head dark chocolate-brown, slightly and irregularly rugose, with long yellowish hairs; upon the front a white S shaped mark; cervical shield yellowish, with a white median line; anterior edge whitish, and an oval black spot on the sides. Below the lateral edges of the cervical shield are two hairy tubercles; second and third segments of thorax each with two rows of hairy tubercles, the anterior of four, the posterior of two large quadrate spaces, sometimes united in the middle. From the 4th to the 10th segment the hairy tubercles above the spiracles are in two transverse rows of four each, those of the anterior row being quadrate with rounded angles, and as large as the interspaces; those of the posterior row transversely elongated, about twice as long as wide. Lateral tubercle of anterior row immediately above the spiracle emarginate at its posterior inferior angle, on all the segments from the sixth to the ninth; on these segments a smaller tubercle behind and beneath the spiracle; and two others between the spiracle and the proleg; a narrow arcuate tubercle, with long hairs outside, in front of each proleg. Anal shield smooth, reddish brown, with a few long brown hairs; spiracles dark brown. Ventral surface paler than the dorsal. Length of full grown larva, .6 to .8 of an inch; greatest width, .1 inch.

Life history. This species was studied by State Entomologist Forbes of Illinois, who found the larvae inflicting considerable injury on corn, attaining full growth the latter part of June or early in July, adults appearing July 22. It is probable that the life history of this species agrees closely with that of others. The eggs are presumably dropped at random in the grass and the partly grown caterpillars hibernate in web-lined retreats. There may be two generations annually, as pointed out by Dr Forbes.

Paneled Crambus

Crambus laqueatellus Clem.

This moth with a wing spread of ⅞ inch may be recognized at once by the two white stripes extending the greater length of the dark brown wings and separated by a brown stripe of almost equal width. The species was a rather abundant one at Ithaca in May and June in 1896 and is one of several which committed serious injuries to the grass and grain fields of Ohio the same year.

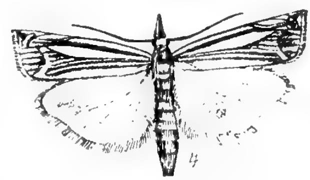

Fig. 7 Crambus laqueatellus, enlarged (Original)

Description of early stages. The eggs are creamy white when first laid, gradually turning to an orange color before hatching. The young larva has a brownish black head, a light brown thoracic shield and a pale body mottled with bright red and bearing blackish tubercles. The full grown larva is unknown.

Life history. This form is the earliest to appear in New York State and is also remarkable because more females than males were taken in trap lanterns. This insect seems to be a prolific one, as each of several females laid over 200 eggs, which is probably below the average. These hatched in about 12 days and the larvae, though quite active, refused to feed on timothy and therefore perished. Practically nothing else is known of the habits of this species.

Garden Crambus

Crambus hortuellus Hübn.

This little species with a wing spread of ⅝ to ⅞ inch may be recognized by its linear markings of yellow and silvery gray combined with short, black lines and dots. It is a very common species in grass lands during July and has attracted considerable attention because of its injuries to cranberry bogs, where it is known as the cranberry girdler.

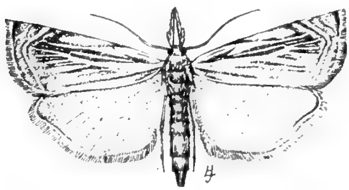

Fig. 8 Crambus hortuellus, enlarged (Original)

Description of early stages. The eggs are creamy white when first laid, turning to a pinkish red before hatching. The young larva has a smutty white color with the head a little darker than the rest of the body. The full grown larva, as characterized by Scudder, has a yellowish head and thoracic shield and the dark body is sparsely clothed with bristles, the longer ones being nearly as long as the width of the body.

Life history. This is a very prolific species, one female depositing 700 eggs. They hatch in about 10 days and the young larvae are very strong and active. They soon construct vertical cylindric nests at the base of grass stalks, covering the outside with bits of dry grass and lining them with silk. The larvae become dormant as cold weather approaches and in November the nests are reinforced with additional silk and the tops closed, affording a secure retreat for the winter. Professor Scudder's observations on this species as a cranberry insect show that the larvae occur in silken galleries beside the prostrate stems or runners upon which they feed. The injury was more marked on the edges of the field, presumably near grass. He found that the cocoons were spun at the surface of the soil and strengthened with particles of sand. They remained therein till the latter part of May or early in June apparently without any feeding, transformed to pupae, and a month later the moths emerged.

Remedies. This species, according to Mr Scudder, can be checked on cranberry bogs by flooding them for five days directly after picking the crop. This destroys the larvae, and where the injury to cranberries is serious this measure might be supplemented by keeping adjacent fields cultivated or in some crop other than grass, upon which this species and its allies thrive.

Experiments in controlling San José scale

Aspidiotus perniciosus Comst.

The following experiments against this insect during the season of 1905 were confined largely to testing several lime-sulfur washes with a view of ascertaining the most efficient preparation and at the same time obtaining more data upon the reliability of these washes under New York conditions. This latter was particularly advisable owing to the unfortunate results obtained during the season of 1904 in New Jersey, and given wide publicity in the early fall. This consideration led us to conduct experiments at Oyster Bay, L. I. making applications in particular to both pear and apple, as the wash was said to be less efficient on these fruit trees than on peach. Corroborative experiments were also carried on, partly in duplicate, on apple and pear trees in an orchard at Washingtonville. The necessity of boiling the wash by an ordinary application of heat or the employment of a chemical to facilitate combination was also investigated. There was slight ground for believing that a very finely divided sulfur might destroy the scale insects if exposed to the oxidizing effects of moisture and air, and to determine this a few limited experiments were tried with a fine amorphus sulfur kindly supplied by Mr F. H. Pough, general manager of the Bergen Port Sulphur Works. Unfortunately this material proved a total failure so far as controlling scale was concerned. The much talked about combinations between kerosene and a carefully hydrated magnesian lime, designated as K-L mixtures were also experimented with to some extent and the results of other applications observed.

Both the Oyster Bay and Washingtonville orchards contained an abundance of badly infested trees, and through the kindness of Mr J. T. McCoun, the owner of the first, and Mr C. R. Shons, proprietor of the latter, every facility was placed at our disposal. Careful plans were made and the actual work of application was intrusted to Assistant Entomologist D. B. Young and Assistant I. L. Nixon. Owing to the limited time during which the work could be done and a succession of windy unfavorable days in connection with the great difficulty of obtaining careful men to do the spraying, not all the trees were covered as thoroughly as desirable. Several trees at least in each lot were very well sprayed and these were used as a basis for determining the efficiency of the various washes. The writer made a personal investigation of the work a few days after it was completed, and the comments on the thoroughness of the work at that time were probably influenced to some extent by the inevitable washing during an interval of a week or 10 days. This is further sustained by the generally favorable results apparent as the season progressed. The record of the field work together with the results noted is given below.

Formula 1

This wash, consisting of 20 pounds of lime and 15 pounds of sulfur to 50 gallons of water was prepared by bringing several pails of water nearly to a boil in an iron kettle, adding the lime, following at once with the sulfur and stirring vigorously and maintaining an active boiling for at least 30 minutes. The wash was then strained and diluted to the requisite amount with cold water. The first lot of this wash became a deep green before boiling was completed. There was more sediment than usual, about 2½ quarts, apparently mostly sand. This was applied March 31 in the orchard of Mr J. T. McCoun at Oyster Bay, to 16 young appletrees in row 2, the first four receiving two sprayings. The wash changed to a yellowish green after being applied. An examination April 15 showed that the four trees twice sprayed were well covered, though a few twigs were missed. The application appeared to be rather thin and the trees were lead-gray. There was no sign of washing. July 11 the insecticide was very apparent and there was very little evidence of breeding. September 26 the trees were examined again and very few young scale insects were found.

Another lot of the wash was made April 2 and applied to row 7 in the same orchard. The only difference in the wash observed was that the color was a red-orange instead of green after standing the usual time. The coating seemed to be thinner when examined April 15 than was the case in row 2 and there was some more breeding July 11. September 23 the scale insects were breeding somewhat and the conditions were not bad, although the trees were very thickly infested the preceding spring.

This wash was also applied April 4 to nine greening trees in the apple orchard of C. R. Shons at Washingtonville. It began to sprinkle before the spraying was completed and during the night there was considerable rain till 10.30 the next morning. The trees did not show much washing and when examined April 14 it was seen that the general application was very good, though a trifle thin. July 13 there was very little or no breeding and the wash was plainly evident. September 28 there was only a slight infestation and very little breeding.

This wash was also applied March 30 to 13 peartrees belonging to J. T. McCoun at Oyster Bay. The reaction was excellent, an orange color being obtained in 10 minutes and gradually changing to red-orange and in 30 minutes to a dark pea-green. There was nearly a quart of sediment and this probably made trouble for the pump, as there was some difficulty in operating it. Examination April 15 showed that the tops of most of the trees were skipped, while the lower portions were fairly well covered. There was very little breeding July 11, and September 26 young were more abundant and on some trees there was considerable breeding, due probably to the trees not being thoroughly covered.

Another lot was applied April 4 to 17 peachtrees in the orchard of Mr Shons at Washingtonville. The preparation of the wash gave the usual reaction except that a wine-red color was obtained. An examination April 14 showed that tree 1 was fairly though rather thinly covered. There was no evidence of washing. July 13 there was very little or no breeding and the wash was still evident and on September 28 there was very little breeding.

Formula 2

This wash, composed of 25 pounds of lime and 20 pounds of sulfur to 50 gallons of water differs only from formula 1 in calling for a larger amount of lime and sulfur. The method of preparation in both instances was identical. The first lot was made with lime from the bottom of a barrel, and as the action was very slow an additional 2 pounds was added about two minutes later. This increased the chemical action and continued it much longer. The wash was a deep red in 20 minutes and eventually became a deep green. There was less than a quart of sediment. It was applied March 30 to 15 appletrees in the orchard of Mr McCoun at Oyster Bay. An examination April 15 showed that the first four trees were well covered except for a few twigs that were missed and that more were skipped where there was but one application. The former trees were well and the latter thinly covered. July 11 the wash was visible to some extent and there was a little more breeding on near-by trees treated with formula 1. September 26 there was some breeding though none of the trees were in a bad condition.

Another lot of this wash was prepared April 7 and applied to seven greening trees in the apple orchard of Mr Shons at Washingtonville. This lot was boiled 30 minutes and stood as long, becoming at the end of this period a pea-green color. An examination April 14 showed that the application was only fair, limbs being skipped in places even on the first tree. The insecticide adhered well to the twigs and there was no evidence of washing. July 11 the wash was easily seen and there was very little or no breeding. September 28 very few young were to be found.

Another lot of this wash was prepared March 30 and applied to 18 Bartlett peartrees belonging to Mr McCoun at Oyster Bay. The action in this instance was very good, becoming orange, gradually changing to red and upon standing till after lunch was a very dark green. There was about a quart of sediment. Upon examination April 15 it was seen that the lower portions of trees 1 and 4 were well covered. July 11 there was some breeding and the same was true September 26.

Formula 3

This wash, composed of 20 pounds of lime, 15 pounds of sulfur and 10 pounds of sal soda to 50 gallons of water, was prepared by placing the lime in four or five pails of hot water, following at once with the sulfur and sal soda. The mixture was then stirred vigorously, and in case the reaction was violent enough to threaten boiling over, a few quarts of cold water were added from time to time. The wash was covered with burlap as soon as danger from boiling over had passed, and allowed to stand 30 minutes. It was then diluted with the requisite amount of cold water. The first lot was prepared March 31 and the action was comparatively mild, there being no necessity of adding cold water to prevent boiling over. The final color of the clear liquid of the wash was a brick-red and there were about 3 quarts of sediment, mostly sand. This wash was applied to five appletrees in Mr McCoun's orchard at Oyster Bay. An examination April 15 showed that the first four trees were pretty well covered though some twigs were missed. The more thoroughly sprayed limbs were moderately white, while those receiving only one application were lead-gray. July 11 there was apparently no breeding in spite of the fact that the trees were so badly infested by scale the previous year that a considerable proportion of the limbs were dead. September 24 the scale was breeding to a limited extent.

The same wash was applied at Washingtonville April 4 to 17 appletrees. The reaction in this instance was slow and continued about 15 minutes. The color of the clear liquid became wine-red. There was very little sediment. An examination April 14 showed that the first tree was fairly though not thickly covered and that the application to the other trees could be classed as fair. The insecticide was thicker on the first tree and there were no signs of washing. July 13 there was very little or no breeding and the wash was still evident. September 28 there was very little breeding and the application seems to have been entirely successful.

Another lot of this wash was made up April 7 and applied to 20 appletrees in Mr Shons orchard at Washingtonville. The action was good in this instance and continued for at least 10 minutes. The wash was an orange-red when stirred and the clear liquid had a wine color. An examination April 14 showed that the first tree was fairly well covered and there were no signs of washing. Very little breeding was evident July 13 and September 23 the conditions were very satisfactory.

Another lot of this wash was made up March 30 and applied to 17 Bartlett peartrees in Mr McCoun's orchard at Oyster Bay. The action was so mild in this case that the addition of cold water was not necessary to prevent boiling over. At the end of 30 minutes the color was a red-orange and there was very little sediment. A lump about the size of one's fist was not reduced. This lot for some reason or other kept clogging the nozzles and gave considerable trouble in this respect. An examination April 15 showed that the first tree was pretty well covered and the tops of the other trees skipped though otherwise well sprayed. July 11 there was some breeding and the same was true September 26.

Formula 4

This wash, composed of 25 pounds of lime, 20 pounds of sulfur and 12½ pounds of sal soda to 50 gallons of water, differs only from formula 3 in being more concentrated. The first lot prepared gave a very good reaction. The mixture rose nearly to the top of the barrel though it was not necessary to add cold water to prevent its boiling over, possibly due in part to a strong, cool wind blowing. The reaction continued for 20 to 25 minutes. There was a considerable amount of sulfur which did not appear to be acted upon, possibly 2 quarts and an equal quantity of residue, probably sand. In this instance but 11½ pounds of sal soda were added because of the limited supply at hand. This wash was applied March 31 to 18 appletrees in the orchard of Mr McCoun at Oyster Bay. April 15 the first four trees were moderately well covered though some twigs were missed on one side. There were no signs of washing. The color of the limbs and branches twice sprayed was grayish white and that of those receiving a single application, lead gray. July 11 the wash was quite apparent and there was very little breeding on tree 2 and some breeding on trees 3 and 4. September 26 there was comparatively little breeding on the first four trees and the results may be considered very satisfactory after making allowance for conditions.

Another lot of this wash was prepared April 5 and applied to nine Ben Davis appletrees in the orchard of Mr Shons at Washingtonville. The water in this case was not boiling hot and there was consequently very little reaction, so slight that it was not regarded as having been sufficiently cooked. Steam was therefore turned on and the preparation boiled for 10 minutes, at the end of which time it was orange-red. Rain interfered with the application and continued all night. The sprayed trees showed some signs of washing though the insecticide was visible upon all. April 14 a close examination showed that there was a little even on apparently bare spots. The wash adheres well to the twigs. July 13 the wash was evident and there was as a rule very little breeding. Some of the fruit was slightly spotted, due probably to portions of twigs being skipped. September 28 there was not much breeding though there was a little more than on the adjacent row in this orchard, sprayed with formula 1.

Another lot of this wash was made up March 30 and applied to 22 Bartlett peartrees in the orchard of Mr McCoun at Oyster Bay. The reaction was very satisfactory, it being necessary to add some cold water in order to prevent the wash from boiling over. The color was very satisfactory, ranging from orange to orange-red. An examination April 15 showed that the lower branches of the first three trees were fairly well sprayed. The application was thick and there were no signs of washing. July 11 breeding was rather abundant and it was continued September 26. The abundance of young in this instance may be accounted for largely by the untreated upper portions of the trees.

Another lot was prepared April 5 and applied to 17 peachtrees in the orchard of Mr Shons at Washingtonville. The reaction was very active and lasted but five minutes, producing an orange-red color. An examination April 14 showed that many portions of the limbs were skipped and that the wash adhered well even on the twigs. There was very little breeding evident July 13 and the same was true September 28.

Formula 5

This wash, composed of 30 pounds of lime and 15 pounds of sulfur to 50 gallons of water depends upon the heat generated by the slaking lime to bring about a combination between the lime and sulfur. The latter was first made up with about 2 gallons of boiling hot water in a barrel and this was then stirred into the barrel containing the lime, adding at once enough to make 9 gallons of boiling water. It was found necessary to add 2 gallons more or the material would have been dry before the reaction stopped. The latter was very violent, and after being covered and standing 30 minutes was a bright orange. There was about 1 quart of sediment. This wash was applied March 31 to 18 appletrees in the orchard of Mr McCoun at Oyster Bay. April 15 it was seen that the first two trees were well covered except in the case of a few twigs. The spray was moderately thick on these and on those treated with only one application the color was lead-gray, the application being thin and more twigs missed. There was no appreciable washing. July 11 the wash was still apparent on the first tree and there was very little breeding in spite of the scale being so abundant the previous season as to kill many limbs. September 26 there was a limited amount of breeding.

Another lot of this wash was prepared April 7 and applied to 17 appletrees in the orchard of Mr Shons at Washingtonville. The reaction was very violent and over in seven minutes. There was a large amount of sediment, probably 4 quarts. The wash did not spray well. An examination April 14 showed that the first tree was well covered in places, only one limb apparently escaping treatment. There were no signs of washing. July 13 very little breeding was evident except on the third tree where there was considerable on a badly infested limb which was probably skipped in part. September 28 there was very little breeding as a rule.

Formula 6

This wash, composed of 15 pounds of lime and 15 pounds of sulfur to 50 gallons of water differs only from formulas 1 and 2 in calling for equal amounts of lime and sulfur. One lot was prepared April 7 and applied to six Ben Davis trees in the apple orchard of Mr Shons at Washingtonville. It was boiled 30 minutes, at the end of which time it was an orange-red color. An examination April 14 showed that the first tree was well covered and the others moderately so, with some twigs skipped. The wash adheres very well even on the twigs. July 13 there was very little or no breeding and the wash was quite evident. September 28 there was very little breeding and the results were generally very satisfactory.

Another lot of this wash was made up March 30 and applied to 23 Bartlett peartrees in the orchard of Mr McCoun at Oyster Bay.

This lot was boiled very rapidly for about 30 minutes, at the end of which time it was a dark green. There had been a shower and the trees were somewhat damp at the time of application. There was quite a little rain during the following night and while the wash was very apparent on the trees the next day, it showed a little washing from the rain. April 15 the application appeared to be fairly even and showed slight signs of washing. July 13 there was comparatively little breeding and the same was true September 26.

Formula 7

This wash, composed of 20 pounds of lime and 15 pounds of a specially fine grade of sulfur, known as the amorphous form to 50 gallons of water, was prepared by first slaking the lime and allowing it to cool, then thinning it to something like whitewash and adding the sulfur. There was some difficulty in mixing in the latter because it lumped rather badly. The preparation was forced through a screen on adding the requisite amount of water before spraying. It was applied to a few appletrees on the south side of the apple orchard of Mr McCoun at Oyster Bay. April 15 it had washed badly except where there was an abundance of scale which aided in keeping it in place. July 11 there was a large amount of breeding and it was plainly evident that this preparation was of comparatively slight value.

Formula 8

This wash, composed of 25 pounds of lime and 20 pounds of the extra fine amorphous sulfur to 50 gallons of water was prepared in the same way as formula 6, and applied April 1 to a few appletrees on the south side of Mr McCoun's orchard at Oyster Bay. The results were practically the same as those recorded for formula 7. These two experiments indicate plainly that comparatively little dependence can be placed upon the beneficial action of elemental sulfur alone. A certain portion of it at least must be brought into combination with the lime in order to obtain satisfactory results.

Formula 9

This wash, composed of 40 pounds of a high grade carefully hydrated magnesian lime known as limoid and 10 gallons (20%) kerosene to 38½ gallons of water, was prepared as follows: The kerosene was added to the limoid and stirred into a smooth paste. There was a slight excess of kerosene and an additional pound of limoid was necessary to take it up. Then four pails of water were added and stirred in vigorously with a hoe. The oil seemed to emulsify very readily. This was then put through a force pump for four minutes before being applied. It sprayed nicely and there was no sediment. An examination the next day showed that the trees were very white and the application seemed to have spread over the tree as well as in the case of lime-sulfur washes. This wash was applied March 31 to 14 Bartlett peartrees in the orchard of Mr McCoun at Oyster Bay. An examination April 15 showed that the trees were whitish with the lime. There was no odor of kerosene and living scale were easily found. July 11 breeding was rather abundant and September 26 young scales were present in large numbers.

Formula 10

This wash, composed of 50 pounds of limoid and 12½ gallons (25%) kerosene to 34½ gallons of water is the same as formula 9 except that there is a slightly larger amount of kerosene, there being 25% oil in place of the 20% oil in formula 9. It was prepared in the same way as the other. There was as in the preceding case a slight excess of kerosene though the paste was somewhat thicker. This was applied March 31 to 14 Bartlett peartrees in the orchard of Mr McCoun at Oyster Bay. It did not spray as well as formula 9 and the nozzles clogged somewhat. An examination April 15 showed that the trees had a whitish appearance. There was no kerosene odor and living scale was easily found. July 11 there was rather abundant breeding and September 28 young scales were very numerous.

Formula 11

This wash, composed of 40 pounds of lime and 10 gallons (20%) kerosene to 38½ gallons of water is the same as formula 9 except that a carefully hydrated calcium or ordinary stone lime was used in place of the magnesian lime sold under the trade name of limoid. The lime was carefully dry slaked by sprinkling with the necessary amount of hot water. The fine slaked lime was then sifted through a very fine sieve and the requisite amount mixed with the kerosene as in the case of the limoid. It was found necessary to add 18 additional pounds of sifted lime and even then fully a quart of kerosene remained on top. This made a very thick paste and it seemed impossible to work any more lime in without producing a lumpy mixture. This was diluted with the necessary amount of water and 2 quarts of sediment remained. It was applied April 1 to 18 trees in the apple orchard of Mr McCoun at Oyster Bay. The emulsion was driven through a force pump for five minutes previous to application. An examination April 15 showed that the trees were slightly sprinkled with lime and that many scale insects were alive, some twigs were missed and there was some washing or else a rather uneven application. July 11 there was very little breeding on the first two trees though on the fourth there were large numbers of young. September 26 the scale was breeding in very large numbers on a number of the trees. This mixture is a difficult one to prepare and our experience with it was certainly not very satisfactory.

General observations

A general observation of the lime-sulfur washes April 15 showed that most of them adhered well even to the smaller apple twigs where the application had been thorough. There was very little evidence of washing. The general results on the experimental trees in the Washingtonville orchard July 13, and also at Oyster Bay were very satisfactory considering the conditions under which the applications were made. This judgment was further substantiated by the trees sprayed by Mr Shons. The latter were practically clean, while the fruit on those he had been unable to treat was well spotted with scale insects and a great many young were to be found on the branches. The same condition obtained September 28. There was only a small amount of breeding on the sprayed trees except here and there where a portion of a limb had been skipped.

Spring applications with lime-sulfur washes in 1905 have been uniformly successful so far as our observations go. The general cooperative work at Glen Cove and vicinity showed that most of the treated trees were almost free from scale, though some of the worst infested ones bore a few living insects. Only occasionally was the pest abundant and then it was limited to a few limbs, evidently skipped. The results on peartrees were fully as satisfactory as those on apple, and in June the scale was well controlled on plum. The few instances where the pest was somewhat abundant on sprayed trees could easily be explained by the rough character of the bark protecting some of the insects. This is particularly gratifying when it is remembered that the work was pushed whenever conditions made spraying at all possible because of the large number of trees needing treatment.

Equally gratifying results were obtained by Mr W. H. Hart in his large orchard at Poughkeepsie, and wherever he was able to spray trees on both sides, each application accompanied by a stiff favorable wind, the pest has been kept under control in a very gratifying manner. The reverse was the case where unfavorable winds prevented treatment from the other side and such bore considerably smaller fruit badly infested by scale. There was also some difficulty in spraying the higher limbs, and in a number of instances Mr Hart has cut the top back with markedly beneficial results. The pest as a consequence has been kept under control at a considerably less expense and trees thus treated were easily recognized because of their larger fruit and more thrifty condition. Some of the others which had not been cut back have rather thin tops with more or less dead branches, showing that the spraying had not been successful at a hight of more than 18 or 20 feet from the ground. The general condition of the orchard is much better than a year ago. Mr Hart now believes in thoroughly drenching the infested trees, using a coarse nozzle and he employs hand pumps in preference to power outfits because of the lightness and mobility of the apparatus.

The results obtained by Mr L. L. Morrell at Kinderhook are equally gratifying and the condition of his orchard is much better than a year ago. A Bartlett pear orchard which was severely injured in 1903 and in bad condition in 1904 has made a very gratifying growth during the past season. It is extremely interesting to note that trees sprayed by Mr Morrell with a lime-sulfur-sal soda wash prepared entirely with cold water, which does not give satisfaction so far as deep brick-red color and vigor of reaction is concerned, were just as free from scale or almost as much so as others sprayed with the regular steam-boiled lime-sulfur wash. We much prefer to adhere to the original recommendation and advise preparing this wash, if it is to be employed, with several pails of hot water to promote a vigorous reaction at the outset. August 10 we had the pleasure of looking over an infested orchard in the central part of the State which had been thoroughly sprayed with a lime-sulfur wash in the spring of 1904 and again in 1905. A specially thorough treatment was given in hopes that the pest could be exterminated, as the infested trees were surrounded by valuable and extensive orchards. The results were exceedingly gratifying and almost no traces of living scale were found on the trees.

Summary of experiments

The results so far as killing the scale is concerned are markedly similar in the case of all lime-sulfur washes employed excepting numbers 7 and 8 where no heat of any kind was allowed to aid in effecting a combination between the lime and sulfur. The general behavior of the washes coupled with experience therewith in previous years leads us to regard formula 1, calling for 20 pounds of lime and 15 pounds of sulfur to 50 gallons of water boiled at least 30 minutes, as of at least equal value to any other fire or steam boiled wash. Formula 2 calling for a little more lime and sulfur was not enough better to warrant the increased amount of material. Formula 6 consisting of 15 pounds each of lime and sulfur to 50 gallons of water gave excellent results, yet previous experience leads us to believe some excess of lime is preferable on several accounts. We therefore continue our recommendation of formula 1 as being among the best of the lime-sulfur washes.

The so called unboiled washes depend upon chemical heat to bring about a combination, and of these formula 3 composed of 20 pounds of lime, 15 of sulfur and 10 pounds of sal soda to 50 gallons of water gave as good results as any similar combination, though more of the soda may be used as called for by formula 4. The lime-sulfur-sal soda wash requires a little care in preparation but after some experience the general results are much more satisfactory so far as chemical behavior and combination is concerned, than is the case with other unboiled or chemically boiled washes we have employed, and as stated above it holds its own in destroying the scale. It requires a minimum amount of hot water to secure a very satisfactory prolonged chemical action. Experience with this wash shows that it can be prepared without any hot water but unless the lime be of very superior quality we believe this to be inadvisable. Formula 5 requiring 30 pounds of lime and 15 pounds of sulfur to 50 gallons of water depends upon the heat generated by the large amount of lime to bring about a satisfactory combination between the sulfur and the lime. The action as noted is violent though of short duration and generally speaking the combination is not nearly so satisfactory as that obtained where sal soda is employed, and the wash itself is not so easy to handle.

Experience with a very fine amorphous sulfur and carefully slaked lime mixed together after the latter had cooled showed that this combination was practically of no value and further discussion thereof is unnecessary. Formulas 9 and 10, making 20 and 25% kerosene limoid washes, were tested under several conditions and generally speaking the results were not equal to those obtained with lime-sulfur washes, though there is no doubt but that a certain amount of scale was destroyed by the application. The general results were disappointing even in the hands of other persons where the treatment was said to be exceptionally thorough.

NOTES FOR THE YEAR

The following brief accounts relate to some of the more interesting species observed during the season, and are grouped as heretofore under appropriate heads.

Fruit tree insects

Codling moth (Carpocapsa pomonella Linn.). This species is well known as the apple worm and is more or less abundant from year to year. The season of 1905 has been marked by considerable injury in different sections of the State, which was further emphasized by the scarcity and high price of apples. The second brood of this pest appears to have caused the greater part of the damage, particularly in the Hudson valley. Some growers, thinking the pest was rather scarce, did not spray at all and as a consequence suffered greatly where others, making the usual applications but not expecting a second brood, were injured to a considerable extent. This is only another instance emphasizing the necessity of constant watchfulness if one would escape severe losses through insect depredations.

Apple maggot (Rhagoletis pomonella Walsh). This species is a very common and destructive pest of early apples, particularly sweet varieties in New England. It is only occasionally brought to notice in this State. Mr C. H. Stuart of Newark, writing August 8, states that this insect was very numerous in early fruit, it being so abundant that he was unable to find a sound early apple. Mr W. H. Hart of Poughkeepsie, a large fruit grower, also called our attention to the work of this species, stating that in his experience it was much more abundant and injurious in sheltered hollows than on side hills or other places where there is presumably more air. This species is a somewhat local form and it is very probable that it is affected to a considerable extent by wind currents, since it appears to exhibit a marked tendency to assemble in sheltered places.

Rose beetle (Macrodactylus subspinosus Fabr.). This common, well known pest of roses in particular, and a considerable number of other trees and plants whenever the insects are excessively abundant, is more or less numerous from year to year in certain favored breeding areas where the soil is almost always of a sandy nature. Reports of unusual abundance and corresponding injury by this species have been received from Staten Island, Grahamsville and the vicinity of Rochester, N. Y. The insects appear in swarms and not only attack rosebushes but extend their depredations to the foliage of appletrees, even eating into the young fruit at Rochester. At Grahamsville the insects swarmed on fruit trees, displaying a marked preference for plum, the foliage of which they completely skeletonized.

This insect is a very difficult one to control and owing to the fact that its favorite breeding grounds are usually in sandy, comparatively valueless land, the cost of plowing the same and destroying the insects thereby would amount to more than the loss incident to their ravages. The beetles are extremely resistant to insecticides, though Professor Webster found that a whale oil soap solution, 1 pound to 2 gallons of water, was fairly effective in destroying the pests, still it is liable to cause more or less injury to the foliage. Dusting the plants with land plaster, ashes etc. may afford some relief and highly valued small trees or shrubs might be protected by mosquito netting. There is a bare possibility that thorough spraying with arsenate of lead, particularly if it was used in bordeaux mixture and a very large proportion of poison employed, would afford a certain amount of protection and perhaps result in the destruction of some beetles. Experience with other beetles leads us to believe that the relief, if any is obtained, will be as much from the beetles disliking the foliage as their being destroyed by the poison thereon.

Scurfy scale (Chionaspis furfura Fitch). This species is more or less prevalent in most sections of the State though rarely abundant enough to cause much injury. The seasons of 1904 and 1905 appear to have been marked by an unusual multiplication and corresponding injury, particularly in Dutchess county, where this scale insect has been abnormally abundant and quite destructive. It can be controlled as has been repeatedly pointed out by thorough spraying with a contact insecticide about the latter part of May or early in June, preferably selecting the time just after the majority of the young have appeared and before they have covered themselves to any extent with the protecting scale.

Grass and grain insects

White grubs (Lachnosterna species). White grubs of the May or June beetle are well known and are more or less abundant from year to year, though the insects have a life cycle extending over three years and a corresponding fluctuation in injuries has been observed. This season appears to be one when the grubs were unusually destructive, as reports of serious damage have been received from several sections of the State and one at least from an adjacent state.

The life history of this species may be summarized briefly as follows: Eggs laid by the parent beetles in loose soil hatch about a month later, the grubs slowly increasing in size for at least two years and from the middle of June till the middle of September of the second or third year, earthen cells are constructed by the beetles, in which the transformation to the pupa occurs and the adults appear the following spring.

The rather serious injuries to grass lands last year renders it very probable, in view of the above given life cycle, that the beetles will be unusually numerous next summer. This suggests the idea that in sections where these pests are unusually abundant and injurious it might be advisable to so plan farming operations as to plow under the majority of the grass lands to be devoted the next two or three years to crops liable to injury by these pests, the year following the abundance of the beetles; namely, in 1907. This procedure if followed by a fair amount of cultivation should result in the destruction of many young grubs, as they are presumably less able to withstand adversity during their early existence than later in life.

The subterranean habits of these pests render their control somewhat difficult. There is hardly a more effective and satisfactory method of checking them in gardens, strawberry beds and similar places, than by digging them out as soon as their presence is indicated by the poor condition of affected plants. Repetition of such trouble can be guarded against to a great extent by planting recently plowed grass lands infested by these grubs with crops not affected by them. Neither of these methods can be employed on lawns, where occasionally considerable injury is inflicted. The grubs can be killed in these latter situations by liberal applications of kerosene emulsion, the standard formula diluted with about six parts of water. This treatment should either be followed by a copious watering or be made just before a good rain. The idea is that the water following the insecticide will wash it down and bring it into contact with the grubs. A successful treatment of this character should result in destroying these insects within a few days.

Saddle-back caterpillar (S i b i n e s t i m u l e a Clem.). This slug caterpillar about an inch long may be recognized at once by the light green "' saddle cloth" thrown over a chocolate-brown body, both the "saddle" and the "saddle cloth" being margined with white. It is somewhat flattened in shape and bears four conspicuous spiny processes, two near each end and a number of spiny tubercles at each extremity and along the margin of the body. Ordinarily this larva is rare, and we were somewhat surprised to receive a communication in September from Mr F. R. Calkins of Ossining to the effect that the larvae were abundant on his corn and devouring the leaves very rapidly. This species is a general feeder, having been recorded on such diverse plants as apple, cherry, rose, raspberry, currant, chestnut, oak, grape, sumac and beet. This caterpillar is also interesting because of its urticating powers. Mr Calkins states that he was severely stung by a larva. It is therefore necessary to handle the caterpillars with caution. This species when at all abundant can be easily controlled by timely spraying with an arsenical poison.

Stalk borer (P a p a i p e m a n i t e l a Guen.). This stalk borer is commonly reported as affecting a number of thick stalked plants, especially corn, potatoes, tomatoes and sunflowers. The latter part of June we received a report, accompanied by specimens, of this larva working in the stems of scarlet runner beans, and only a few days before we removed a nearly full grown caterpillar from the succulent tip of a raspberry shoot.

Spittle insects (P h i l a e n u s l i n e a t u s Linn. and P. s p u m a r i u s Linn.). Conspicuous frothy masses of spittle on grass were unusually abundant in different sections of the State and have attracted a corresponding amount of notice. The two common species upon grasses in New England, according to Professor Fernald, are those above named and it is very probable that the young of these two forms produced most of the spittle masses.

These little insects are very peculiar and possess marked characteristics. The eggs are said to be laid in the stems of plants in the autumn, remaining unhatched until the spring. The young establish themselves on various grasses usually at the joint, and begin drawing the juices therefrom. A clear liquid is extruded from the posterior extremity and this is beaten into a froth by the insect extending the tip of its abdomen and drawing bubble after bubble of air into the fluid with its spoon-shaped extremity. This is continued till the little spittle insect is completely enveloped with a mass of froth which undoubtedly protects its soft tender body from the drying atmosphere and is probably of some service in warding off natural enemies, though certain wasps are known to search out these frog hoppers, taking them from their slimy surroundings for the purpose of provisioning their nests.

The general appearance of a spittle insect is easily ascertained by parting the frothy matter, when a stout, blunt headed, pale greenish or straw-colored hopper less than 1/4 inch long is revealed. The parents differ from the young only in being slightly larger, of a pale green or brown color and with well developed wing covers.

The injury to plants infested is directly proportional to the amount of sap withdrawn, and while these insects are occasionally quite abundant the damage is rarely serious. There is no practical method of controlling them in grass lands because the expense would amount to more than the value of the crop.

Shade tree insects

White marked tussock moth (Hemerocampa leucostigma Abb. & Sm.). This well known insect more frequently comes to attention because of its depredations on shade and other trees within the confines of the city than on account of injuries inflicted on fruit trees. It has been unusually destructive in a number of our principal cities, defoliating thousands of trees in Buffalo, Lockport, Geneva, Rochester, Syracuse, Utica and Brooklyn and undoubtedly causing more or less injury in some other cities and villages. This species occasionally produces a partial second brood in the latitude of Albany, Rochester and Buffalo, though our observations show that in these cities the number of caterpillars appearing late in the summer are so very few that they may be ignored as a rule. The devastations of this pest are more or less periodical, being governed largely by the activity of its numerous natural enemies. The caterpillar succumbs readily to timely application of arsenical poisons and the conspicuous white egg masses deposited upon the flimsy cocoons are very easily removed from infested trees. This species can be controlled with so little difficulty that we must attribute the stripping of so many shade trees to indifference or neglect.

Fall webworm (Hyphantria textor Harr.). This very common leaf feeder well known as a pest of fruit, shade and forest trees, may be easily recognized by its large filmy white nests or tents inclosing the foliage on the tips of limbs. The leaves are skeletonized soon after being covered with the web, and turning brown give an infested tree a very unsightly and characteristic appearance. This pest causes more or less injury from year to year and the past season has been marked by serious depredations in certain sections of the State. It has caused considerable injury in woodlands about Angola, Erie co., and its nests have been more or less prevalent in apple orchards of the fruit-growing section in western New York. The injury in the latter has not been serious because most of the trees receive enough care to prevent great damage by any leaf feeder. The ordinary spraying practised so generally by progressive fruit growers as a rule keeps this pest under and it is only occasionally that a supplemental application must be made or the nests cut from the trees and the inhabitants destroyed.

Elm leaf beetle (Galerucella luteola Müll). This species continues to be more or less destructive in the Hudson valley, and were it not for the systematic annual spraying with arsenical poisons in Albany, the elms, particularly the European species, would be seriously injured every year. Observations about Mount Vernon and Tarrytown, N. Y. showed that many of the elms had been somewhat seriously damaged by this pest and the same is true of Oyster Bay. This pest was particularly destructive at Ossining, the beetles being so abundant as to badly injure the foliage before the grubs appeared. This pest is generally distributed throughout Glens Falls according to Mr C. L. Williams, though not very destructive except to certain European elms.

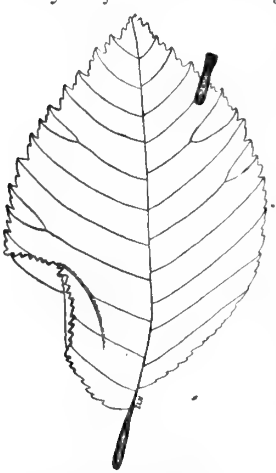

Fig. 9 Case of European elm case-bearer on leaf, much enlarged (Original)

European elm case-bearer (Coleophora limosipennella Dup.). This miner is easily recognized as a case-bearer because of the peculiar habit the larva has of carrying about a cylindric light brown cigar-shaped case in which it lives. It has the same habits so far as known as the allied cigar case-bearer, Coleophora fletcherella Fern. The destructive work of this species has been evident for several years in Brooklyn parks, and investigations last summer disclosed the fact that it was well established at Oyster Bay, where it was about as injurious as the elm leaf beetle, Galerucella luteola Müll. The two species were abundant enough, so that the foliage in certain portions of the village was badly marked. The general result of injury by these forms is somewhat similar though easily separable. The areas mined by the case-bearer are markedly rectangular, being bounded on either side as a rule by a parallel vein and extending rather evenly for some distance from the central feeding hole which is easily seen when looking up toward a bright sky. The eroded, semitransparent, skeletonized areas produced by elm leaf beetle larvae are at once recognized by their greater irregularity, the lack of the central feeding orifice and the fact that there is no mining of the foliage. This species, like the common cigar case-bearer on our fruit trees, should be easily controlled by early and thorough spraying with an arsenical poison, making the application at the time the leaves begin to appear.

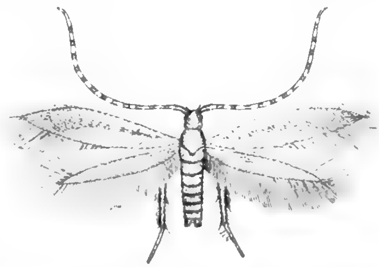

Fig. 10 Adult of European elm case bearer (Original)

Cottony maple scale (Pulvinaria innumerablis (Rathv.). This species was observed in some numbers on the lower limbs of a soft maple at Glen Cove and it has been reported as unusually abundant in St Lawrence county. It is by far the more common insect pest covered with woolly matter, occurring on maple trees, particularly on Long Island where it is likely to cause more or less injury from year to year. It can be controlled by thorough spraying in midsummer with a kerosene emulsion, using about 10 to 12% of oil. Winter treatment with the kerosene emulsion diluted with three parts of water, or a whale oil soap solution, 1 pound to a gallon, has been found very effective by Mr S. Arthur Johnson in Denver, Col. This latter method results in a great saving, as one fourth the amount of the insecticide necessary to spray a tree in foliage is sufficient to cover it after the leaves have fallen.

Fig. 11 Cottony maple scale, much enlarged (Original)

Maple Phenacoccus (Phenacoccus acericola King). This, ordinarily a rare insect, has attracted more attention in recent years on account of its abundance on sugar maples in Albany and vicinity. The first general outbreak which came to our notice occurred in 1901, at which time a number of hard maples in Albany, N. Y. and Worcester and Springfield, Mass. were very badly infested. This species appears to have been somewhat abundant and destructive the past summer to the hard maples at Mount Vernon, N. Y. It may be readily distinguished from the more common cottony maple scale, Pulvinaria innumerabilis Rathv., and its allies by the presence of the woolly females on the under surface of the foliage and the numerous minute young on the bark, particularly that of the larger limbs and trunk. There is another maple leaf scale, Pulvinaria acericola Walsh & Riley, which occurs on the underside of maple foliage. This form may be at once recognized, however, by the conspicuous brown scale so characteristic of the cottony maple scale. This maple leaf scale so far as known is by no means common though it is very probable that it has been confused with the more prevalent destructive cottony maple scale. Neither of these Pulvinarias occur in white felted masses on the bark of the larger limbs and trunk, which is very characteristic of the maple Phenacoccus. This species should be controlled as well as the cottony maple scale, and it is probable that both respond equally well to thorough and timely spraying with a 10 or 12% kerosene emulsion or a strong whale oil soap solution.

Woolly maple leaf aphid (Pemphigus acerifolii Riley). This species is rarely abundant enough in New York State to attract popular notice. It was so numerous during the summer of 1905 that a number of inquiries accompanied by soft maple leaves almost covered with these woolly plant lice were received from different sections of the State. Complaints of this character came from Cornwall, Menands, and what was presumably this species gave rise to a report from Floral Park. This aphid may be easily recognized by the large amount of woolly matter, which is sometimes nearly as long as the insect itself. It may be separated from the closely allied Pemphigus aceris Monell, which lives on the underside of hard maple limbs, by the antennae reaching only to the wing insertion, whereas in the last named the fourth joint extends to the base of the wings. These plant lice usually desert the trees early in June and as a rule remedial measures are unnecessary.

Forest tree insects

Black walnut worm (Datana integerrima Grote & Rob.). The work of this species on black walnut and butternut trees is more or less apparent from year to year, particularly in the western part of the State. This species was unusually abundant and destructive in the vicinity of Westfield, N. Y., stripping entire trees of their leaves and devouring a considerable proportion of the foliage of others. The caterpillars were so numerous that late in October masses of cast skins were still evident on black walnut trees. It is probable that this species is responsible for serious depredations on black walnuts at Angola. Similar injury to walnut trees at Stanley was reported by Mr J. Jay Barden.

Hickory gall aphid (Phylloxera caryaecaulis Fitch). Young galls of this species may be met with in early June. They then vary from the size of a pea to that of a small marble, are irregularly spheroid, being usually prolonged at the juncture with the midrib or petiole, and with a more or less distinct, somewhat irregular ventral orifice which is completely closed. The galls at this time vary in color from pale greenish to a bright pink, those attached to the mid vein of the leaves showing slightly on the upper surface. Many of the structures are so near each other that they fuse and each contains a central cavity with a stem-mother and numerous young plant lice evidently just hatched from the egg. Later these deformations become green or rosy and as they increase in age the young plant lice become more abundant, so that an examination during the later period of growth may show the inner surface literally covered with numerous young pale green plant lice, and somewhere in the cavity the much larger, stouter form of the parent insect. Later the green distorted tissues die, turn black, leaving an ugly shrunken mass. This gall insect is one of our common species and is sometimes so abundant as to cause considerable injury to hickory trees.

The life history of this insect, based upon our own observations and those of Mr Pergande upon a closely allied species, is substantially as follows: The green galls begin to develop with the unfolding foliage and are caused by an abnormal growth of tissue around the stem-mother, which latter hatches from a winter egg about the time the young leaves appear. The increase in tissue is very rapid and soon the insect is inclosed in a globular cavity. An examination shows the latter to be inhabited by a single stem-mother or parent insect and numerous young. The galls become fully developed in the course of a few weeks and allow winged individuals to escape. These latter may be observed upon all kinds of vegetation in the neighborhood of the tree and eventually produce the generation which deposits on the trees eggs as mentioned above.

These latter remain quiescent nearly 10 months in the year and it is in this stage that we have the best chance of controlling the insect.

It is possible that thorough spraying with kerosene emulsion or a whale oil soap solution in early spring before there was the slightest signs of hickory foliage would result in the destruction of many of the winter eggs. It is very probable that a treatment with a standard lime-sulfur wash would be much more effective than kerosene emulsion or a whale oil soap solution, particularly if it was applied very thickly, because this material possesses active insecticidal properties for some time, and even if it was not strong enough to kill the eggs at the outset, something which is rather doubtful, it might possibly destroy the young plant lice upon hatching and thus prevent further injury. Unfortunately this method of control can be applied in a practical way only to small trees as a rule and it should be supplemented where possible by cutting off the green galls and destroying them before any of the insects escape, since this species appears to be somewhat local in its work.

Spindle-shaped elm gall (Pemphigus ulmifusus Walsh). Specimens of this rare gall were received from Mr C. L. Williams of Glens Falls, N. Y. July 7, 1905. The galls are confined to the upper surface of the leaf and are usually from ¼ to ½ inch from its free edge, originating in a clear area between the veins. The galls range in size from ¼ to ⅝ of an inch in length and have a very narrow neck with a widely dilated body. The specimens transmitted vary in color from pale yellowish white to dark brown. The latter appear to have attained maturity and several at least had ruptured near the base, thus allowing the occupants to escape. An examination of several of the green galls shows that the walls are moderately thick, each inhabited by a solitary stout, wingless, purplish black plant louse. There were no signs of rapid multiplication.

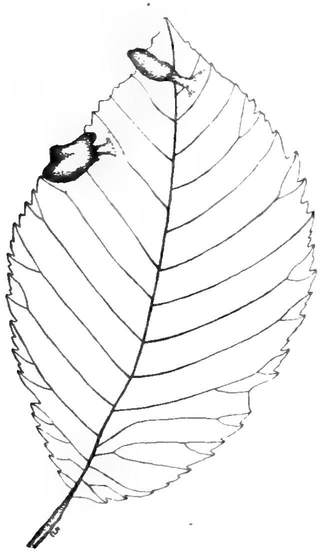

Fig. 12 Spindle shaped elm galls on leaf, much enlarged (Original)

Eulecanium quercifex Fitch. Young chestnut shoots badly infested with this scale insect, kindly identified through the courtesy of Dr Howard, were received in early June from Miss Eliza S. Blunt of New Russia, N. Y. with the statement that the trouble

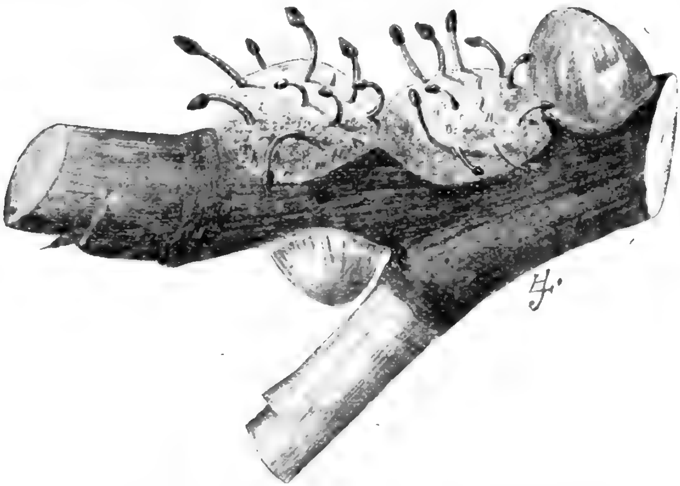

Fig. 13 Eulecanium quercifex, on chestnut, two scales infested with Cordyceps pistillariaeformis, enlarged (Original)

was very prevalent on all the young chestnut growth in that locality and about Bolton Landing, Lake George. A most interesting feature of the outbreak was the abundance of a fungous disease, kindly identified by State Botanist Peck as Cordyceps pistillariaeformis B. & Br. This fungus was so prevalent that nearly half of the scale insects were affected thereby. Its peculiar characteristic capitate fruiting stems about $\frac{3}{16}$ inch high made the detection of infested scales very easy. The unfortunate individuals appeared to be permeated by this growth and the entire surface changed thereby to an ashy gray color.

This scale insect varies widely in color, the old ones being a dark brown with irregular, fuscous markings, sometimes approaching the appearance of Eulecanium nigrofasciatum Perg. to some extent, while the young ones are lighter and in a few instances bright orange. A few partly grown young were observed and also several males just about to escape. A small, greenish, black headed caterpillar was noticed on one of the twigs. It had evidently been feeding upon the scale insects, and may have been the larva of Laetilia coccidivora Comst. The fungus attack and the work of the Lepidopterous larva were so evident that it is doubtful if the scale will inflict much injury, in spite of its being so generally present.

Miscellaneous

Caucasian bee. The United States Bureau of Entomology has given considerable attention to the honeybee and its products, making a special effort to obtain more desirable strains. Through its efforts the Caucasian bee has become established in this country, and in November 1904 the Entomologist made application for a queen for the purpose of making comparative tests. This queen together with a number of workers was received in excellent condition June 10, 1905 and put in the custody of Mr Robert Wilke of 210 Livingston av. Albany, N. Y. with instructions to make a careful comparison between this bee and the more common form. The following statements were drafted from a report submitted by him after the close of the active season.

He states that the bees, which were a peculiar brownish black color, were immediately given two frames of hatching hybrids in an eight frame Langstroth hive. The entrance was then closed with wire netting to keep out robber bees. June 12 he gave more capped brood and honey, and on examining on the 19th he found a fair number of bees, the queen having laid between six and ten thousand eggs. He gave the bees their first flight at this time and observed that they were active on pollen. June 24 the colony was picking up strength and there were a fair number of field bees. July 11 young brood was emerging, the bees were active and there was plenty of brace comb. He added two frames to the six, making eight in all and observed that there was plenty of honey. All the brace comb was cut out on the 18th when the bees were beginning to work on the super. They then had brood in eight frames. August 8 preparations to swarm were in progress. The super was taken off, the swarm cast and it was then put back. The next day the bees swarmed again and returned, the hive was again examined and a number of long, slender queen cells removed. These latter presented a marked difference in construction from those of any other that has come under his observation, since they were often 2 inches in length and quite slender and little wax was used in covering the walls. The bees also exhibited a marked tendency to build these cells on the bottom of the comb. August 31 the bees swarmed and returned. They were gentle but slow on the super. October 15 the bees had not finished a super of 24 pounds.

They were quiet and healthy and had broods in all stages, also eggs. December 2 they were put in the cellar for the winter.

It does not appear to Mr Wilke that the bees showed to best advantage, since they were received too late in the season to do much on honey, yet they were rather slow in building up even when mild weather favored them. Respecting comparative gentleness he is not certain, as all of his bees with the exception of one strain were somewhat more vicious than usual.

Large carpenter ant (Camponotus herculaneus Linn.). This large, black ant is frequently observed in small numbers about dwellings and occurs commonly in dead stumps or trunks in nature. It is a well known wood borer and occasionally excavates large cavities even in living trees. Its work is particularly noticeable in the Adirondacks, where spruce and balsam trunks are sometimes badly riddled by its operations.

Our attention was called to the work of this ant in dwellings by the receipt of a communication July 14 from Mr C. C. Merriam of Lyons Falls. He stated that they first observed a heap of sawdust in the attic of their recently constructed house, and on investigation found that this ant was working in the rafters. The insects had fairly riddled about 3 feet of two 2 inch spruce rafters lying side by side. The injury was of such a nature as to raise a serious question as to the ultimate effect upon the building. These insects rarely carry their depredations to the point where the integrity of a structure is threatened, though there is no reason why considerable damage might not be inflicted wherever the pests are abundant, since tree trunks may be so thoroughly tunneled by this species that they break readily in a high wind. It would probably be advisable, in case a few timbers in a dwelling are somewhat injured and contain numerous ants, to either remove them and replace with some wood less likely to be attractive to the pests, or else adopt some active measure for the destruction of the ants. The insects in infested timbers should be destroyed so far as possible, and the cavities might be filled with a creosote or tar preparation or even a thin plaster of paris, with a view of preventing further depredations. Blowing insect powder into the cavities or the injection of carbon bisulfid will drive out or destroy many of the ants. There is a possibility that they could be attracted to poisoned sweets or destroyed in large numbers by placing a syrup, made by dissolving borax and sugar in boiling water, in the vicinity of their haunts.

Green-headed horsefly (Tabanus lineola Fabr.). This species was very abundant and annoying to horses about

Long Island, N. Y. being particularly numerous in the vicinity of the salt marshes. It assembles in large numbers in the horse sheds and is a serious annoyance to animals tied thereunder. A significant fact in connection with this species is the statement by several reliable observers to the effect that a few years ago when considerable oiling was done for the suppression of mosquitos, these pests were much less abundant than during the last year or two, when ditching operations have been relied upon more largely for mosquito control. This latter seems to have had no effect upon the horseflies, as was attested by their abundance about the salt marshes last July while mosquitos were conspicuous because of their absence.

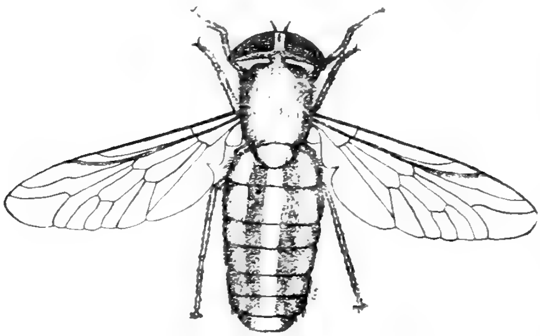

Fig. 14 Green-headed horsefly, much enlarged (Original)

These observations are particularly gratifying as they bear out the results obtained in Russia by Professor Porchinski, who found that the adults were destroyed if there was an oily film on forest pools frequented by them. Horseflies or Tabanidae have a habit of repeatedly drinking from favorite damp, woodland pools and in that way may come in contact with the oil and perish. Similar results on a smaller scale were obtained in this country by Dr Howard. The application of oil to pools is now generally regarded as merely a temporary expedient for checking the multiplication of mosquitos, but it seems to be of considerable value in destroying horseflies and might be employed to advantage wherever these insects are unusually numerous and annoying. The only essential is that there be a film of oil on the pools when the horseflies are abundant, something self-evident to any resident. The more pools treated the greater the chances of success and it is very probable that a little observation would result in finding the pools most favored by these insects and thus result in a great saving in controlling the pest without materially diminishing the effectiveness of the method.

Giant water bug (Belostoma americanum Leidy). A specimen of this gigantic brown water bug was received July 5 from Mr E. J. Casler, Hoffmeister, Hamilton co., N. Y., with the statement that it was attached to the back of a trout weighing half a pound. This giant water bug is a well known enemy of fishes, preying as a rule on the smaller forms and when abundant it may cause considerable injury by destroying large numbers of fish. The full grown insect is nearly 2½ inches long, almost an inch in breadth and of a nearly uniform brown color. These bugs fly readily, which is often a necessity, as pools inhabited by them may dry up completely, and at such times they may be attracted to electric lights in large numbers. This has led to the popular designation of electric light bug. These insects with their inconspicuous brownish coloring probably have very similar habits to an enormous tropical American species measuring some 4 inches long. These latter are said to lurk in quiet pools, darting out suddenly upon an unsuspecting victim, which is grasped with the strong clasping forelegs and cruelly wounded, when the powerful beak is plunged deep into the flesh. A copious supply of saliva is injected into the wound and undoubtedly hastens the paralysis so soon following an attack.

THE SHADE TREE PROBLEM IN NEW YORK STATE

The value of a moderate number of trees along our streets is questioned by no one, though judging from conditions prevalent in many cities and villages of the State there is a distinct understanding on the part of abutting landowners that the trees after being set must look out for themselves. The employees of telephone and telegraph companies lop off limbs or heads with very little regard to the injury inflicted, while ditches, run in our streets for water, sewer, gas pipes and other purposes, destroy many of the feeding roots. Electric currents from the wires overhead and gas escaping from leaky pipes underground, all threaten the trees with destruction. Waterproof concrete or other paving renders a thrifty growth still more difficult, and the trees are not helped by the careless driver who allows his horse to gnaw the trunks while no one protests. Bacterial and fungous diseases and injurious insects of one kind or another frequently multiply without check and either lower the vitality of the tree, seriously deform it or accomplish its destruction.

Very few have an adequate idea of the value of shade trees. Some prize a few highly while the majority are more or less indifferent. Shade trees are valuable assets and add greatly to the desirability of adjacent property. There should as a rule be in the neighborhood of 200 trees to a mile of street, which would give rows on both sides with the trees in each about 50 feet apart. Col. William Fox of the State Forest Preserve estimates that there should be 196 trees a mile. None of these could be replaced for less than $10 apiece and in not a few instances 10 times the amount would be inadequate to secure their duplication. Furthermore the supply is very limited and can not be renewed under 25 to 50 years. Taking the above figures as a basis it is interesting to estimate the total amount of this form of wealth. The city of New York, with over 3200 miles of street, has shade trees valued at the enormous sum of $6,475,100. There is an entomologist connected with the department of public parks in the borough of Manhattan and he, with a force of men, does all that is possible with the means at his command to protect the trees in that large area. The cities of Albany and Troy, each with about 100 miles of street and shade trees therein valued at nearly $200,000, were compelled by the ravages of the elm leaf beetle in the early 90's to adopt some measure for the protection of their elms. Experience is costly, and before the public really comprehended the danger some 2500 trees in the two cities were ruined or dead, a loss of at least $25,000 and probably of double or treble that amount. The result has been that the city of Albany as a municipality has in the last few years expended annually with most beneficial results from $1600 to about $2000 in protecting its trees from this pest, while the same ends have been obtained in Troy through private enterprise. It is estimated that all the cities of the State have 6831.9 miles of street giving us a total valuation for the trees therein of $12,590,524. This is by no means the whole, as many beautiful villages throughout the State owe much of their attractiveness and prosperity to the rows of stately trees adorning their streets. Our incorporated villages have at least 2800 miles of street, and using the same estimate as before we have a total of $5,511,324, representing the value of street trees in the villages. There are in addition to the above, according to estimates by the State Engineer, 73,746 miles of country road, most of which might easily be bordered here and there with street trees. A pertinent suggestion was made a few years ago by Colonel Fox, who advocated the setting of trees beside the newly built State roads, stating that only 2% additional would be necessary for this purpose.

The above gives some idea of the general conditions of our shade trees and of the large values represented by them. The season of 1905 was characterized by very severe injury to shade trees by tussock moth caterpillars. This was particularly true in the cities of Buffalo, Rochester, Geneva, Syracuse and Utica and many thousands of beautiful shade trees adorning their streets and those of other cities and villages were partially or entirely defoliated by this pest, which is more or less injurious from year to year. This has been specially marked in the city of Buffalo, where the horse-chestnuts at least are far from being models and some of the other shade trees are in very poor condition. These depredations resulted in a great many newspaper notices, and beyond a brief characterization of the injury nothing more comprehensive was urged than the somewhat makeshift recommendation that the conspicuous egg masses be removed through the efforts of school children or by general cooperation. Rochester undertook this work and appropriated $500 for the purpose of paying school children so much a quart for the egg masses. Interest was further stimulated by offering prizes to a few obtaining the largest number. Newspaper items in November state that the plan has not been entirely successful, only $7 of the $500 having been claimed by the children. There is no doubt but what the tussock moth can be controlled by collecting egg masses and where a large amount of enthusiasm and push is behind the effort it is possible to have this done by school children, as was demonstrated in Rochester some 10 years ago. This method of combating an insect pest is open to several objections. In the first place it is sporadic in nature and rarely becomes effective till public opinion is aroused, and this latter does not usually occur till after the trees have suffered serious injury and in some cases not even then. The value represented by our shade trees leads us to question the wisdom of exposing them to serious injury for the sake of saving a very small percentage of their value. It seems as though the time is ripe to make more comprehensive plans for the protection of our trees, particularly as there are other insects to be checked beside the one mentioned above, and unfortunately some of these are much more difficult to control. The elm leaf beetle and the associated elm bark louse are both exceedingly destructive to elms in the Hudson valley and are likely to cause equally great injury in other cities and villages in the State. The soft maples [pl. 1] in and about New York city are affected by a very pernicious borer, the leopard moth, and the cottony maple scale is a dangerous pest of soft maples in that section. There is in addition a soft brown scale which is fast becoming a serious enemy to both soft and hard maples in the Hudson valley and presumably in other sections of the State. Many beautiful white birches have been killed by a destructive borer [pl. 2]. The situation is rendered much more grave by the slow and sure spread of the now thoroughly established and almost omnivorous gipsy moth in Massachusetts and its able and hardly less baneful associate, the brown tail moth. The former has made its way about 30 miles west of Boston and the latter has already invaded the Connecticut valley. Both are quite injurious to shade trees, the brown tail moth showing a decided fondness for maples. There are minor insect enemies in addition to those mentioned above. Bacterial and fungous diseases are also insidious foes and should be checked wherever possible.

It is a short-sighted policy that allows this vast wealth of our municipalities and villages to be destroyed for the want of a little protection, and the present seems a most fitting time to urge the adoption of more comprehensive measures to safeguard the welfare of our trees. Every city of 50,000 or more should make provision for the adequate care of its shade trees by putting them under the control of a properly qualified forester or entomologist connected with either the park or street department. Most villages would also find it advantageous to make some provision for the welfare of their shade trees, even though it is impossible to place their care in the hands of a specially qualified person. It is not necessary that one charged with this work be a college graduate or a professional entomologist. A practical knowledge of trees and methods of protecting them from insect depredations is all that should be insisted upon. Such a man's first duty should be to keep the shade and park trees in good condition and protect them from fungous diseases and insect ravages. It should also devolve upon him to set out trees wherever needed, and a knowledge of their habits and methods of growth would prove invaluable in selecting those adapted to the various conditions found in every city and village.

The cost of such work is not excessive and in a city of 100,000 inhabitants or thereabouts very much could be accomplished by an annual expenditure of two to three thousand dollars or one to one and one half per cent of the value of the trees, and the benefits resulting therefrom would be beyond computation. There are in various cities and villages of the State thousands of unsightly, ruined or dead shade trees, the result of a failure to appreciate the possibilities of judicious protection. Even the cutting out of the dead trees and the removal of diseased or rotten limbs would help general appearances very much. Most communities have little conception of the value of shade trees and we wish that every one interested in this work might visit Saratoga Springs or some other village where the trees receive adequate care. These places have their magnificent trees in spite of insect pests and other troubles because they are willing to incur a reasonable expense for their protection. Such results are possible in practically every city and village, and civic pride if not self-interest should lead all citizens to insist upon better protection of their shade trees.

MOSQUITO CONTROL

Mosquito control means immunity from malaria, yellow fever and freedom from hosts of the more common pestiferous forms. It is somewhat costly, though the wisdom of the investment can not be questioned when it is remembered that malaria is more or less prevalent in the North and, according to an authority, "is responsible for more sickness among the white population of the South than any disease to which it is now subject." A recent yellow fever outbreak at New Orleans recalls vividly the disastrous results attending such epidemics in former years and affords a striking illustration of what may be accomplished when scientific measures are vigorously prosecuted. The malady of 1905 was not of a type easily controlled, and its eradication before frosts destroyed the mosquitos demonstrated in our own country the value of the work prosecuted with such notable success in Cuba a few years earlier and adds a most striking page to the abundant evidence, proving that this dangerous enemy of humanity in tropical and subtropical regions is dependent on mosquitos for dissemination. It is only necessary now to enforce quarantine regulations that will render it impossible for the disease-carrying mosquitos of this country to become infected in order to make such outbreaks as that experienced last summer of historic interest only.

Intelligent control presupposes some knowledge of the various forms and their habits. There are between four and five hundred described species in the world. About 50 are known to occur in New York State, though only four years ago but 24 were listed from North America. Closely allied forms may have nearly identical habits, though in some instances there are wide divergencies. Fortunately the disease carriers rarely fly more than 200 yards or thereabouts, a marked contrast to the troublesome salt marsh mosquito, which has been known to make its way 40 miles or more from its breeding grounds. The eggs of certain species float upon the water, hatch soon, and within 15 or 20 days mosquitos are flying again. Others deposit ova in water or damp places, where they remain unhatched till the following spring. The eggs of some species develop simultaneously, those of others at irregular intervals, due to successive inundations by rain or sea. The wrigglers or larvae are very diverse; a few have no air tubes, others very short ones, some are moderate in length and a few possess extremely attenuated breathing tubes [*see* pl. 3, fig. 1, 2, 3]. This usually large appendage is frequently of great service in identifying species. Certain wrigglers occur only in clear water, others in either clear or foul pools, still others prefer brackish water, and the larvae of one species are remarkable because they live only in the water of the semiaquatic pitcher plants [pl. 6, fig. 2, pl. 7, fig. 1]. Adult mosquitos vary widely; some are brightly marked with yellow and rich browns, many have white banded legs, while the color of others is obscure. Great diversity also obtains in their habits. Some are extremely bloodthirsty and wander long distances in search of victims, others remain close to their breeding places, rarely biting man, and certain forms do not molest him even when their haunts are invaded. The wrigglers or larvae have widely different habits. These conditions would seem to render mosquito control impossible. Such is not the case because the dangerous places are near-by small pools, standing water in other receptacles such as barrels [pl. 5, fig. 1], cisterns and cesspools. The problem is further simplified by the fact that comparatively few species in a locality are annoying.

Our native malarial mosquitos have nearly identical habits. The spotted-winged adults [pl. 4, fig. 2], easily recognized by their resting with the beak and body in a straight line, winter in almost any available shelter. Eggs are deposited on the surface, preferably in grassy or weedy, rather shallow, fresh-water pools [pl. 5, fig. 2]. The very short-tubed wrigglers hatch soon and feed at the surface. The life cycle occupies between three and four weeks and breeding is continued during most of the warm weather. Recently excavated spring pools [pl. 6, fig. 1] appear to be exceptionally attractive to these insects, even though the water surface is not materially increased by the digging. This was extremely well shown last summer in one locality we had frequently visited in the search of larvae. Before excavations were made mosquito wrigglers were present in very small numbers and sometimes absent. The recent digging changed this remarkably, and newly made water-filled hollows were literally swarming with the wrigglers of both malarial and nonmalarial mosquitos. The connection between excavations and malarial outbreaks has long been recognized, and this observed partiality of mosquitos for waters in such places affords some expanation of why this should be the case, particularly if Italians infected with a mild type of the malady are employed, since when the disease is communicated in this manner it is liable to assume a virulent form in nonimmunes.

The tropical and subtropical yellow fever mosquito has much the same breeding habits as our common rain barrel or house mosquito, though the wrigglers of the two species are very different. Both breed largely in rain barrels, cisterns and similar places, a number of generations being produced during warm weather. The salt marsh mosquito and several of its allies pass the winter as eggs, only a portion hatching with successive rain storms or inundations due to high tides. Thus series of swarms are produced during warm weather. A number of fresh-water species present marked differences from the above, since the eggs hatch in early spring and only one generation is produced. These species are of small importance, though some of their allies breed more or less in early summer and may prove annoying. Another group, known as midsummer mosquitos, is remarkable for its very long-tubed wrigglers. This includes among others the rain barrel mosquito and the little black mosquito. The latter, one of our smaller forms, makes frantic attempts in mid or late summer to get indoors, working through the mesh of ordinary wire screen.

Destruction of mosquitos prevents the dissemination of malaria and yellow fever because they are the only carriers of these diseases. More than this, mosquitos must first become infected before they can convey either of these disorders; consequently the medical man has only to destroy as many mosquitos as possible and then, by screening, prevent others from becoming infected by biting patients and his object is attained. Yellow fever cases are occasionally brought to Havana and, for that matter, to New York and cared for, the only precaution taken being to keep mosquitos away from patients and the results have justified the procedure. It would hardly be necessary to do even this in New York, since the yellow fever mosquito, Stegomyia, does not occur in this latitude; still some precaution is advisable. The slight difference between an abundance of mosquitos with suffering and none with health and comfort is strikingly exemplified in the case of Sea Cliff, L. I., with its elevation of about 100 feet. Owing to the character of the soil there are no favorable near-by breeding places for malarial mosquitos, though attractive springs and pools occur within a quarter of a mile and near by are extensive salt marshes producing millions of mosquitos, yet the village of Sea Cliff is exempt from malaria and never troubled by mosquitos. The former is due to the absence of favorable breeding places within a few hundred yards, and the latter to its comparatively slight elevation. Mosquito control is practical provided the habits of the insects are understood and the troublesome forms recognized. Breeding areas are really very limited and in many cases they can be drained with comparatively slight expense. The salt marsh mosquito, extremely annoying along the coast, does not breed throughout the marshes but is confined to a portion along the upland and extending out a distance of 150 to 250 feet, or in other words limited to parts flooded by high tides and not reached by ordinary ones. This strip contains brackish pools in which the wrigglers mature and escape between high tides or severe storms. None occur in pools containing fish or in association with fiddler crabs. The breeding of this and associated species may be prevented by draining these areas so that no pools will be left from one high tide to another. The state of New Jersey has done much to encourage antimosquito work, which has been ably seconded by local efforts in the Oranges and other communities in that state.

A most striking illustration of the efficacy of this work is that given by Lawrence, L. I., which has amply demonstrated the feasibility of controlling the salt marsh mosquitos by relatively simple and comparatively inexpensive ditching operations. The annual expense is only about $1000 and the total expenditure on these operations during the past four years does not exceed $10,000, in spite of the fact that the village is situated upon a narrow neck of land with the extensive salt marsh areas of Jamaica bay to the north and west and large marshes south and east, all producing in former days millions of mosquitos which invaded the village in swarms with every favorable breeze. Some of these marshes extend almost to the center of the village, which is so completely surrounded that a journey of 2½ miles in almost any direction will bring one to a salt marsh. More unfavorable conditions for mosquito control could hardly be found, and before this work was attempted mosquitos swarmed in the village in May and remained in numbers most of the season. The second year swarms did not invade this territory till June, and last year it was the first of July before they appeared. Our investigations at the end of last July showed that there were practically no mosquitos in the center of the village. It was our privilege to sit on a piazza one evening when conditions were most favorable for mosquito activity. Though it was cloudy with only a little breeze and rather warm, not one appeared. Previous to this antimosquito work it was said that one could not sit on this piazza without being covered by netting, and the owner even went to the trouble of making a framework to hold netting suspended over individual chairs, so that his family and guests could sit in comfort.

This very desirable result has been brought about by a drainage system so planned that the entire length of all ditches will be flushed by every tide. The general practice is to run these ditches within about 200 feet of firm ground and sometimes closer, making them 18 to 24 inches in width, from 2 to 3 feet deep [pl. 8, fig. 2], with main ditches here and there to tidal channels. A few headland ditches are run into the more dangerous swampy areas in baylike extensions of the marsh. Such ditches require no surveying and cost only 1½ cents a running foot. A little experience enables one to lay them out properly and the tides make the determining of levels extremely easy. It was very interesting to compare the conditions between ditched areas and undrained marshes. The former were so free from mosquitos that one could tramp upon them with practical immunity from bites, though occasionally a few mosquitos were seen on one's person. No larvae were found and in fact there were very few places where breeding was possible. Undrained marshes presented a very different condition. Mosquitos swarming in adjacent woodlands made driving very uncomfortable, and when on the marshes one was attended by considerable swarms of vicious biters, even in midday. Here and there breeding pools were literally black with young wrigglers. This contrast between drained and undrained areas would doubtless have been much greater were it not for the act that our inspection was made during such a dry time that even undrained marshes presented comparatively few favorable breeding places.

Experience at Lawrence has shown that deep ditches with perpendicular sides are far more permanent than shallow ones with sloping sides [*see* pl. 8-10]. The attempt to slope the bottom of the ditch so that all the water will drain out invariably results in depressions which may become dangerous breeding places and the drainage value of the ditch itself is much lessened. Sloping sides [pl. 10, fig. 2] afford opportunity for the growth of grass and sedges with the result that the ditch soon becomes choked with vegetation. The deep perpendicular ditches described above remain entirely free from vegetable growth, and with a little care in removing sods and drifting matter will last for years. Some dug four years ago [pl. 9, fig. 2] were in perfect condition last July, though the grass growing along the sides overhung and almost hid the ditch from view in places. An area of 25 feet on each side is easily drained by such a ditch. The village now has 40 miles of marsh drains which require more or less attention from three men during most of the open season. They keep the ditches clear, supplementing their work by judicious oiling here and there wherever mosquito larvae are abundant and then have considerable time available for perfecting the system and ditching more distant marshes. Experience showed that a considerable number of salt marsh mosquitos bred on that portion of Jamaica bay northwest of the village were brought in by southwest followed by northeast winds. This led to the extension of ditching operations some 2 miles beyond the village limits. The work in the immediate vicinity of Lawrence was done partly at public expense assisted by contributions from owners benefited, though it was impossible to secure the cooperation of persons owning the distant marshes, which latter were drained entirely at village expense. The existence of such breeding areas is an imposition upon adjacent communities and it is only a question of time before public opinion will demand a law either compelling owners to abate such nuisances or else provide for their suppression at public expense. The money invested by Lawrence in this work, a total of less than $10,000, has amply justified itself in vastly improved conditions. The village and its vicinity have been entirely freed from breeding places, though occasionally it is subject to late summer invasions by hordes of mosquitos when favorable winds bring them from undrained marshes. Even this will be obviated when the value of the work becomes more generally appreciated and then the cost of the operations will be amply returned in increased land values, to say nothing of the satisfaction accruing from the absence of these dangerous and annoying pests.

Considerable has been written and said about controlling salt marsh mosquitos by a system of dikes designed to prevent the daily ebb and flow of tides within the protected areas. The great trouble with this system is that it is much more expensive than the simple ditching outlined above, and the problem is further complicated by the very slight fall obtainable. Diking supplemented by considerable filling will undoubtedly prevent breeding over large areas, but the latter is costly and for a term of years at least essential if one would control mosquitos. The Lawrence authorities have experienced more difficulty in preventing breeding in a diked and drained marsh where there was no filling than in open marshes, because it was almost impossible to provide for the prompt drainage of small hollows here and there. Further, the slight fall made it impossible to put drain tile low enough, so that it would be beyond the reach of the plow. The result is that drainage systems behind dikes become almost useless in the course of a few years unless there is a large amount of filling. There is no doubt as to the ultimate value of diking and filling, but this work should be charged to land development rather than to mosquito control.

Draining as outlined above is a comparatively cheap way of eliminating salt marsh mosquitos, and if it be supplemented by judicious filling, oiling and the introduction of fish into breeding pools which can not be drained, the problem is solved. This work also results in a greatly improved crop of salt marsh hay. The migratory habit of the salt marsh mosquito makes it desirable to extend drainage operations over rather large areas, otherwise communities undertaking this warfare may find their efforts partly nullified by swarms coming from more or less distant undrained marshes. We expect shortly that mosquitos originating from adjacent undrained marshes or other breeding places will be regarded as nuisances which may be abated by prescribed legal measures.

The control of fresh-water species including malarial mosquitos is ordinarily less difficult than that of the salt marsh forms, because breeding areas are usually very restricted, in many instances limited to cisterns, water barrels or something of the kind. This fact is well recognized at Lawrence, L. I., the authorities insisting that individuals must look after their domestic mosquitos. As a rule it is the small area and not the large one which causes trouble. The presence of a fresh-water form may be regarded as conclusive evidence of near-by breeding places and should lead to an exhaustive search for the source of the trouble. It must be remembered that mosquitos breed in all manner of places where there is standing water and that it is the easiest thing in the world to overlook a prolific breeding spot.

Compaign work against mosquitos may be outlined briefly as follows: First, recognize the troublesome species and if possible drain all dangerous breeding areas, supplementing this by judicious filling and oiling and do away with or cover tightly tanks, cisterns, barrels [pl. 5, fig. 1], old bottles, etc. This, supplemented by the introduction in waters uncared for by the above means of gold fish, top minnows, killifish and the like, will result in destroying most of the larvae, particularly if the borders of small undrained pools can be deepened slightly, so that the fish will have access to all parts. These little creatures are voracious feeders on mosquito larvae and can be depended on to keep the pests in check if given a fair opportunity. There is no doubt as to the outcome of judicious efforts to control mosquitos, and we confidently look forward to a time when this will be generally appreciated and the presence of swarms of these insects rightly attributed to indifference or incompetence, rather than to supposedly insuperable obstacles to their eradication. It logically follows that mosquitos must be declared nuisances and adequate provision made for their suppression or control through both private and public agencies.

STUDIES IN CECIDOMYIIDAE

The gall gnats are extremely interesting not only because of the peculiar vegetable malformations produced but also on account of the striking morphologic characters presented, particularly in the high specialized antennae. The galls caused by members of this group are better known than the insects, and as our recent studies of species affecting forest and shade trees in particular have resulted in the rearing of a number of forms previously unknown in the adult, this opportunity is taken of characterizing the various stages of several species, so far as the material secured will permit. The generic references must be considered as provisional only, at present.

Goldenrod leaf gall (L a s i o p t e r a c a r b o n i f e r a n. sp.). This species produces oval, brown or black, blisterlike galls about $\frac{3}{16}$ of an inch long on goldenrod. It was described by Osten Sacken from the gall, was referred to the genus Cecidomyia, and so far as we can learn the adults which were bred from this species in some numbers the latter part of June have remained uncharacterized. This interesting form is described below.

Female. The jet-black, coarsely granulate eyes are conspicuous, fused dorsally and bordered posteriorly with a narrow line of white scales or scalelike hairs. The short, thick, light brown moniliform antennae composed of 14 segments, arise between the eyes and are about one fifth as long as the insect. The individual segments are subglobular with a somewhat irregular row of well marked setigerous elevations near the apical fourth, each bearing a hair as long or longer than the segment, other portions thickly ornamented with minute, chitinous points and with very irregular clear spaces visible as in the case of the European willow gall midge, Rhabdophaga salicis Schrk. Palps consisting of two well marked segments, the basal fusiform with several stout, subapical setae, the apical slightly longer, tapering gradually to a subacute point. Mouth parts well retracted, mandibles strongly excavated internally, terminating in a conspicuous broad, internal tooth. Mesonotum dark brown or black, bordered narrowly anteriorly and laterally with yellowish white, subtriangular scales and with a sparse clothing of yellow hairs posteriorly. Scutellum prominent, arched and rather thickly clothed with short, yellowish scales; postscutellum dark brown, somewhat lighter anteriorly. Abdomen dark brown with the segments sparsely and somewhat irregularly margined posteriorly with whitish scales, terminal segment brownish. Terminal lobes pedicelled, orbicular. Wings hyaline with the membrane rather thickly clothed with long, coarse hairs; basal portion of the costa and subcosta thickened and thickly clothed with rather large, dark brown striated scales, the subcosta joining the costa at the middle of the wing, which is marked at the point of union by a white spot, the mid vein uniting with the border at the posterior apical fourth, anal vein somewhat angulate near the middle, joining the posterior margin at the basal third. Halteres light brown, basal portion short, stout, apical part slightly fusiform, much elongated, with its tip sparsely clothed with fine, yellowish scales. Anterior leg with coxae light yellowish, dark brown ven-

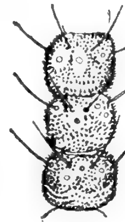

Fig. 15 Lasioptera carbonifera, three antennal segments of female, much enlarged (Original)

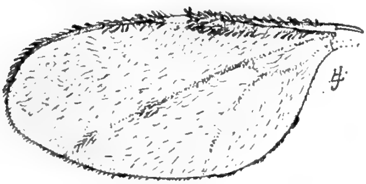

Fig. 16 Lasioptera carbonifera, female wing, much enlarged (Original)

Fig. 17 Lasioptera carbonifera, last tarsal segment of female, much enlarged (Original)

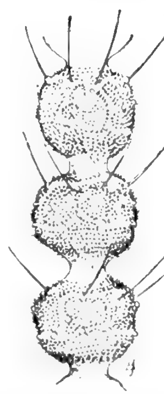

Fig. 18 Lasioptera carbonifera, three antennal segments of male, much enlarged (Original)

trally; tibiae and tarsi dark brown, the latter with the segments yellowish white basally; first tarsal segment short, second much produced, third half the length of the second, fourth shorter and about as long as the first, fifth very short; claws bidentate. The middle leg is practically the same as the anterior except for the well defined basal band on the tibia; posterior leg like the middle aside from the first tarsal segment being white and each extremity of the other segments narrowly banded with the same except the apex of the fifth, which is yellowish.

Fig. 19 Lasioptera carbonifera, ventral aspect of larval head, possibly near pupation, much enlarged (Original)

Male. This sex closely resembles the other except in size. The antennal segments are possibly more cylindric and not quite so much dilated as those of the female, while the palpi appear to differ in having the basal segment considerably larger than the apical, both bearing irregularly located, stout, chitinous setae. Basal clasp segment stout, slightly curved exteriorly, strongly excavated interiorly; terminal clasp segment strongly arcuate, terminating in a rather blunt, dark, recurved spine, other structures indeterminate in the preparation.

Pupa. Yellowish brown with brownish wing pads extending nearly to the middle of the abdomen, the leg cases reaching to the extremity and the antennae extending almost to the basal abdominal segments. This pupa is stout and easily recognized because of the definite markings, there being a series of light lateral spots on each of the brownish abdominal segments. The brown tarsi have definite yellowish white bands.

Fig. 20 Lasioptera carbonifera, larval breastbone, enlarged (Original)

Larva. The full grown larva is about 1.25 mm long, pale yellowish with the segmentation rather indistinct. Head rather prominent, narrow, tapering anteriorly; antennae apparently three segmented, the basal being stout, a little longer than broad, the second subcylindric, about half the diameter of the first and nearly as long, the third subconical and slightly thicker than the second, giving a capitate

Fig. 21 Lasioptera carbonifera, larva, ventral aspect of posterior extremity, enlarged (Original)

appearance to this organ. Chitinous fork or "breastbone" stout, slightly expanded posteriorly, widely produced anteriorly in two conspicuous lateral processes and with a pair of large, well separated anterior teeth. Terminal segment about one half the width of the body, distinctly produced posteriorly and bisected ventrally by the slitlike anal orifice.

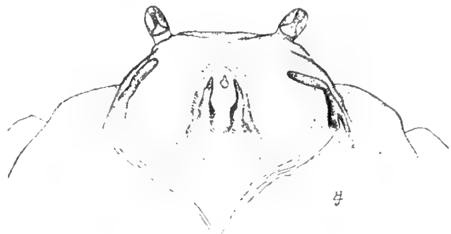

Fig. 22 Lasioptera vitis, ventral aspect of larval head, much enlarged (Original)

Grape gall fly (Lasioptera vitis (O. S.). The large, irregular, reddish mass of tissue produced by this insect has been repeatedly described, while so far as known the larva has not been characterized, though it is an exceedingly peculiar form.

Fig. 23 Lasioptera vitis, breastbone, much enlarged (Original)

Larva. The full grown larva is about 3 mm long, yellowish in color and rather slender. Head somewhat retracted, short, tapering rapidly to a nearly truncate anterior margin. Antennae short, stout, basal segment stout, about two thirds as long as broad, apical segment about as long as broad, gently rounded apically and apparently excavated ventrally, there being two broad, ventral, flaplike appendages with gently rounded margins. Chitinous fork or "breastbone" very short, its posterior portion being indistinct, anterior portion broad, stout and with a pair of large, acute, cephalic teeth. Body with many transverse wrinkles, posterior extremity with a simple anal slit and with a pair of rather prominent submedian pseudopods arising from tuberculelike elevations, the terminal portion of these appendages somewhat fusiform. Anterior of the pseudopods there is a median, large, subtriangular elevation bearing numerous minute tuberculate processes.

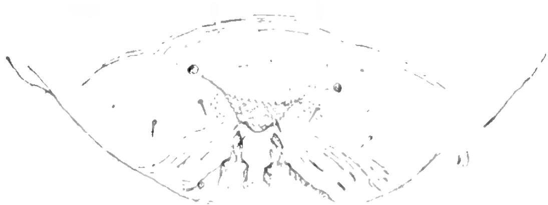

Fig. 24 Lasioptera vitis, larva, dorsal aspect of posterior extremity, much enlarged (Original)

Willow potato gall (Rhabdophaga batatus Walsh). Very irregular, gouty, polythalamous enlargements occur on the shoots of low swamp willows. . Specimens taken at Karner April 13, 1903, produced adults the 27th. The pupae wriggle partly out of the gall as in the case of some other species, the flies escaping and leaving the white pupal skins adorning the surface of the gall.

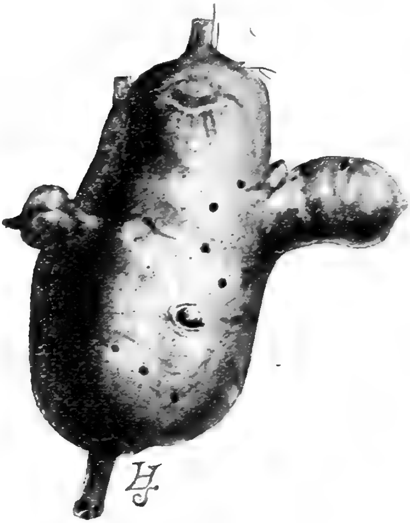

Fig. 25 Rhabdophaga batatus, gall enlarged (Original)

Female. Antennae reddish brown, moniliform, reaching to the base of the abdomen and consisting of 20 subsessile segments, the basal one enlarged, subglobular, the second short, the third about twice the length of the preceding and the others decreasing gradually in length to the extremity. There is on each segment a subbasal whorl of rather short, nearly straight setae, while the central portion is more or less irregularly ornamented with long, curved setae arising from conspicuous tubercular elevations. The segments are marked with more or less distinct smooth, transverse lines containing oval, whitish spots at the basal third and near the apex. In one or two instances there appears to be a slight ridge as described for R. rigidae. Eyes black, coarsely granulate, inclosing the base of the antennae; palps composed of five

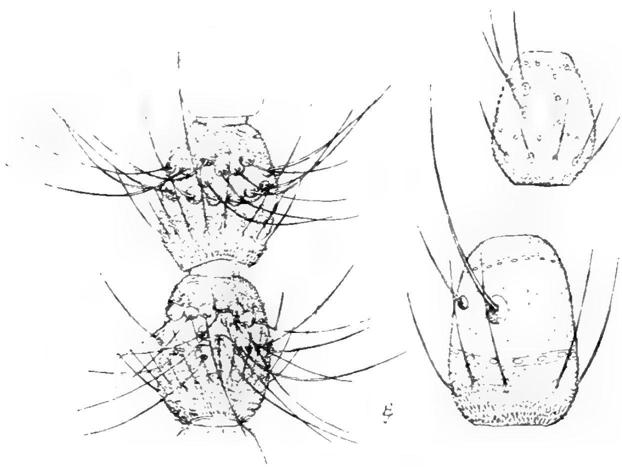

Fig. 26 Rhabdophaga batatus, two antennal segments of female, with views of two other segments, much enlarged (Original)

segments, the basal short, rather small, second and third thick, subequal, the fourth the same length as the third, more slender and the fifth about one half longer than the fourth. Mesonotum dark brown with a somewhat distinct median, lighter, broad vitta. Scutellum prominent, yellowish; postscutellum yellowish, abdomen reddish; terminal lobes slender, finger-shaped. Wings subhyaline, anterior veins dark brown; subcosta joining costa before the middle and the second longitudinal vein uniting with the border before the

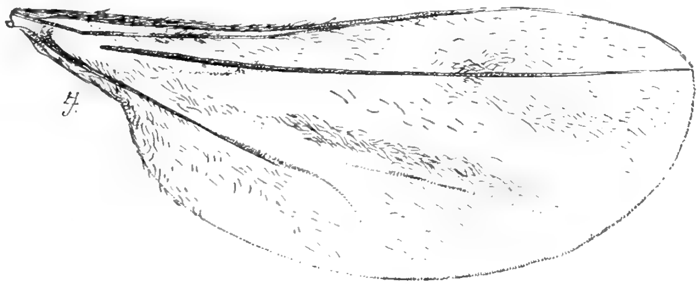

Fig. 27 Rhabdophaga batatus female wing, much enlarged (Original)

apex; anal vein uniting with the posterior margin at the apical third, its branch at the basal third. Halteres with a slender, semitransparent, long pedicel, apex expanded, fusiform, yellowish. Legs pale yellowish, first tarsal segment of posterior leg short, second very much prolonged, third one half as long as the second, fourth two thirds as long as the third and the fifth about half as long as the

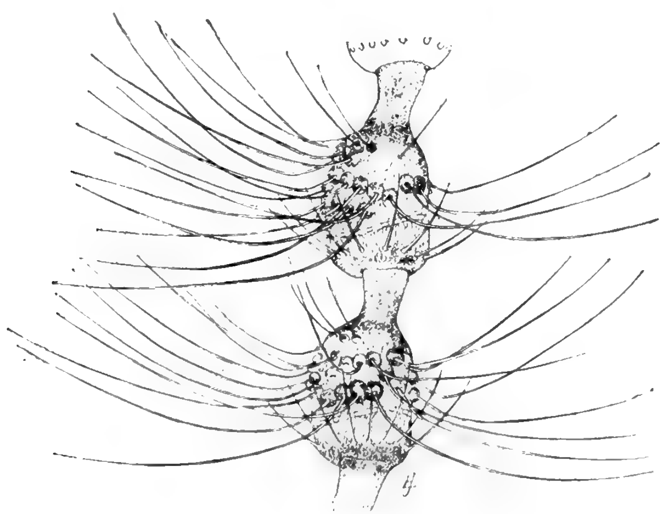

Fig. 28 Rhabdophaga batatus, two antennal segments of male, much enlarged (Original)

fourth; claws simple, empodium well developed. Length nearly $\frac{3}{16}$ inch, wing spread $\frac{1}{4}$ inch.

Male. The dark red antennae extend to the middle of the body and are composed of 19 segments, the first and second each stout, subglobular and the 3d to 18th inclusive, pedicellate, 19th simple. Each segment consists of a broadly expanded basal two thirds, the remainder forming a simple, narrow pedicel. The enlarged part bears a basal whorl of short, nearly straight setae followed by irregularly placed, long, curved setae arising from conspicuous tubercular elevations. Most of the segments appear to have a distinct though nearly invisible ridge with whitish, oval spots along its length at the basal third of the enlargement. Male genitalia with the clasp segment rather slender, strongly curved exteriorly, nearly straight interiorly, the apical segment strongly curved and tapering gradually to an acute, dark apical tooth. Dorsal lamella greatly dilated, broadly rounded laterally, nearly divided and widely separated posteriorly; ventral lamellae slender, nearly parallel, tapering gradually to a rather acutely rounded apex. Stylet rather prominent, stout, tip broadly rounded.

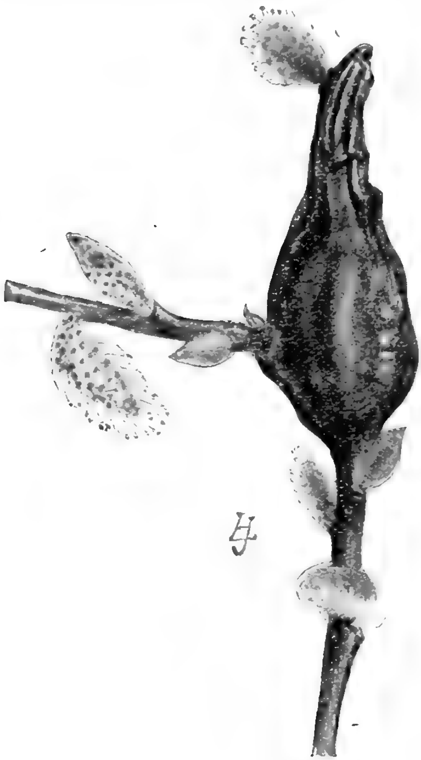

Fig. 20 Rhabdophaga rigidae, gall enlarged (Original)

Described from alcoholic specimens.

Willow beak gall (Rhabdophaga rigidae n. sp.). The galls of this species are comparatively common on the small willows (Salix rigidae and S. lucida) in the vicinity of Albany and may be instantly recognized by their terminal or subterminal location and fusiform shape. They are about an inch long and are tipped with a rather characteristic, slender, curved beak. The gall of this species was early described by Dr Fitch under the name of Cecidomyia salicis, and on account of its specific name being preoccupied, it was changed by Baron Osten Sacken to C. rigidae.

Female. Antennae dark brown, moniliform, composed of 24 or 25 segments and extending to the base of the wings; basal segment much enlarged, subglobular, the second short, thick, the third somewhat elongate and with a very short pedicel, the fifth and following subglobular, decreasing gradually in length and each except the last with a rather well marked, short pedicel. The enlarged portion of the segment bears near its base a nearly uniform row or whorl of rather stout, slightly curved setae, and the remainder of the distal surface is sparsely ornamented with longer, more curved setae arising from distinct setigerous punctures, each segment with a distinct though not conspicuous transverse ridge with white punctures at regular intervals on the basal third and another at the distal border of the enlargement. Palpi composed of five segments, basal short, second longer, third a little shorter than the second and about equal to the fourth, fifth slender, finger-shaped and about as long as the two preceding segments. Eyes black, coarsely granulate and inclosing the base of the antennae. Mesonotum dark brown or black, with a more or less distinct pair of curved, lighter, submedian vittae expanding anteriorly and a lighter area at the base of the wing. Scutellum prominent, with a median, lighter spot; postscutellum yellowish. Abdomen reddish brown, terminal lobes slender, broadly rounded apically and thickly clothed with long, slender setae. Wings with a distinct fucous shade; anterior veins brown, well marked; subcosta joining costa at the middle, the first longitudinal vein uniting with the border just before the apex, anal vein indistinct distally, its posterior fork uniting with the margin at the posterior third. Halteres with a slender, yellowish pedicel, distal portion strongly capitate, semitransparent, whitish. Legs yellowish, first tarsal segment of posterior leg very short, second much produced, third about half the length of the second, fourth a little shorter than the third and the fifth half the length of the fourth; claws simple, empodium well developed. Length ¼ inch, wing spread ⅜ inch.

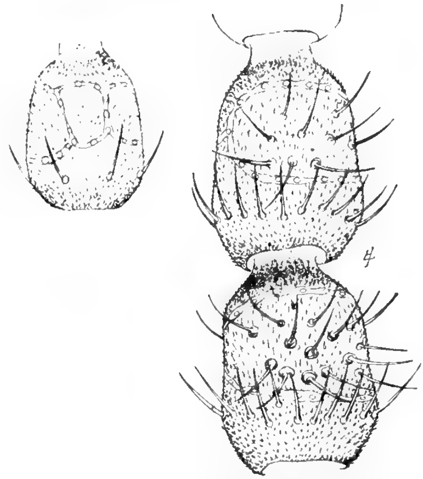

Fig. 30 Rhabdophaga rigidae, two antennal segments of female, with another aspect of a third, much enlarged (Original)

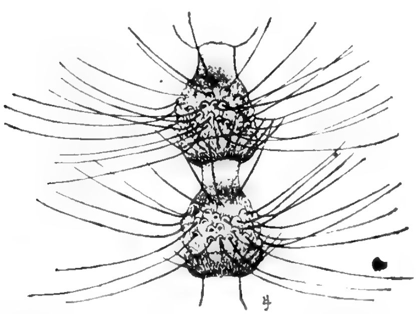

Fig. 31 Rhabdophaga rigidae, two antennal segments of male, much enlarged (Original)

Male. Antennae brown, extending to the base of the abdomen and composed of 24 pedicellate segments, the first subglobular, much enlarged, the second stout, the others with the exception of the last, each with a smooth pedicel about one third the length of the segment. The enlarged portion is ornamented basally with a regular row of short, straight setae, the remainder being thickly clothed with long, slender, curved setae arising from prominent setigerous tubercles. There is a distinct though not conspicuous transverse band with a line of white spots along its length near the basal fourth, much as in the female. There appears to be another similar structure at the apical portion of the enlargement as in the opposite sex. Male genitalia with the basal clasp segment broadly dilated at the base, slightly rounded exteriorly, strongly so interiorly and obliquely truncate apically; terminal clasp segment broadly expanded at the base, curved and tapering to a strong, dark, chitinous point. Dorsal lamella deeply incised mesially, each lobe stout and broadly rounded at the apex; ventral lamella broad, truncate apically, gently rounded and produced laterally; stylet stout, short, broadly rounded apically.

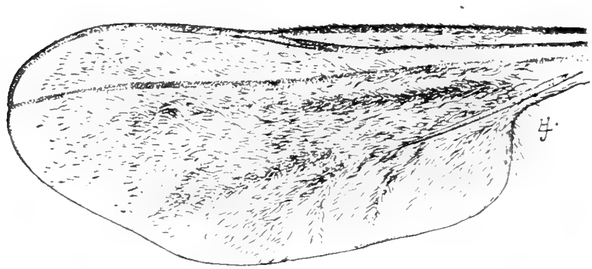

Fig. 32 Rhabdophaga rigidae, male wing, much enlarged (Original)

The above are described from alcoholic specimens bred from twigs taken at Karner April 13, 1903, adults appearing the 27th.

Pupa. Stout, brown, curved, ¼ inch long, wing cases reaching to base of the third abdominal segment, leg sheaths extending to the sixth abdominal segment. Antennae with a small, basal, tubercular process and extending to the base of the abdomen.

Larva. Yellowish, stout, $\frac{3}{16}$ inch long and with the segments well marked. Head small, retracted; antennae with a large basal and a smaller terminal conical segment. Chitinous fork or "breastbone" short, stout, with the arms well separated and bearing conical, polished, acute teeth, basal parts dark though not sharply defined. Spiracles occur on the 2d and 5th to 12th segments inclusive, those on the latter

Fig. 33 Rhabdophaga rigidae, larval breastbone, enlarged (Original)

being sublateral, each consisting of a circular, chitinous elevation with a median depression or aperture.

Black locust midge (Dasyneura pseudacaciae Fitch). Occasionally young leaves of black locust are badly deformed by being folded together so as to produce peculiar podlike galls about ¼ inch long. This is the work of the above named small, black midge or fly, which probably deposits two or three eggs in each unfolding leaf. The young maggots hatching therefrom produce sufficient irritation to prevent the leaf unfolding, and its free edges adhering together more or less form a fairly perfect gall, within which the nearly helpless larva develops to maturity. Sometimes this species is very numerous, since we received specimens from Mr C. L. Williams of Glens Falls, N. Y., accompanied by the statement that some parts of a black locust hedge had nearly every leaf infested by this little insect. It is rarely so abundant as this, though Dr Smith records it as a common species in New Jersey.

This insect is with very little doubt the same as that described under the above specific name and referred to the genus Cecidomyia by Dr Fitch in his 5th report for the year 1859, page 53. Some years later Baron Osten Sacken described what is very probably the same form, under the name of Cecidomyia gleditchiae. There are some inconsistencies in colorational characters between the two descriptions, but these perhaps may be partly explained by one describing more matured or even dried specimens while the other characterized fresh individuals.

Description. This little fly was described by Dr Fitch as follows: "A small, blackish midge, the base of its thorax tawny yellow, its abdomen pale yellowish, with the tip dusky and clothed with fine hairs, as is also the neck; its legs black, with the thighs pale except at their tips; its wings dusky, feebly hyaline, with the fringe short; its antennae with 13 short cylindrical joints separated by short pedicels; its length, .065 inch to the tip of the body."

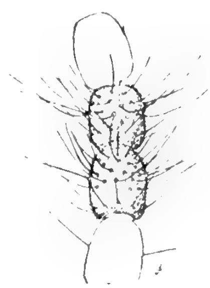

Fig. 34 Dasyneura pseudacaciae, antennal segments of female, much enlarged (Original)

The above description varies somewhat from dried specimens bred by us in July, and the discrepancy is probably due to the drying of the specimens.

Female. Antenna dark brown, moniliform, extending to the base of the wing and composed of 14 stout, closely set segments, each rather sparsely clothed with long, somewhat stout, curved setae arising from conspicuous elevations. Careful focusing brings out more or less distinctly on each segment a middle and subapical, transverse row of pale, circular spots, which are evidently connected on one side at least by a similar longitudinal row as in the case of Rhabdophaga salicis Schrk. Palps composed of five distinct segments, a short, basal one, the second a little longer, the third and fourth fully half longer than the second and the fifth about half longer than either the third or fourth, all sparsely ornamented with irregularly placed, stout setae; mouth parts rather prominent. Eyes large, coarsely granulate. Mesonotum light brown with indistinct grayish vittae and with a sparse clothing of fine, yellowish hairs. Scutellum prominent, crowned with a sparse row of golden yellow setae, dark brown anteriorly, golden yellow posteriorly; postscutellum golden yellow. Abdomen dark brown or reddish, sparsely ornamented with rather coarse golden yellow setae, pleura yellowish. Wings hyaline sparsely clothed with rather coarse, curved hairs; base of costa a little more thickly clothed and with a few linear scales; subcosta rather indistinct, uniting with costa at the basal third; first longitudinal vein well marked, joining the border just before the apex, anal vein indistinct. Halteres with a long, yellowish pedicel, apex greatly enlarged, elongate, fuscous. Legs pale yellowish clothed with a silvery white pubescence, first tarsal segment very short, second much prolonged, third less than one half that of the second, fourth and fifth each two thirds the length of the preceding segment. Claws simple, empodium well developed. Terminal abdominal lobes slender, finger-shaped.

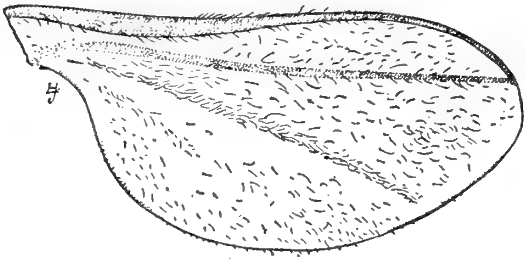

Fig. 35 Dasyneura pseudacaciae, female wing, much enlarged (Original)

Male. Antennae composed of 14 segments, all except the basal two and the 14th pedicellate distally, the apical two thirds of the large basal portion of each irregularly ornamented with conspicuous setigerous tubercles bearing long, slightly curved setae two or three times as long as the width of the segment, the distal third of the latter smooth, narrow, forming a pedicel. There is a narrow, distinct though inconspicuous, transverse, white spotted band at the

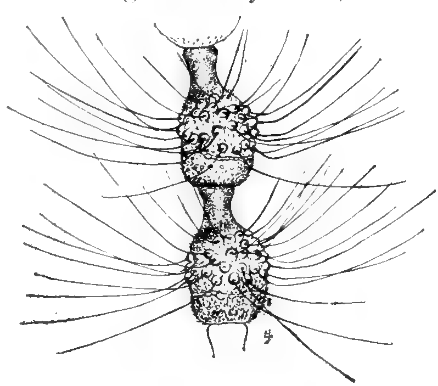

Fig. 36 Dasyneura pseudacaciae, two antennal segments of male, much enlarged (Original)

basal third of each segmental enlargement. Male genitalia with the basal clasp segment stout, much expanded basally, terminal clasp segment rather stout, short, tapering gradually to a rounded, denticulate tip; dorsal lamella long, very deeply incised, tips of lobes subacute; ventral lamellae broad, distant, the inner margins approaching each other posteriorly, the tip subacute with the outer margin broadly rounded and produced laterally; stylet short, broad, with a rounded apex.

Pupa. Brownish, length $\frac{1}{16}$ inch. The antennae reach to the base of the wings, the wing pads extend to the tip of the second abdominal segment and the leg sheaths to the third and fourth abdominal segments; eyes dark brown. The long, slender spines originate near the base of the antennae.

Larva. Pale yellowish, $\frac{3}{32}$ inch long. Segmentation rather well marked. Head retracted, small, antennae simple with a rather large, conical, terminal segment. Chitinous fork or "breastbone" Y-

Fig. 37 Dasyneura pseudacaciae, larval breastbone, much enlarged (Original)

Fig. 38 Dasyneura pseudacaciae, larva, ventral aspect of posterior extremity, much enlarged (Original)

shaped, basal portion long, expanded posteriorly; branches of the fork stout, well separated, obliquely, arcuately truncate; posterior extremity relatively simple with lateral groups of stout, semitransparent spines posteriorly.

Trumpet vine midge (Bremia tecomae n. sp.). Our attention was called to the work of this insect in early September by the crumpling of the leaves of a trumpet vine. The minute, pale yellowish larvae were found within the distorted leaves, and adults were bred a few days later. This insect was so abundant as to seriously injure a small trumpet vine in Albany. The larvae did not produce galls, but their operations on the under surface of the leaf resulted in pseudogall-like formations partially sheltering the tender maggots which were otherwise without protection and fed on the nearly exposed leaf surface.

This species, apparently unknown, may be recognized by the following characteristics:

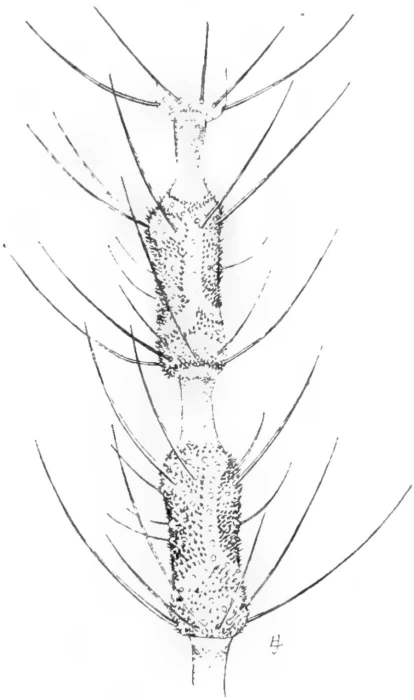

Fig. 39 Bremia tecomiae, two antennal segments of female. much enlarged (Original)

Female. Antennae fuscous yellow, about two thirds the length of the body and composed of 14 segments, the first short, subglobular, the second stout, elongate and the 3d to the 14th inclusive, pedicellate distally. A typical segment has the basal two thirds cylindric, broadly dilated and bearing a basal and subapical whorl of long, stout setae, an intervening space thickly ornamented with irregularly placed black, chitinous spots, and on focusing, showing pale, transverse and longitudinal lines inclosing circular areas much as in Rhabdophaga salicis Schrk. The distal third of the segment is slender, smooth, with the apex slightly expanded. Palpi long, composed of five segments, the basal two short, stout, subequal, the third a little longer, the fourth and fifth one half longer, subequal, slender; all sparsely ornamented with stout setae. Mandibles distinct, broad and with a number of subapical, apical and lateral, stout setae. Eyes large, jet-black, rather coarsely granulate and confluent. Thorax yellow with lateral, yellowish, fuscous, mesonotal elevations at the base of the wings, and with fuscous, chitinous, rounded elevations above the base of the somewhat fuscous anterior coxae.

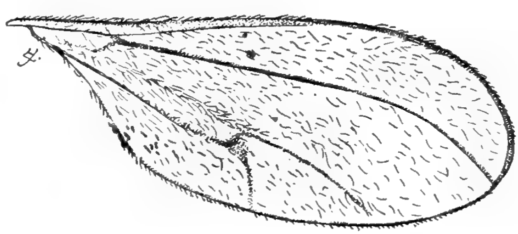

Fig. 40 Bremia tecomiae, female wing, much enlarged (Original)

Abdomen lemon-yellow, slightly fuscous apically, terminal lobe slender, tapering to a minute rounded apex. Wings semitransparent with iridescent reflections, membrane rather thickly clothed with long, fine hairs; subcosta indistinct, uniting with the margin at the basal third; first longitudinal vein distinct and extending to the posterior margin just behind the apex, anal vein indistinct, joining the posterior margin at the distal third and its branch near the basal third. Legs pale yellowish, rather thickly clothed with grayish brown hairs, tarsi lighter; first tarsal segment short, second very much produced, third about one half the length of the second, the fourth two thirds the length of the third, and the fifth a little shorter. Claws simple, empodium well developed.

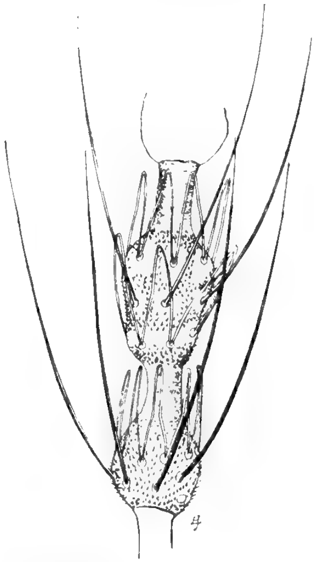

Fig. 41 Bremia tecomiae, one antennal segment of male, much enlarged (Original)

Male. Very similar to the female, except that the antennae are about as long as the body, and the distal segments presumably 3 to 14 inclusive, have two subglobular dilations, one at the base and the other at the apical third. The basal subglobular dilation bears a whorl of very long, stout, simple setae and just distally thereof, a whorl of fine, much shorter, arched filaments. The distal pear-shaped enlargement bears a whorl of stout setae a little beyond its middle, and at its base and near the apex, whorls of fine, arched filaments like that on the basal enlargement; both dilations are ornamented with many irregularly placed, chitinous spots, the basal being separated by a narrow, smooth stem from the distal, and that in turn from the basal of the next segment by a similar stem or pedicel. The coarse, granulate eyes are larger than in the female and inclose a greater proportion of the head. The abdomen is more slender and the terminal appendages are dark brown. Male genitalia with the basal clasp segment stout, broadly curved exteriorly and somewhat arcuate interiorly, distal internal margin oblique. Terminal clasp segment stout, tapering gradually to a strong, bidentate apex. Dorsal lamella irregularly rounded distally, deeply incised mesially, ventral lamella with distinct lateral orbicular lobes separated by a deep medium incision; stylet slender, broadly rounded at the apex.

Fig. 42 Bremia tecomiae, pupal skin, much enlarged (Original)

Pupa. Pupa yellowish with wing pads extending two thirds the length of the abdomen, the leg cases reaching to the extremity and the antennae touching the basal abdominal segments, which latter are ornamented dorsally with irregular, double rows of chitinous spines. The conspicuous dorsal processes are slender, curved, tapered to an acute point and are three fourths as long as the width of the pupa.

Larva. The full grown larva is about 1.5 mm long, pale yellowish, with the segmentation distinctly marked. Head rather prominent, narrow, tapering anteriorly, antennae consisting of a very broad, retracted basal segment and a rather large, spindle-shaped, terminal segment. Chitinous fork or "breastbone" Y-shaped, the anterior arms broad, well separated, each slightly emarginate anteriorly, distal extremity somewhat enlarged. Antepenultimate abdominal segment with a pair of sublateral, chitinous, dark brown tubercles ventrally, while on the dorsum there appears to be a median, subconical, slightly curved, chitinous tubercle, the last segment with two pairs of sublateral minor protuberances.

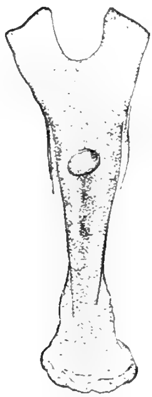

Fig. 43 Bremia tecomiae, larval breastbone, much enlarged (Original)

Chokecherry gall fly (Cecidomyia virginianiae n. sp.). The peculiar enlarged, galled fruit of the chokecherry, Prunus virginianus, has been known for some time and was noticed by the late Dr Lintner in his 12th report for 1896, p. 313. He there states that cherries apparently galled by this insect have been very abundant in Keene Valley, and adds that Prof. George F. Atkinson of Cornell University named and described a fungus, Exoascus cecidomophilus, which was usually associated with these insects. Repeated though unsuccessful efforts have been made to obtain the adult, and, lacking this, we have deemed it advisable to describe and illustrate the larva under the above name.

Larva. The full grown larva is 2.5 mm long, yellowish or yellowish red in color and rather stout. Head rather prominent, narrow, tapering very slightly anteriorly and with short, rather conspicuous two segmented antennae. The first joint of the latter is very short, about twice as broad as long, the second subconical and twice as long as broad. Chitinous fork or "breastbone" rather long, slender, basal portion simple, of uniform size; anterior part greatly dilated and with two short, distinct cephalic teeth or dentitions. Body segments each with a pair of submedian ventral and lateral setae; dorsum apparently simple. Spiracles on the second thoracic and the abdominal segments evident, those on the eighth being sub-

Fig. 44 Cecidomyia virginianiae, larval breastbone, much enlarged (Original)

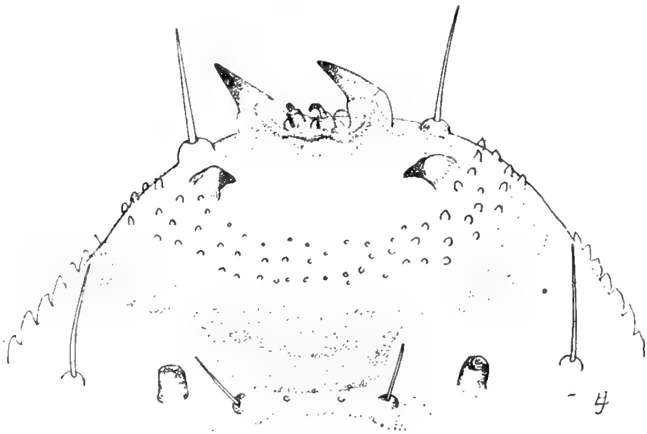

Fig. 45 Cecidomyia virginianiae, larva, dorsal aspect of posterior extremity, much enlarged (Original)

median, others nearly lateral. Posterior extremity with a simple anal slit, and with a pair of conspicuous submedian, subconical pseudopods, a median pair of smaller tubercles lying between the latter and similar sublateral ones anteriorly.

Fig. 46 Cecidomyia sambuci, gall, natural size (Original)

Gouty elder gall (Cecidomyia sambuci n. sp.). This is an irregular gnarly swelling on one side of small elder stems, about 1¾ inch long and ¾ inch in diameter. Adults were not obtained

Larva. The full grown larva is about 3 mm long, yellowish red and rather stout. Head moderately prominent, enlarged at the base, rounded laterally and tapering rapidly to a broadly rounded apex. Mouth parts very small and indistinct. Chitinous fork or "breastbone" long, slender, basal portion indistinct, anterior part broadly rounded with two large, lateral, blunt teeth and a smaller median one. Body smooth, spiracles moderately prominent. Anal slit simple, extending across most of the posterior extremity, which latter bears a few slender, transparent, spiny processes.

Fig. 47 Cecidomyia sambuci, larval breastbone, enlarged (Original)

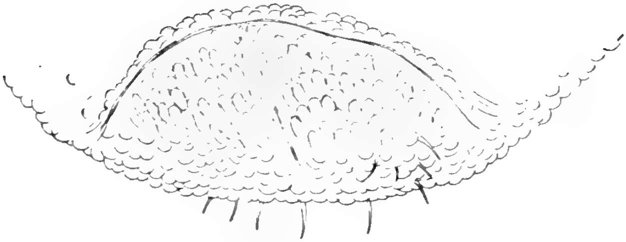

Fig. 48 Cecidomyia sambuci, larva, ventral aspect of posterior extremity, enlarged (Original)

VOLUNTARY ENTOMOLOGIC SERVICE OF NEW YORK STATE

This work has now been carried through seven seasons and has resulted in the accumulation of a large amount of data particularly valuable because it relates to the relative abundance of a number of common pests, species so well known as to be rarely the subject of careful records. Such data continued through a series of years as previously pointed out should prove of considerable service in determining the causes governing insect outbreaks. Particularly is this true if these reports are correlated with temperature fluctuations and other climatic changes, which evidently have a profound influence on insect life, specially during the hibernating winter period. It is still early to draw conclusions upon this important point, as observations should be continued over a series of years. It will be noticed that some observers attribute the relative scarcity of insect depredations to the midsummer drouth. This is undoubtedly the case with some species, while injuries by other forms were emphasized because the dry weather prevented the normal growth of vegetation and thus made apparent depredations which under ordinary conditions escape notice. This was particularly true of the webworm outbreak in Rensselaer, Columbia and Albany counties, noticed on page 67.

The corps of voluntary observers aside from rendering more or less regular reports on local conditions has proved of great service in the case of unusual outbreaks of one kind or another. All parties have responded cheerfully to requests from the office, making it possible in emergencies when serious injuries like those of the webworm in the eastern part of the State or that of the army worm in the western part of the State are threatened, to determine within a few days the approximate extent of the depredations.

This is something of very great importance at times and would have proved of much service in 1896, when the army worm inflicted serious losses in 55 of the 60 counties then existing.

Cattaraugus county [C. E. Eldredge, Leon] — Potato beetles (Doryphora decim-lineata Say) are unusually abundant. Horn flies (Haematobia serrata Rob.-Desv.) are very numerous and annoying to cattle. Fall webworms (Hyphantria textor Harr.) have appeared in large numbers on appletrees. Mosquitos have been exceedingly abundant the past two or three weeks.—*July 25*. There is no evidence of army worms (Heliophila unipuncta Haw.) in this section.—*August 2*

[F. A. Fitch, Randolph] — Grasshoppers are not abundant and squash bugs (Anasa tristis DeGeer) are scarce. Striped cucumber beetles (Diabrotica vittata Fabr.) were very thick the middle of June but have largely disappeared. Potato beetles have been very numerous and the same is true of the Texas horn fly, which has been quite annoying to stock.—*July 5*. Potato beetles continue to be abundant and green horseflies (probably Tabanus lineola Fabr.) have been quite numerous. Mosquitos are not so abundant as three weeks ago. Insects appear to have been kept under control largely by the cool wet weather.—*July 12*

Dutchess county [Henry D. Lewis, Annandale] — The scurfy scale (Chionaspis furfura Fitch) is unusually prevalent and destructive on young fruit trees in this section.—*May 25*. Plant lice are becoming somewhat abundant. Apple aphids (Aphis mali Linn.) have appeared in considerable numbers and threaten to cause serious injury. Striped cucumber beetles (Diabrotica vittata Fabr.) and squash bugs (Anasa tristis DeGeer) are both very abundant.—*June 7*. Spittle insects (probably Philaenus lineatus Linn. or P. spumarius Linn.) are quite numerous on grass, attracting attention because of the conspicuous frothy masses here and there on almost every grass stem in restricted areas. Plant lice are about the only insects present in numbers.—*June 13*. Apple aphids continue very abundant and are causing a great deal of damage, especially on young trees. Potato beetles (Doryphora decim-lineata Say) are more numerous than for several years. There is some pear psylla (Psylla pyricola Forst.) in evidence.—*July 8*. Pear psylla has increased somewhat and the aphids on apple have nearly disappeared. Potato beetles are more numerous than they have been for years. The scurfy scale is generally abundant and threatens to cause considerable injury.—*July 29*

Erie county [John U. Metz, Swormville] — Mosquitos are present in great numbers and currant worms (Pteronus ribesii Scop.) are abundant. Potato beetles (Doryphora decim-lineata Say) are very evident. Horn flies (Haematobia serrata Rob.-Desv.) have been rather annoying to stock some two weeks. Green-headed horseflies (probably Tabanus lineola Fabr.) are much more common than usual, small swarms following teams about. There is no evidence of injury to wheat by Hessian fly (Mayetiola destructor Say).—*July 18*

Genesee county [J. F. Rose, South Byron] — Tent caterpillars (Malacosoma americana Fabr.) are very scarce, only three nests having been observed. Plant lice are abundant on roses.—*May 24*. There are no complaints of injury by striped cucumber beetles (Diabrotica vittata Fabr.) and potato beetles (Doryphora decim-lineata Say) are not injurious. Rose slugs (Monostegia rosae Harr.) are much more numerous than usual.—*July 3*. Fall webworm (Hyphantria textor Harr.) appears to be becoming more injurious each year. Squash bugs (Anasa tristis DeGeer) and striped cucumber beetles are not abundant. Tussock moth caterpillars (Hemerocampa leucostigma Abb. & Sm.) are more numerous than usual but not causing serious damage in this vicinity. Potato beetles are quite plentiful though they are easily controlled by thorough and timely spraying.—*July 20*

Greene county [O. Q. Flint, Athens] — Tent caterpillars (Malacosoma americana Fabr.) are remarkable for their scarcity, not one nest having been observed.—*June 13*. Spittle insects (probably Philaenus lineatus Linn. or P. spumarius Linn.) are somewhat abundant and have attracted notice because of the tops of injured grass stems dying.—*July 4*. Plant lice have been more than ordinarily destructive in gardens, even cabbage plants being affected. Potato beetles (Doryphora decim-lineata Say) are about as destructive as usual. The elm leaf beetle (Galerucella luteola Müll) is quite scarce and there is very little evidence of tent caterpillar work. Pear orchards have suffered considerable injury, many of the trees turning black and dying. This is probably due to the exceptionally severe weather of winter before last, in some instances supplemented by bacterial or fungous disease or insect injury. The trees had vitality enough to live through one summer but were unable to survive another winter.—*July 18.* Fall webworms (Hyphantria textor Harr.) are quite numerous. Plant lice have been somewhat annoying to lettuce and other tender plants. The elm leaf beetle while evident has not been so destructive as in some other years.—*July 27*

Herkimer county [George S. Graves, Newport] — The oyster scale (Lepidosaphes ulmi Linn.) appears to have been very prolific, judging from its abundance on trees this spring.—*April 20.* It appears to be a very serious pest in the apple orchards of this section. The cold wet weather is retarding insect development.—*May 15.* Currant worms (Pteronus ribesii Scop.) were seen May 16 and two nests of tent caterpillars (Malacosoma americana Fabr.) observed the 18th. The season appears to be a very irregular one and comparatively few insects are abroad. White grubs (Lachnosterna species) seem to be the principal grass enemy in this section.—*May 23.* Black flea beetles (Epitrix cucumeris Harr.) were observed on cucumber plants May 27. Tent caterpillars are remarkably scarce.—*June 2.* Young currant worms were hatching June 4, and the first potato beetles (Doryphora decim-lineata Say) were seen the 8th, the adults being scarce. Currant aphis (Myzus cerasi Fabr.) have been increasing rapidly within a few days. Flies are also becoming aggressive.—*June 19.* Potato beetle larvae were observed June 25, though the adults are somewhat scarce. Elm aphids (probably Callipterus ulmifolii Mon.) are present in some numbers. Currant aphis is causing some injury, particularly since there has been a week of hot weather. Apple aphids (Aphis mali Linn.) are present in small numbers.—*July 1.* Another brood of currant worms appeared July 4. Striped cucumber beetles (Diabrotica vittata Fabr.) are causing considerable injury. Flea beetles are not much in evidence.—*July 10.* Rose beetles (Macrodactylus subspinosus Fabr.) are abundant and feeding on plants of many kinds. Cabbage butterflies (Pieris rapae Linn.) appear to be somewhat numerous. Currant worms have been destructive for a week past. Black-headed turnip worm (Evergestis straminalis Hübn.) is seriously injuring turnip leaves. Horn flies (Haematobia serrata Rob.-Desv.) are more or less troublesome to cattle. The foliage of red cedartrees is badly eaten, possibly by the rose beetle. Large numbers of plant lice (probably the undescribed Lachnus smilacis Willm.) were found on smilax.—*July 20.* The peculiar subglobular galls of Cecidomyia verrucicola O. S. are quite abundant on basswood leaves.—*July 22.* Horn flies appear to be increasing in numbers and potato beetles are not very destructive, while currant worms have been more injurious than usual. Grasshoppers are quite scarce.—*July 28.* Black plant lice (probably Aphis rumicis Linn.) occur in great abundance on pigweed (Chenopodium). Fall webworms (Hyphantria textor Harr.) are very scarce, but one nest being observed. Horn flies are exceedingly abundant and annoying to cattle. The season appears to be from 10 days to 2 weeks later than usual.—*August 8.* Young currant worms are present in considerable numbers.—*August 12.* Cabbage butterflies are becoming numerous and horn flies are exceedingly abundant and troublesome. Excessive rains and high winds have destroyed many insects.—*August 17.* Fall webworm nests are becoming more numerous. Codling moth larvae (Carpocapsa pomonella Linn.) appear to be more destructive than usual. This may possibly be due to the small amount of fruit emphasizing its injury. The black walnut trees in this section are more or less severely injured from year to year by some insect which strips the leaves therefrom (possibly the work of the black walnut worm, Datana integerrima Grote & Rob.). Spiny elm caterpillars (Euvanessa antiopa Linn.) are working in small numbers on both elm and willow.—*August 29.* Grasshoppers are somewhat abundant in dry pastures and gardens and fall webworms are quite numerous on all trees except maple.—*September 27*

Onondaga county [Mrs A. M. A. Jackson, Warner] — Plant lice have not been at all abundant in this section. Black flea beetles (Epitrix cucumeris Harr.) are present in small numbers. Not a striped cucumber beetle (Diabrotica vittata Fabr.) has been observed. Rose beetles (Macrodactylus subspinosus Fabr.) are present in small numbers and are not doing much damage. Rose leaf hoppers (Typhlocyba rosae Harr.) are not very abundant. Tussock caterpillars (Hemerocampa leucostigma Abb. & Sm.) are much later than usual and are present only in small numbers. Plantains have been seriously injured in some places by a leaf miner (probably the plantain leaf miner, Dibolia borealis Chev.).—*July 12.* Dog day Cicadas (Tibicen tibicen Linn.) were observed in small numbers July 16. Cabbage butterflies (Pieris rapae Linn.) are common along the highways. Currant worms (Pteronus ribesii Scop.) have been abundant in some gardens while in others there is very little injury. The horn fly (Haematobia serrata Rob.-Desv.) and the stable fly (Stomoxys calcitrans Linn.) have been very annoying to cattle. Warm damp weather has been followed by the appearance of many mosquitos. There is a report to the effect that wheat in this vicinity has been injured by some root worm.—*July 19.* Codling moth (Carpocapsa pomonella Linn.) injury has been quite prevalent in early apples. Later varieties do not show as much damage. Fall webworm (Hyphantria textor Harr.) nests are to be seen in small numbers. Egg belts of tent caterpillars (Malacosoma americana Fabr.) are scarce. —*August 3*

Orleans county [Virgil Bogue, Albion] — Rose beetles (Macrodactylus subspinosus Fabr.) have been somewhat more abundant than usual, though the damage inflicted was not very great, due to the fact that the unusual growth of foliage more than counterbalanced their work. There are three breeding areas of this insect in the county, one is located 1 mile east of here, one in the southwest corner of the county and one 5 miles north of Medina. Potato beetles (Doryphora decim-lineata Say) are as abundant as usual. The trees have grown so vigorously that aphids have had little opportunity to inflict injury. Pear slugs (Eriocampoides limacina Retz.) have been unusually scarce owing to excessive rains. Late cherries have been exceptionally free from worms (probably the cherry maggot, Rhagoletis cingulata Loew).—*July 17*

Queens county [C. L. Allen, Floral Park] — Cutworms have been very destructive and are still doing a great deal of injury, cutting off all the early cabbages in many places and causing much mischief with tomatoes. Woolly maple leaf aphids (Pemphigus acerifolii Riley) have appeared in some numbers though they are not doing much injury.—*July 3*

Richmond county [David Muirhead, West New Brighton] — Potato beetles (Doryphora decim-lineata Say) are fairly abundant and correspondingly injurious. Cabbage butterflies (Pieris rapae Linn.) and cabbage worms are somewhat numerous, the latter inflicting more or less damage.—*July 16*

St Lawrence county [C. J. Locke, Ogdensburg] — Currant worms (Pteronus ribesii Scop.) appeared May 15 and larvae were at work July 1. Asparagus beetles (Crioceris asparagi Linn.) and the cottony maple scale (Pulvinaria innumerabilis Rathv.) were observed July 10. Black flea beetles (Epitrix cucumeris Harr.) are numerous and striped cucumber beetles (Diabrotica vittata Fabr.) were present in some numbers July 1. Fall webworms (Hyphantria textor Harr.) are rather numerous. Tussock moth larvae (Hemerocampa leucostigma Abb. & Sm.) are numerous and destructive on maples and elms.—*July 28*

Suffolk county [Frank E. Lutz, Cold Spring Harbor]—San José scale (Aspidiotus perniciosus Comst.) is greatly feared in this section and is apparently becoming generally distributed. The green striped grasshopper (Chortophaga viridifasciata DeGeer) was taken March 20.—*April 8.* Hyphantria textor Harr., Apantesis virgo Linn., Isia isabella Abb. & Sm. and Estigmene acraea Drury are still common at the trap lantern.—*June 10.* Asparagus beetles (Crioceris asparagi Linn. and C. duodecim-punctata Linn.) were observed, the former abundant, the latter rare. Potato beetles (Doryphora decim-lineata Say) occur in small numbers; the small black flea beetle (Epitrix cucumeris Harr.) is abundant and destructive on tomatoes. A dipterous larva (probably the radish miner Anthomyia radicum Linn.) is at work in radish roots.—*May 24.* The striped cucumber beetle (Diabrotica vittata Fabr.) is fairly abundant and the fall webworm moth (Hyphantria textor Harr.) is somewhat numerous at lights. The small black flea beetle was so abundant as to nearly destroy some petunias. The radish worms have been somewhat injurious in several localities, in at least one case almost destroying the crop. Rose beetles (Macrodactylus subspinosus Fabr.) are exceedingly abundant and destructive. The white marked tussock moth (Hemerocampa leucostigma Abb. & Sm.) is reported as causing a great deal of injury in Brooklyn.—*July 6.* Salt marsh mosquitos (Culicada sollicitans Walk.) were exceedingly abundant last week, though local marshes were well oiled. This is our usual end of the season's invasion from the south side.—*August 25*

Sullivan county [J. E. Barkley, Grahamsville] — Potato beetles (Doryphora decim-lineata Say) were observed May

27, and cucumber beetles (Diabrotica vittata Fabr.) were abroad May 23 in sufficient numbers, so that serious injury will result if they are not kept in check by poisoned sprays. Currant worms (Pteronus ribesii Scop.) are becoming very destructive to both currants and gooseberries. Hellebore and insect powder seem to be of little value compared with the arsenical spray. Ants of various kinds are proving very troublesome and promise to become as serious an annoyance as last year when they overran everything and it was almost impossible to protect victuals and other articles from their ravages.—*May 29.* The small black flea beetle (Epitrix cucumeris Harr.) is abundant on everything in the garden, particularly tomatoes and cucumbers though not very destructive. The currant worm is one of the most destructive species at present and the larder beetle (Dermestes lardarius Linn.) is quite numerous.—*June 6.* Potato beetles have appeared in small numbers and have been recorded as feeding on tomato plants. The striped cucumber beetle is at work on both squash and cucumber vines but is not doing much injury.— *June 10.* The striped cucumber beetle is very numerous and destructive.—*June 17.* The rose beetle (Macrodactylus subspinosus Fabr.) appeared in very large numbers during the last few weeks, attacking trees, grapevines and a large number of other plants. Previously they have been present in small numbers and their depredations confined largely to rosebushes. This year they occurred in swarms in some places, literally covering grapevines and fruit trees, exhibiting a decided partiality for plum. Potato beetles are not very abundant.—*June 24.* The white frothy masses of spittle insects (probably Philaenus lineatus Linn. and P. spumarius Linn.) are exciting considerable attention because of their abundance. Tent caterpillars (Malacosoma americana Fabr.) are unusually scarce. The small black flea beetles are very numerous on potatoes, tomatoes, cucumbers and other garden plants.—*June 27.* Potato beetles are very abundant and a second brood of currant worms has appeared. The striped cucumber beetle is present in some numbers and the black flea beetle has nearly disappeared. The latter is also true of the rose beetle. Horn flies (Haematobia serrata Rob.-Desv.) are present in swarms and are proving a serious annoyance to cattle.—*July 8.* Cabbage worms (Pieris rapae Linn.) are riddling cabbage plants. The striped cucumber beetle is fairly numerous on both cucumber and squash vines. Potato beetles still continue abundant though not so destructive as in earlier years.—*July 15.* Cabbage worms are very injurious. The striped cucumber beetle continues numerous. Potato beetles are still abundant though easily held in check with paris green. Squash bugs (Anasa tristis DeGeer) have not been observed this season though they are usually very destructive.—*July 22.* Cabbage worms continue their injuries. The house fly (Musca domestica Linn.) is becoming very abundant. The horn fly is exceedingly annoying to cattle; their sides and the base of their horns are often black with them.—*July 29.* Nests of the fall webworm (Hyphantria textor Harr.) are becoming quite abundant. Potato beetles have nearly disappeared. Very few squash bugs have been observed.—*August 12.* Fall webworms are becoming more abundant and destructive.—*August 26*

Warren county [C. L. Williams, Glens Falls] — Larvae of a small midge (Dasyneura pseudacaciae Fitch) have been exceedingly abundant in the leaves of a black locust hedge, some portions of which have been so badly infested that nearly every leaf was destroyed. This insect also works to a limited extent on larger trees.—*June 10.* Potato beetles (Doryphora decimlineata Say) are abundant. Rose beetles (Macrodactylus subspinosus Fabr.) are disappearing. The elm leaf beetles (Galerucella luteola Müll.) continue at work in this locality though they are not more abundant than last year. They are confined largely to the small European elm. There are signs of the insect's work on the trees all over town but only in this locality were specimens found at work. The rather rare galls of Pemphigus ulmifusus Walsh are somewhat prevalent on red elm.—*July 6*

Westchester county [F. R. Calkins, Ossining] — Potato beetles (Doryphora decim-lineata Say) appeared May 16 and many cabbage butterflies (Pieris rapae Linn.) were observed the 19th. The elm leaf beetle (Galerucella luteola Müll.) is present in unusually large numbers and the tops of many elms are nearly lifeless owing to the ravenous feeding of the beetles, which left nothing but the veins. The grass fields and lanes present a very peculiar appearance. There are large dead spots here and there and examination reveals no insects beneath (this may possibly be the work of grass webworms, Crambids). Peartrees are in very poor condition, many of them throwing out long suckers. This condition is probably due to psylla attack combined with severe injury from the extremely cold weather of winter before last. Tent caterpillars (Malacosoma americana Fabr.) appeared in larger numbers than last year. —*May 26.* The cottony maple aphis (probably Pemphigus acerifolii Riley) is abundant though not much injury has been inflicted at present. The insects are flying considerably. Striped cucumber beetles (Diabrotica vittata Fabr.) are increasing in numbers and elm leaf beetles are confining their operations largely to the tops of the trees. Cabbage worms are very abundant and corn root worms (?Diabrotica longicornis Say) are proving destructive. Tussock caterpillars (Hemerocampa leucostigma Abb. & Sm.) are exceedingly abundant and correspondingly injurious to the maples.—*July 2.* Mosquitos appeared for the first time in large numbers June 26. Black flea beetles (Epitrix cucumeris Harr.) are forsaking the tomato plants. Potato beetles are causing some trouble. Plant lice (Aphis mali Linn.) are proving quite injurious to appletrees.—*July 3.* Black flea beetles have again appeared in numbers on tomato plants and the tussock moth females are depositing eggs. Beans except limas are being severely injured by a small green louselike insect (possibly the garden flea, Smynthurus hortensis Fitch). The young of striped cucumber beetles are exceedingly abundant and plant lice have almost completely destroyed the foliage on many appletrees. It is very dry and hot and appears to be especially favorable to elm leaf beetles, as the fence tops and sidewalks are literally covered with the grubs seeking favorable places for the final changes to the beetle. The cottony maple aphis (Pemphigus acerifolii Riley) or the maple Phenacoccus (Phenacoccus acericola King) is proving quite injurious to maple foliage. Tussock moth larvae have devoured all but the main veins of many leaves.—*July 18.* Saddle-back caterpillars (Sibine stimulea Clem.) are unusually abundant on corn, devouring the leaves very rapidly.—*September 5*

Wyoming county [W. H. Roeper, Wyoming]—Forest tent caterpillars (Malacosoma disstria Hübn.) appeared May 9 and are remarkably scarce. The bud moth (Tmetocera ocellana Schiff.) has caused a great deal of injury in this locality and the codling moth (Carpocapsa pomonella Linn.) is inflicting some damage. Another insect (probably the steely flea beetle, Haltica chalybea Illig.) is working in grape buds and destroying them.—*June 5*

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1904. Sixty-two are given with the title,[1] place, time of publication and a summary of the contents of each. Volume and page number are separated by a colon, the first superior figure gives the column, and the second the exact place in the column in ninths: e. g. 69: 1076[15] means volume 69, page 1076, column 1, beginning in the fifth ninth, i. e. nearly two thirds of the way down.

Mosquitos or Culicidae of New York State. N. Y. State Mus. Bul. 79, Entomology 22 (Advance copies issued Oct. 29, complete bulletin with appendix mailed Dec. 10). 1904. 164p. 57 pl.

Contents

The following species are noticed: Anopheles punctipennis Say, A. maculipennis Meig., A. crucians Wied., Psorophora ciliata Abr., Janthinosoma musica Say, Culex squamiger Coq., C. fitchii Felt & Young, C. cantans Meig., C. sylvestris Theo., C. cantator Coq., C. sollicitans Walk., C. discolor Coq., C. jamaicensis Theo., C. taeniorhynchus Wied., C. confinis Arrib., C. annulatus Schrank, C. canadensis Theo., C. onondagensis Felt, C. atropalpus Coq., C. dyari Coq., C. territans Walk., C. lazarensis Felt & Young, C. cinereoborealis Felt & Young, C. consobrinus Felt, C. absobrinus Felt, C. magnipennis Felt, C. restuans Theo., C. pipiens Linn., C. abserratus Felt & Young, C. nemorosus Meig., C. salinarius Coq., C. trivittatus Coq., C. serratus Theo., C. dupreei Coq., C. triseriatus Say, C. aurifer Coq., C. melanurus Coq., Stegomyia signifer Coq., Taeniorhynchus perturbans Walk., Aedes fuscus Osten Sacken, A. smithii Coq., Uranotaenia sapphirina Osten Sacken, Corethrella brakeleyi Coq., Corethra karnerensis Felt, C. lintneri Felt, C. cinctipes Coq., Eucorethra underwoodi Undw., Sayomyia punctipennis Say, S. trivittata Loew, S. albipes Johans., S. rotundifolia Felt, S. americana Johans., S. hudsoni Felt, Culex abfitchii Felt.

The following genera are erected: Culicelsa, Culicada, Ecculex, Culicella, Culiseta and Protoculex.

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

Horticulture: Diseases and Pests. N. Y. State Lib. Bul. 87. Legislation 22. 1904. p.015-016

Review of legislation relating to plant diseases and insect pests in 1903.

Scurfy Bark Louse. Country Gentleman, Nov. 24, 1904, 69:1076[15]

Brief account with remedies for scurfy bark louse, Chionaspis furfura Fitch, and San José scale, Aspidiotus perniciosus Comst.

A New Lime Sulfur Wash. Country Gentleman, Dec. 1, 1904, 69:1115[12]

Method of preparing the lime-sulfur sal soda wash without boiling, and results therewith.

How to Kill the San José Scale. Garden Magazine, Feb. 1905, 1:22-23

Brief general account of San José scale, Aspidiotus perniciosus Comst., with special reference to remedial measures.

New York State Fruit Growers Association. Report of the Committee on Entomology. Country Gentleman, Feb. 2, 1905, 70:106

Summarized account of experiments against grape root worm, Fidia viticida Walsh, and San José scale, Aspidiotus perniciosus Comst.

A New Way of Killing San José Scale. Garden Magazine, Mar. 1905, p. 76

The value of the lime-sulfur and sal soda wash and kerosene limoid spray as remedies for the San José scale, Aspidiotus perniciosus Comst., discussed.

Insecticides and Fungicides. N. Y. S. E. D. Handbook 18, p.1-18, Jan. 1905

Revised edition giving principal formulas.

Culex brittoni *n. sp.* Ent. News, 16:79-80

Original description.

Controlling San José Scale. Country Gentleman, Mar. 16, 1905, 70:261[11]

Brief discussion of remedial measures; recommending a boiled lime-sulfur wash for the San José scale, Aspidiotus perniciosus Comst., with comments on the lime, sulfur, sal soda and other washes.

Getting the Poison Ready. Garden Magazine, 1:144[32]

Formulas for lime-sulfur washes and poisoned bordeaux mixture.

Martins for Mosquitos. Country Gentleman, Mar. 30, 1905, 70:296[26]

Importation of martins is discouraged because our native swallows are probably equally valuable in checking mosquitos.

Important Work in May. Garden Magazine, May 1905, p.200, 202

Methods of controlling common garden species with mention of arsenate of lead and kerosene emulsion.

Rose Beetles, Squash Bugs and Asparagus Beetles. Garden Magazine, June 1905, p.234[35]

Brief directions for control of common pests.

To Corn Planters. Country Gentleman, May 25, 1905, 70:492[22]. Also in Albany Evening Journal, Troy Times

Webworms, Crambus species, are unusually abundant and preventive measures for corn planters in particular, are given.

The Round Headed Apple Tree Borer. Country Gentleman, May 25, 1905, 70:501[12]

Descriptive life history of round headed appletree borer, Saperda candida Fabr., with methods of controlling it.

Webworm Depredations. Argus (Albany) May 28, 1904, p.4

Webworm Injuries. Country Gentleman, June 1, 1905, 70:513[11]

A brief account of present and earlier injuries with a discussion of remedial measures.

New York Entomologic Service. Country Gentleman, June 8, 1905, 70:537[15]

Summary of reports from voluntary observers.

Go for Cutworms. Country Gentleman, June 8, 1905, 70:540[23]

Remedial measures.

Report of the Committee on Entomology. New York State Fruit Growers Association Proc. 4th Ann. Meeting, 1905, p.27-30

Results obtained against the grape root worm, Fidia viticida Walsh, and with lime-sulfur washes in controlling San José scale, Aspidiotus perniciosus Comst.

San José Scale on the Move. Garden Magazine, July 1905, p.284

Warning notice giving formulas for summer washes for San José scale, Aspidiotus perniciosus Comst., and directions for controlling sundry other pests.

Hickory Gall Aphid. Country Gentleman, June 15, 1905, 70:564[42]

Observations upon and life history of hickory gall aphid, Phylloxera caryaecaulis Fitch.

New York Entomologic Service. Country Gentleman, June 15, 1905, 70:561[42]

Summary of reports.

Grape Root Worm, Fidia viticida Walsh. N. Y. State Entomologist, 20th Report. 1905. p.1-19 (issued June 19, 1905). Reprinted in part in Grape Belt (Dunkirk, N. Y.) June 27, 1905, p.7

Account of experiments and investigations during 1904.

Horticulture: Diseases and Pests. N. Y. State Library Bul. 97. Legislation 25. 1905. p.*08*-*010*

General review of legislation for 1904.

Cecropia Moth. Country Gentleman, June 22, 1905, 70:584[32]

Brief descriptive account of the cecropia moth, Samia cecropia Linn.

New York Entomologic Service. Country Gentleman, June 22, 1905, 70:585[12]; New York Farmer, June 22, 1905, p.5

Summary of reports from voluntary observers.

Perhaps Elm Leaf Beetle. Country Gentleman, June 22, 1905, 70:592[21]

Descriptive account with general remedial measures for elm leaf beetle, Galerucella luteola Müll.

Danger in the Use of Sprays. Country Gentleman, June 22, 1905, 70:592[26]

Careful spraying is not dangerous to fruit consumers when ordinary discretion is employed.

Cherry Aphid. Country Gentleman, June 29, 1905, 70:606[25]

Brief account of injuries and control measures for cherry aphid, Myzus cerasus Fabr.

New York Entomologic Service. Country Gentleman, June 29, 1905, 70:607[12]; New York Farmer, June 29, p.8

Summary of reports from voluntary observers.

Arsenical Poison for Elm Tree Beetles. Dayton (O.) Herald, July 1, 1905, p.4

A summarized account of the elm leaf beetle, Galerucella luteola Müll. with special reference to control methods.

May Flies and Midges of New York. N. Y. State Mus. Bul. 86. Entomology 23. 1905. 352p. 37pl. (issued July 3, 1905)

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New York Entomologic Service. Country Gentleman, July 6, 1905, 70:627[34]; New York Farmer, July 6, p.5

Summary of reports from voluntary observers.

North American Hydroptilidae. Reprint from N. Y. State Mus. Bul. 86. 1905. p.63-75. 3pl. (issued July 7)

Aquatic Nematocerous Diptera II. Reprint from N. Y. State Mus. Bul. 86. 1905. p.74-327. pl.16-37 (issued July 7)

New York Entomologic Service. Country Gentleman, July 13, 1905, 70:647[13]; New York Farmer, July 13, p.8

Summary of reports from voluntary observers.

Four pests in August. Garden Magazine, Aug. 1905, p.39

Remedies for fall webworm, Hyphantria textor Harr., San José scale, Aspidiotus perniciosus Comst., stalk borer, Papaipema nitela Guen. and ants.

Elm Leaf Beetle. Country Gentleman, July 20, 1905, 70:666[23]

Remedial measures for elm leaf beetle, Galerucella luteola Müll.

Notes for the Year in New York. U. S. Dep't Agric. Bureau of Ent. Bul. 52. 1905. p.51-52

Brief notices of several injurious species, with special mention of the Chinese lady beetle, Chilocorus similis Rossi, and the grape root worm, Fidia viticida Walsh.

Experiments with Lime-sulfur Washes. U. S. Dep't Agric. Bureau of Ent. Bul. 52. 1905. p.25-27

General observations on preparation and effects, with an account of the sal soda lime-sulfur wash.

New York Entomologic Service. Country Gentleman, July 20, 1905, 70:666[13]; New York Farmer, July 20, p.4

Summary of reports from voluntary observers.

Spittle Insects or Frog Hoppers. Country Gentleman, July 20, 1905, 70:669[13]

Brief general account of spittle insects, with mention of Philaenus spumarius Linn. and P. lineatus Linn.

Electric Light or Giant Water Bug. Country Gentleman, July 27, 1905, 70:689[21]

Records injury to ½ pound trout, with notes on habits of electric light or giant water bug, Belostoma americanum Leidy.

Woolly Maple-leaf Aphid. Country Gentleman, July 27, 1905, 70:689[27]

Records unusual abundance of woolly maple-leaf aphids, Pemphigus acerifolii Riley, with discussion of remedies.

An Army Worm Outbreak. Country Gentleman, July 27, 1905, 70:694[28]

Records injuries in Erie and Chautauqua counties and gives a general account of *Heliophila unipuncta* Haw., with discussion of remedial measures.

New York Entomologic Service. New York Farmer, July 27, 1905, p.8

Summary of reports from voluntary observers.

New York Entomologic Service. Country Gentleman, Aug. 3, 1905, 70:707[12]

Summary of reports from voluntary observers.

New York Entomologic Service. New York Farmer, Aug. 3, 1905, p.5

Summary of reports from voluntary observers.

New Yrok Entomologic Service. Country Gentleman, Aug. 10, 1905, 70:726[46]

Summary of reports from voluntary observers.

Trapping Squash Bugs. Country Gentleman, Aug. 17, 1905, 70:747[23]

Shingle method of trapping squash bugs, *Anasa tristis* DeGeer.

Experience in Controlling San José Scale in New York. Ct. Pom. Soc. Proc. 1905, p.132-46

Summarized account of work against the San José scale, *Aspidiotus perniciosus* Comst., with special discussion of lime-sulfur washes.

The Borers are Active. Garden Magazine, Sep. 1905, p.82

Directions for combating borers, specially apple borers, *Saperda candida* Fabr. and the leopard moth, *Zeuzera pyrina* Fabr., are given.

Fighting San José Scale. Country Gentleman, Aug. 24, 1905, 70:774[41]

Winter treatment with lime-sulfur washes advised for San José scale *Aspidiotus perniciosus* Comst., though whale oil soap is valuable. The selection of a spraying outfit must be governed by condition.

Plea for the Shade Trees. The Argus [Albany] Sep. 3, 1905, p.3, also in Albany Press & Knickerbocker, Sep. 3; Troy Times, Sep. 5; Cohoes Dispatch, Sep. 5; Utica Observer, Sep. 6; Utica Press, Sep. 4; Rome Sentinel, Sep. 5; Syracuse Post-Standard, Sep. 5; Geneva Times, Sep. 6; Rochester Democrat, Sep. 6; Rochester Post-Express, Sep. 8; Buffalo Commercial, Sep. 9; Buffalo Courier, Sep. 6; Lockport Journal, Sep. 12; Lockport

Union Sun, Sep. 5; New York Herald, Sep. 5; New York Post, Sep. 7; Newburgh Register, Sep. 11; Niagara Falls Gazette, Sep. 30; Rochester Union, Oct. 13

A brief general circular making a plea for the better protection of our shade trees.

Insects Dangerous as Disease Carriers. The Argus [Albany] Sep. 3, 1905, p.11; Amsterdam Recorder, Oct. 10, 1905

Brief résumé of the role of insects as disease carriers with special reference to malaria and yellow fever.

Moth Traps Again. Country Gentleman, Sep. 7, 1905, 70:814-15

Brief comments on the value of trap lanterns for insect control.

Spraying Apples. Country Gentleman, Sep. 14. 1905, 70:838[25]

Comments on the value of spraying, now considered established beyond question.

Stingless Bees. Country Gentleman, Sep. 21, 1905, 70:870[45]

Comments on the value of these bees in the United States.

Locust Borer. Country Gentleman, Sep. 28, 1905, 70:884[23]

Brief descriptive account of the locust borer, Cyllene robiniae Forst.

Gnarled Pears. Country Gentleman, Sep. 28, 1905, 70:885[23]

Control methods for plant lice and the tarnished plant bug, Lygus pratensis Linn. are given as possible remedies for deformed fruit.

Beech Blight. Country Gentleman, Oct. 12, 1905, 70:932[47]

Brief general notice of Pemphigus tessellata Fitch with mention of its interesting enemy, Feniseca tarquinius Fabr.

SPECIES ACQUIRED THROUGH EXCHANGE

An exchange list was prepared early in 1903 and sent to various entomologists, with the result that a number of valuable additions were made to the State collection. These lists were further elaborated in the report for that year and exchanges have been continued with mutual benefit. The following are lists of species acquired largely in 1905 though a few of the insects were received in 1904.

Mosquitos received in exchange

Grabhamia jamaicensis Theo., adults, pupae and larvae, **Prof. Glenn W. Herrick,** Agricultural College, Miss.

Theobaldia incidens Thom. and Culicada curriei Coq., **Prof. V. L. Kellogg,** Stanford University, Stanford, Cal.

Culicada annulifera Lud., Mansonia annulifera Theo., M. uniformis Theo. and Nyssorhynchus fuliginosus Giles, **C. S. Ludlow,** Surgeon General's office, Washington, D. C.

Anopheles *sp.*, Culicada squamiger Coq., C. curriei Coq., Culex tarsalis Coq. and Theobaldia incidens Thom., **H. J. Quayle,** University of California, Berkeley, Cal.

Culicada squamiger Coq., C. pretans Gross., C. punctor Kirby, C. dupreei Coq., Pneumaculex signifer Coq., Protoculex serratus Theo. and Wyeomyia smithii Coq., **Dr J. B. Smith,** State Entomologist, New Brunswick, N. J.

Taeniorhynchus aurites Theo., Culex fatigans Wied., and Pyretophorus costalis Loew., **Dr Andrew Balfour,** Director Gordon College Laboratories, Khartoum, Egypt.

Myzorhynchus sinensis Wied., Desvoidea obturbans Walk., Culex fatigans Wied. and Chironomids *sp.* from **M. Gist Gee**, Soochow, China.

Culicada cantans Meig. from Staeger's old collection, through **Dr F. Meinert,** Zoological Museum, Copenhagen, Denmark.

Other insects received in exchange

Dendroctonus piceaperda Hopk., Scirtes tibialis Guen., Cryptorhopalum triste Lec., Corticaria deleta Mann., Miris affinis Reut., Apiomerus crassipes Fabr., Cicada canicularis Harr., Stictocephala lutea Wlk., Empoasca mali LeB., Aleyrodes vaporariorum Westw., Saissetia hemisphaericum Targ-Tozz., Dichromorpha viridis Scudd., Arphia sulphurea Fabr., A. xanthoptera Burm., Scudderia curvicauda DeG., Schistocerca rubiginosa Harr., S. alutacea Harr., Gryllus pennsylvanicus Burm., Periplaneta americana Linn., Chrysopa oculata Say, **Dr W. E. Britton,** State Entomologist, New Haven, Ct.

Dorytomus mucidus Say, Chaetocnema confinis Cr., Orthaltica melina Horn., Disonycha xanthomelaena Dalm., Oedionychus gibbitarsis Say, Colaspis praetexta Say, Lachnosterna rubiginosa Lec., Aphodius inquinatus Hbst., Trypherus latipennis Germ., Telephorus bilineatus Say, Omosita colon Linn., Olibrus consimilis Marsh, Phalacrus politus Melsh., Oxytelus insignitus Grav., Laccophilus fasciatus Aube., L. proximus Say, Anisodactylus terminatus Say, A. verticalis Lec., A. rusticus Say, A. opaculus Lec., Selenophorus ellipticus Dej. , Harpalus herbivagus Say, H. caliginosus Fabr., Cratacanthus dubius Beauv., Zygoneura toxineura O. S., Leptocoris trivittatus Say, Coriscus punctipes Reut., Melanolestes picipes H.S., Podisus maculiventris Say, Euchistus variolarius P.B., Thyanta custator Fabr., Tettigonia bifida Say, T. hieroglyphica Say, Diedrocephala coccinea Forst., D. mollipes Say, Gypona flavilineata Fb., Platymetopius frontalis VanD., Deltocephalus inimicus Say, Limotettix exitiosus Uhl., Jassus olitorius Say, Stobera tricarinata Say, **E. S. Tucker,** Lawrence, Kan.

Epicauta cinerea Forst., Bruchus quadri-maculatus Fabr., Adimonia rufosanguinea Say, Diabrotica vittata Fabr., D. duodecim-punctata Oliv., Cerotoma trifurcata Forst., Doryphora decim-lineata Say, Ligyrus rugiceps Lec., Monocrepidius vespertinus Fabr., Phorbia fusiceps Zett., Hypoprepia fucosa Hübn., Utetheisa bella Linn., Oligia grata Hübn., Prodenia commelinae Sm. & Abb., P. ornithogalli Guenee *var.* B. praefica Grt., Mamestra laudabilis Guenee, Heliophila unipuncta Haw., H. phragmitidicola Guenee, Heliothis armiger Hübn., Schinia marginata Haw., Alabama argillacea Hübn., Drasteria erechtea Cram., Catocala viduata Guenee, Panapoda carneicosta Guenee, Homoptera lunata Dru. *var.* edusa Drury, Epizeuxis lubricalis Geyer, Sanninoidea exitiosa Say, Murgantia histrionica Hahn., Leptoglossus phyllopus Linn., Chrysomphalus tenebricosus Comst., C. obscurus Comst., Aspidiotus forbesi John, **Prof. Glenn W. Herrick,** Agricultural College, Miss.

Acrolophitus hirtipes Say., Amphitornus bicolor Thom., Cordillacris crenulata Brun., C. occipitalis Thom., Phlibostroma quadrimaculatum Thom., Chloealtis abdominalis Thom., Platybothrus brunneus Thom., Gomphocerus clepsydra Scudd., Stirapleura decussata Scudd., Ageneotettix scudderi Brun., Aulocara elliotti Thom., A. femoratum Scudd., Arphia tenebrosa Scudd., A. teporata Scudd., Chortophaga viridifasciata DeG., Hippiscus neglectus Thom., H. pardalinus Sauss., Metator maculosum Sauss., Dissosteira carolina Linn., Spharagemon aequale Say., S. collare Scudd., Derotmema haydeni Thom., Mestobregma kiowa Thom., M. pulchellum, Trimerotropis azurescens Brun., T. juliana Scudd., T. plattei Thom., T. monticola Sauss., T. suffusa Scudd., Circotettix lapidicola Brun., C. undulatus Thom., Hadrotettix trifasciatus Say., Aeoloplus turnbulli Brun., Melanoplus affinis Brun., M. alpinus Brun., M. altitudinum Scudd., M. bruneri Scudd., M. dawsoni Scudd., M. fasciatus Parnst., M. flabellifer Scudd., M. fluviatilis Brun., M. gladstoni Brun., M. infantilis Scudd., M. minor Scudd., M. packardi Scudd., Asemoplus montanus Brun., **Prof. R. A. Cooley,** State Entomologist, Bozeman, Mon.

Elaphrus riparius Oliv., Carabus genei Gene., Percus reichei Fairm., Haliplus lineatocollis Marsh., Bidessus geminus Fabr., Deronectes opatrinus Germ., Hydroporus griseostriatus DeG., H. lepidus Oliv., H. analis Aube., Gyrinus urinator Ill., Hister major Linn., H. quadri-maculatus Linn., H. sinuatus Fabr., Saprinus semipunctatus Fabr., S. nitidulus Payk., S. dimidiatus Ill., Lucanus servus Linn., Scarabeus sacer Linn., S. laticollis Linn., Copris hispanus Linn., Potosia metallica Payk., Lixus iridis Oliv., L. algirus Linn., L. cardui Oliv., Brachytemus porcatus Germ., Balaninus turbatus Gyll. Leptura rubra Linn., L. maculata Poda., Morimus asper Sulz., Colaspidea oblonga Blanch., Chrysomela polita Linn., Galerucella luteola Müll., Podagrica discedens Boield., Hispa atra Linn., Lema melanopus Linn., Diplognatha gagates, Onthophagus trituber, Hymantocera plumosa, Sternotomis regalis, S. imperialis, Pyllvenima latipes DeG., Prionocerus coevulipennis, Bruchus bimaculatus Oliv., Cryptorhynchus frigidus, Sphenophorus sordidus, **G. VanRoon,** Rotterdam, Holland.

Poecilus cupreus Linn., Amara atrata Heer., Harpalus aeneus Fabr., Metabletus pallipes Dej., Pardileus calceatus, Laccophilus obscurus Panz., Coelambus impressopunctatus Schall., Bidessus geminus Fabr., Cymatopterus fuscus Linn., Cybister laterimarginalis Deg., Hydrous piceus Linn., Limnoxenus oblongus Herbst., Cercyon quisquilius Linn., Heterocerus laevigatus Panz., Paederus fuscipes Curt., Oxytelus laqueatus Marsh., O. tetracarinatus Block., Anthobium sorbi Letzn., Bryaxis haematica Reichb., Silpha obscura Linn., Hister quadrinotatus Scriba., Copris lunaris Linn., Onthophagus ovatus Linn., Aphodius fimetarius Linn., Geotrupes mutator Marsh., G. sylvaticus Panz., G. vernalis Linn., Serica holosericea Scop., Anomala vitis Fabr., Epicometis hirta Poda. Agriotes sputator Rdtb., Plagionotus arcuatus Linn., Otiorhynchus gemmatus Scop., Baris lepidii Germ., Chrysomela sanguinolenta Linn., Subcoccinella vigintiquattuorpunctata Linn., **Robert Meusel,** Ujpest, Hungary.

CONTRIBUTIONS TO COLLECTION OCT. 17, 1904–OCT. 14, 1905

Hymenoptera

Tremex columba Linn., pigeon Tremex, larvae in beech, Ap. 20, **George S. Graves,** Newport, N. Y.

Pontania hyalina Nort., galls on willow, July 18, **Paul Hayhurst**, Dunkirk, N. Y.

Lophyrus abbotii Leach, Abbott's pine sawfly, larvae on pine, Sep. 6, **C. R. Pettis**, Saranac Inn, N.Y.

Coleoptera

Mardarellus undulatus Say, Mar. 11, **L. H. Joutel,** New York city.

Calandra oryzae Linn., adult on corn, Jan. 9, **Thomas Cunningham,** Victoria, B. C.

Bruchus rufimanus Sch., European bean weevil, adult on bean, Jan. 13, **Paul Hayhurst**, Columbia, Mo. (In beans presumably from Italy)

Cyllene robiniae Forst., locust borer, adult on honey locust, Sep. 25, **L. G. V. McDonough,** Newcastle co. Del. (Through Country Gentleman)

Plagionotus speciosus Say, sugar maple borer, adult, July 1, **Frederick Pfahl,** Albany, N. Y.

Uliota dubius Fabr., Ap. 5, **J. T. Brakeley,** Hornerstown, N. J.

Dytiscus harrisii Kirby, margined water beetle, May 19, **J. D. Collins,** Utica, N. Y.

A number of undetermined South African species were kindly donated to the collection by **Ogden Stevens,** Albany.

Diptera

Rhagoletis pomonella Walsh, apple maggot, maggots in apple, Aug. 8, **C. H. Stuart,** Newark, N. Y.

Oedaspis polita Loew., adult on Solidago juncea, Sep. 1, **Miss Harriet B. Badeau,** Matteawan, N. Y.

Straussia longipennis Wied. on pepper, May 14, **George S. Graves,** Newport, N. Y.

Pollenia rudis Fabr., Oct. 3, **M. R. Wilbur,** Old Chatham, N. Y.

Bombyliomyia abrupta Wied., parasite fly, July 22, **Hamilton B. Brown,** Elmira, N. Y.

Deromyia umbrinus Lowe, robber fly, adult, July 31, **O. Q. Flint,** Athens, N. Y.

Cecidomyia antennaria Wheeler, galls on Antennaria plantaginifolia, Sep. 10, **S. H. Burnham,** Little Falls, N. Y.

Dasyneura pseudacaciae Fitch, black-locust midge galls on black-locust, June 10, **C. L. Williams,** Glens Falls, N. Y.

Cecidomyia sp., galls on Eupatorium ageratoides, Sep. 10, **S. H. Burnham,** Little Falls, N. Y.

Lasioptera vitis O. S., grape tomato gall, Aug. 4, **H. A. Van Fredenberg,** Port Jervis, N. Y.

Anopheles franciscanus McCracken, Dec. 20, **H. G. Dyar,** Washington, D. C.

Anopheles maculipennis Meig., adult, Jan. 10, **Henry Clay Weeks,** Ithaca, N. Y.

Cycloleppteron grabhamii Theo., male and female, larvae, Mar. 29, and adult, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

Cellia albipes Theo., males, females and larvae, Mar. 29, **M. Grabham,** Kingston, Jamaica, W. I.

Janthinosoma musicum Say, Dec. 20, **H. G. Dyar,** Washington, D. C.

Grabhamia jamaicensis Theo., adult, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

Grabhamia pygmaea Theo., adult, Sep. 18, **M. Grabham**, Kingston, Jamaica, W. I.

Culicelsa taeniorhynchus Wied., females and larvae, Mar. 29, **M. Grabham,** Kingston, Jamaica, W. I. Same, adult, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

Culicada canadensis Theo., young larvae, Mar. 31, **J. T. Brakeley,** Hornerstown, N. J. Same, larvae, Ap. 17, **W. T. Davis,** Staten Island, N. Y.

Culicada curriei Coq., Dec. 20, **H. G. Dyar,** Washington, D. C.

C. varipalpus Coq., Dec. 20, **H. G. Dyar,** Washington, D. C.

C. pretans Grossbeak, adults, Jan. 9, **W. E. Britton,** New Haven, Ct.

C. triseriatus Say, very young larvae from a tree hole, Ap. 18, **F. E. Lutz,** Cold Spring Harbor, L. I.

C. pullatus Coq., Dec. 20, **H. G. Dyar,** Washington, D. C.

C. abserratus Felt & Young, adult, Jan. 9, **W. E. Britton,** New Haven, Ct.

Culicella melanurus Coq., larva, Mar 31, **J. T. Brakeley,** Hornerstown, N. J.

Culex fatigans Wied., adults, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

C. restuans Theo., July 27, **C. R. Pettis,** Lake Clear, N. Y.

C. tarsalis Coq., Dec. 20, **H. G. Dyar,** Washington, D. C.

C. confirmatus Arri., males and females, Mar. 29, **M. Grabham,** Kingston, Jamaica, W. I.

C. janitor Theo., adult, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

C. secutor Theo., Dec. 20, **H. G. Dyar,** Washington, D. C. Same, adults, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

C. microsquamosus Theo., adults and larvae, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

Melanoconion atratus Theo., males, females and larvae, Mar. 29, **M. Grabham,** Kingston, Jamaica, W. I.

Taeniorhynchus perturbans Walk., adult, Jan. 9, **W. E. Britton,** New Haven, Ct.

Stegomyia fasciata Fabr., Dec. 20, **H. G. Dyar,** Washington, D. C. Same, June 13, **Arthur I. Kendall,** Panama.

Pneumaculex signifer Coq., adults, Jan. 2, **Nathan Banks,** Washington, D. C. Same, Dec. 20, **H. G. Dyar,** Washington, D. C.

Deinocerites cancer Theo., Dec. 20, **H. G. Dyar,** Washington, D. C. Same, females and larvae, Mar. 29, **M. Grabham,** Kingston, Jamaica, W. I.

Uranotaenia lowii Theo., adults and larvae, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

U. socialis Theo., males, females and larvae, Mar. 29, **M. Grabham,** Kingston, Jamaica, W. I.

Wyeomyia smithii Coq., larvae, Mar. 31, **J. T. Brakeley,** Hornerstown, N. J. (Abundant sending Ap. 2). Same, June 27, **George E. Casler,** Haymarsh. (Haymarsh is ½ mile east of Crooked Pond)

Dendromyia mitchellii Theo., adults, Sep. 18, **M. Grabham,** Kingston, Jamaica, W. I.

Howardina walkeri Theo., female and larvae, Mar. 29, **M. Grabham,** Kingston, Jamaica, W. I. Same, Dec. 20, **H. G. Dyar,** Washington, D. C.

Megarhinus portoricensis Roeder, Dec. 20, **H. G. Dyar, Washington, D. C.**

Corethrella brakeleyi Coq., larvae, Mar. 31, **J. T. Brakeley,** Hornerstown, N. J.

Tipula abdominalis Say, larvae, Ap. 24, **J. T. Brakeley,** Hornerstown, N. J.

Lepidoptera

Noctua clandistina Harr., W-marked cutworm on pine, May 15, **C. R. Pettis,** Saranac Junction, N. Y.

Papaipema nitela Guen., stalk borer on tomatoes and scarlet runner beans, June 20, **H. B. Chown,** Falls Village, Ct.

Drasteria erechtea Cramer, clover semilooper caterpillar, Aug. 12, **James E. Barkley,** Grahamsville, N. Y.

Melalopha inclusa Hübn., poplar nest worm, larvae on cottonwood, Sep. 15, **Dr M. W. VanDenburg,** Mt Vernon, N. Y.

Symmerista albifrons Sm. & Abb., red-headed oak worm, larvae on maple, Sep. 14, **C. E. Eldridge,** Leon, N. Y.

Hemerocampa leucostigma Sm. & Abb., white marked tussock moth, larvae, July 8, **L. L. Woodford,** Pompey, N. Y. Same, half grown caterpillar, July 15, **F. E. Fitch,** Randolph, N. Y. Same, young, cocoon and egg mass, Aug. 7, **Dr M. W. VanDenburg**, Mt Vernon, N. Y.

Thyridopterix ephemeraeformis Haw., bag worm, cocoons on Arbor vitae, Jan. 16, **Hermann VonSchrenck,** St Louis, Mo. Same, on purple beech, July 31, **Joseph H. Dodge,** New York.

Sibine stimulea Clem., saddle back caterpillar, larva on corn, Sep. 6, **Frank R. Calkins,** Ossining, N. Y.

Phobetron pithecium Sm. & Abb., hag moth, larva on bitter sweet, Sep. 5, **Miss M. R. Wilbur,** Old Chatham, N. Y.

Lithacodes fasciola Herrick & Schafer, larva, Aug. 3, **G. S. Graves,** Newport,N. Y.

Memythrus polistiformis Harr., larvae on grape, Nov. 30, **Mrs A. Rogers,** Hyde Park, N. Y. (Through **Thomas P. Connor,** gardener)

Enarmonia prunivora ? Walsh., larvae on apple, Feb. 5, **T. Cunningham,** Vancouver, B. C.

Ecdytolopha insiticiana Zell., locust twig gall on locust, Sep. 27, **Dr Frank Overton**, Patchogue, N. Y.

Anarsia lineatella Zell., work on cherry, Oct. 5, **P. L. Huested,** Blauvelt, N. Y.

Nepticula castaneaefoliella ? Chamb. on chestnut, Aug. 23, **R. H. Johnson,** Cold Spring Harbor, L. I.

Tischeria malifoliella Clem., apple leaf miner, larva on apple, Sep. 11, **T. F. Niles,** Lockport, N. Y. (Through N. Y. State Dep't Agric.)

Hemiptera

Clastoptera proteus Fitch, spittle insect, young on Cornus, June 28, **George T. Powell,** Ghent, N. Y.

Ptyelus ? lineatus Linn., spittle insect, nymph and adult on grass, June 20, **J. P. VanNess,** East Greenbush, N. Y.

Cicada sp., Jan. 6, **George D. Miller,** China.

Belostoma americanum Leidy, giant water bug on trout, adult, July 5, **E. J. Casler,** Hoffmeister, Hamilton co., N. Y. Same, Sep. 19, **H. H. DeyErmand,** Albany, N. Y.

Phylloxera caryaecaulis Fitch, hickory gall aphid, galls and young on hickory, June 5, **Dr J. B. Southworth,** Nassau, N. Y.

P. vitifoliae Fitch, grape Phylloxera on grape, July 21, **Dr J. B. Southworth,** Nassau, N. Y.

Pemphigus acerifolii Riley, woolly maple leaf aphid, adult on maple, June 28, **Mrs D. H. Bayard,** Cornwall on the Hudson, N. Y. Same, on soft maple foliage, July 3, **Prof. C. H. Peck,** Menands, N. Y.

P. imbricator Fitch, beech blight, nymphs and adults on beech, Sep. 9, **F. M. Foote,** Chester, Mass. (Through *Country Gentleman*).

P. rhois Fitch, sumac gall, adult on sumac, Sep. 10, **S. H. Burnham,** Little Falls, N. Y.

P. ulmifusus Walsh, spindle-shaped elm gall, on cork or rock elm, July 6, **C. L. Williams,** Glens Falls, N. Y.

Lachnus smilacis Will., on smilax, July 24, **George S. Graves,** Newport, N. Y.

Callipterus betulaecolens, birch aphid on birch, June 20, **C. H. Stuart,** Newark, N. Y.

Chrysomphalus smilacis Comst., on smilax, Mar. 30, **E. B. Southwick,** New York.

C. tenebricosus Comst., gloomy scale on hackberry, May 15, **Mrs P. L. Windsor,** Austin, Tex.

Eulecanium nigrofasciatum Perg., black-banded scale on maple, Ap. 6, **E. B. Southwick,** New York.

Phenacoccus acericola King, maple Phenacoccus on maple, Aug. 12, **R. A. Kenworthy,** Poughkeepsie, N. Y. Same, on maple, Aug. 15, **C. F. Polk,** Troy, N. Y.

Eriopeltis coloradensis Ckll. on grass, Dec. 19, **Theo. D. A. Cockerell,** Boulder, Col.

Eulecanium quercifex Fitch, on chestnut, June 2, **Eliza S. Blunt,** New Russia, N. Y.

Tachardia glomerella Ckll. on gutienesia, Dec. 19, **Theo. D. A. Cockerell,** Mesilla valley, N. M.

The following species of Hemiptera were received from **Mr J. R. de la Torre Bueno,** who collected them in the vicinity of New York city. The determinations were kindly made by Mr E. P. VanDuzee of Buffalo, and Mr O. Heidemann, through the courtesy of Dr L. O. Howard of Washington: Lopidea media Say, Neurocolpus nubilus Say, Phytocoris pallidicornis Reut., P. eximus Reut., Stiphrosoma stygica Say, Poecilocapsus affinis Reut., P. goniphorus Say, Systratiotus venaticus Uhl., Orthops scutellatus Uhl, Plagiognathus obscurus Uhl, P. politus Uhl, Chlamydatus (Agalliastes) verbasci H.S., Episcopus ornatus Reut., Deraeocoris segusinus Muell., Onychumenus decolor Fall., Agalliastes associatus Uhl., A. suavis Reut., Diommatus congrex Uhl., Stenotus (Oncognathus) binotatus Fabr., Orthometrops decorata and Salda ligata Say.

Orthoptera

Gryllotalpa borealis Burm., mole cricket, adult, Aug. 15, **Hugh H. DeyErmand,** Albany, N. Y.

Aracnida

Tetranychus telarius Linn., red spider on apple, July 27, **William H. Hart,** Poughkeepsie, N. Y. Same, on elm, Aug. 4, **F. J. H. Kracke,** New York.

Eriophyes fraxiniflora ash flower gall on ash, June 24, **H. G. Pauli,** Brooklyn, N. Y.

EXPLANATION OF PLATES

PLATE I

Row of soft maples badly injured by the leopard moth, *Zeuzera pyrina* Fabr. Astoria, L. I., 1900

Plate 1

Work of leopard moth

PLATE 2

White birch killed by bronzed birch borer, *Agrilus anxius* Gory.
Photograph by M. F. Adams

Plate 2

Work of bronze birch borer

PLATE 3

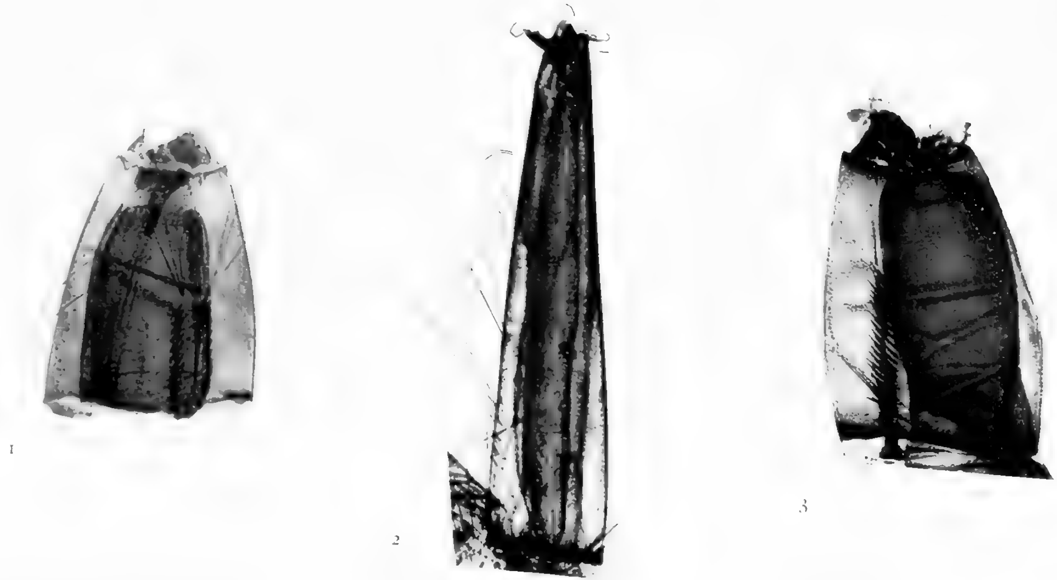
Air tubes of Culicid larvae

1 Air tube of larva of yellow fever mosquito, Stegomyia fasciata Fabr. x55

2 Air tube of larva of house or rain barrel mosquito, Culex pipiens Linn. x55

3 Air tube of larva of salt marsh mosquito, Culex sollicitans Walk. x45

Plate 3



Air tubes of mosquito larvae

PLATE 4

Culicid wings

1 Female wing of house or rain barrel mosquito, Culex pipiens Linn. x21

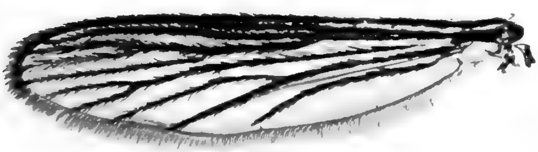
2 Female wing of malarial mosquito, Anopheles maculipennis Meig. x21

3 Female wing of yellow fever mosquito, Stegomyia fasciata Fabr. x21

Plate 4

1

2



3

Wings of mosquitos

PLATE 5

1 Washtubs under rain spout, containing numerous mosquito larvae

2 A spring-fed, easily drained, roadside pool producing hundreds of malarial mosquitos

Plate 5

1

2

Breeding places of mosquitos

PLATE 6

1 Recently excavated spring pool swarming with wrigglers of malarial and other mosquitos, though before digging Culicid larvae were rare

2 An Adirondack beaver meadow, the home of the pitcher plant mosquito, W y e o m y i a s m i t h i i Coq.

Plate 6

1

2

Breeding places of mosquitos

PLATE 7

1 Several pitcher plants in which Wyeomyia breeds

2 An Adirondack woodland road which fairly swarms with mosquitos during warm weather

Plate 7

I

Breeding places of mosquitos

PLATE 8

1 An Adirondack stream haunted by thousands of mosquitos

2 A new ditch being excavated on salt marshes near Lawrence, L. I., showing perpendicular sides and level bottom.

Plate 8

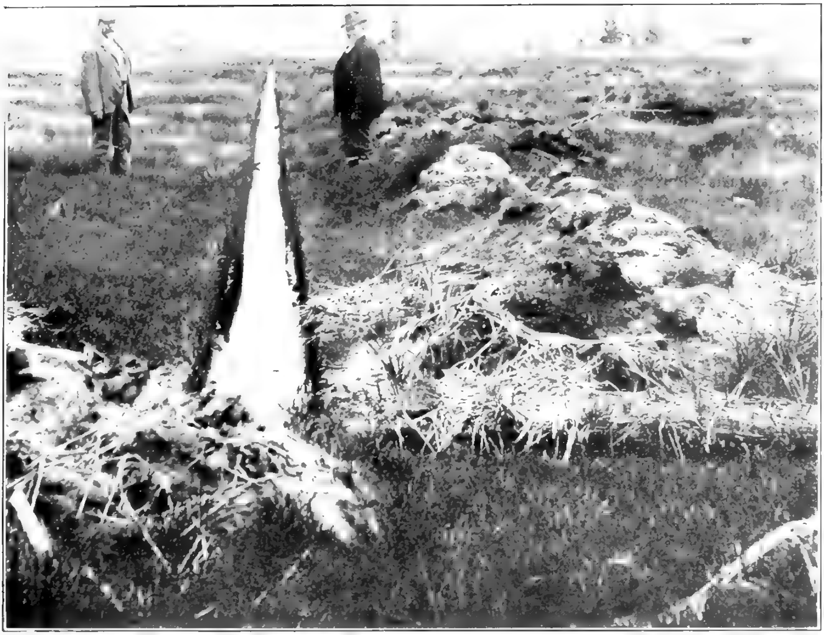
Mosquito haunts: ditching salt marsh

PLATE 9

1 Recent salt marsh ditches near Lawrence, L. I., partly filled with the tide

2 A salt marsh ditch at Lawrence, L. I., dug four years ago, showing grass hanging over and in places meeting, otherwise the ditch is in excellent shape

Plate 9



Salt marsh ditches

PLATE 10

1 A drained breeding pool on salt marshes near Lawrence, L. I. This pool is some 30 or 40 feet from a ditch and illustrates nicely the efficacy of such drainage

2 A salt marsh ditch near Lawrence, L. I., with sloping sides and slanting bottom; a very unsatisfactory type.

Plate 10

Drained breeding pool and main distributary ditch in salt marsh

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The superior figures tell the exact place on the page in ninths; e.g. 98^3 means page 98, beginning in the third ninth of the page, i.e. about one third of the way down.

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Museum bulletin 105

9 Report of the State Botanist 1905

Published monthly by the
New York State Education Department

BULLETIN 381 AUGUST 1906

New York State Museum

JOHN M. CLARKE Director

CHARLES H. PECK State Botanist

Bulletin 105

BOTANY 9

REPORT OF THE STATE BOTANIST 1905

New York State Education Department

Science Division, January 2, 1906

Hon. Andrew S. Draper LL.D.

Commissioner of Education

SIR: I herewith transmit for publication as a bulletin of the State Museum the annual report of the State Botanist for the year ending September 30, 1905.

Very respectfully

JOHN M. CLARKE

Director

Approved for publication, January 5, 1906

A. S. Draper

Commissioner of Education

New York State Museum

John M. Clarke Director
Charles H. Peck State Botanist

Bulletin 105

BOTANY 9

REPORT OF THE STATE BOTANIST 1905

To John M. Clarke, Director of Science Division:

I have the honor of submitting to you the following report of work done in the botanical department of the State Museum during the year 1905.

Specimens of plants for the State herbarium have been collected in the counties of Albany, Allegany, Essex, Livingston, Rensselaer, Saratoga, Steuben, Suffolk, Warren and Wyoming. Specimens have been contributed that were collected in the counties of Albany, Chautauqua, Columbia, Fulton, Herkimer, Monroe, Oneida, Onondaga, Orleans, Oswego, Queens, Rensselaer, Suffolk, Tompkins, Warren, Washington, Wayne and Westchester. Specimens have also been contributed or sent for identification that were collected in the states of California, Connecticut, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, North Carolina, Pennsylvania and Virginia; also in the District of Columbia, and in the country of Mexico and the provinces of Alberta, British Columbia, New Brunswick and Ontario.

The number of New York species added to the herbarium is 277. Of these, 76 are new to the herbarium. A list of the names of these species may be found under the title "Plants added to the herbarium."

The number of contributions received, including specimens sent for identification, when their character and condition was such as to make their preservation desirable, is 63. A list of the names of the contributors and their respective contributions is given under the title "Contributors and their contributions."

One of the most notable of these contributions consists of a bell jar containing about 6 quarts of dried specimens of an edible mushroom which is found in China and Japan growing on oak branches. A cabinet case about 4 feet long and 2 feet wide, containing four oak branches bearing specimens of the mushroom in place and showing their mode of growth, forms a part of the contribution. There are certain marks on the branches indicating that the mushroom is cultivated. These specimens had been on exhibition at the Louisiana Purchase Exposition at St Louis and at the close of the fair they were presented to the New York State herbarium by the Osaka Mushroom Merchants Association. The botanical name of the mushroom is Pleurotus bretschneideri, the common Japanese name is Shiitake.

The number of species added to the flora of the State is 82. Some of these have before been recorded as varieties of various species, but recently they have been raised to specific rank and they are herein reported as species. Of the 82 additions, 41 are considered new species and are described as such in this report. Of the new species, 19 belong to the genus Crataegus and are described in a chapter entitled "Species of Crataegus found within 20 miles of Albany." The remaining 22 are fungi. A chapter on species not before reported contains the names of the species new to our flora, descriptions of the new species not elsewhere described in this report and remarks concerning the others with the names of the places where and the times when the specimens were collected.

A record of new stations of rare plants and of persistence in old stations, descriptions of new varieties and remarks concerning peculiar and distinguishing features of closely related species may be found under the title "Remarks and observations." In this chapter 38 species are noticed.

The investigation of our species of Crataegus has been continued. In the study of our species in the vicinity of Albany I deem myself fortunate in having had the expert aid of Prof. C. S. Sargent, our highest authority on this, our largest and most difficult genus of trees and shrubs. He has visited with me some of the most prolific and interesting localities and personally examined the trees and shrubs in their place of growth and has kindly identified others from specimens sent him. He has named and described the new species reported in the chapter on species of Crataegus found within 20 miles of Albany and has prepared the bibliographic references of the others. Specimens collected in other parts of the State have not yet been fully identified. The number of species of this genus already identified and known to belong to our flora is 89.

The number of species of plants identified for correspondents and others who have sent or brought specimens to the office of the Botanist for this purpose is 601. The number of persons for whom identifications have been made is 86.

The work of testing our wild mushrooms for their edible qualities has been continued. The number of species tried and approved is 11. Descriptions of these have been written and constitute a chapter on edible fungi. They are illustrated on 10 plates by colored figures of natural size. Similar figures of four new species of fungi have been prepared on two plates. The number of species and varieties of New York edible mushrooms figured and described up to the present time is 172.

Mr Stewart H. Burnham was employed as temporary assistant during July, August and September. He continued the work begun by him last year and was chiefly engaged in disinfecting, arranging and labeling specimens. He also assisted in conducting the correspondence of the office and in the identification of specimens sent by correspondents.

Respectfully submitted

CHARLES H. PECK

State Botanist

Office of the State Botanist

Albany October 1, 1905

SPECIES ADDED TO THE HERBARIUM

New to the herbarium

Aecidium trientalis *Tranz.*
Anthostoma gastrina (*Fr.*) *Sacc.*
Boletus acidus *Pk.*
Clavaria conjuncta *Pk.*
Clitopilus squamulosus *Pk.*
Coccospora aurantiaca *Wallr.*
Cortinarius rubripes *Pk.*
Crataegus acuminata *Sarg.*
C. ambrosia *Sarg.*
C. asperifolia *Sarg.*
C. beckiana *Sarg.*
C. casta *Sarg.*
C. caesariata *Sarg.*
C. conspicua *Sarg.*
C. contortifolia *Sarg.*
C. demissa *Sarg.*
C. divergens *Sarg.*
C. eatoniana *Sarg.*
C. edsoni *Sarg.*
C. flagrans *Sarg.*
C. genialis *Sarg.*
C. halliana *Sarg.*
C. helderbergensis *S.*
C. howeana *Sarg.*
C. hystricina *Ashe*
C illuminata *Sarg.*
C. mellita *Sarg.*
C. menandiana *Sarg.*
C. oblongifolia *Sarg.*
C. peckietta *Sarg.*
C. pentandra *Sarg.*
C. polita *Sarg.*
C. rhombifolia *Sarg.*
C. robbinsiana *Sarg.*
C. rubrocarnea *Sarg.*
C. sejuncta *Sarg.*
Entoloma flavifolium *Pk.*
Erinella raphidospora (*Ellis*)
Exoascus cecidomophilus *Atk.*
Geopyxis nebulosa (*Cke.*) *Sacc.*
Geranium sibiricum *L.*
Gloeosporium riessii *S. & S.*
Hydnum cyaneotinctum *Pk.*
Hypomyces camphorati *Pk.*
H. lateritius (*Fr.*) *Tul.*
Inocybe diminuta *Pk.*
I. radiata *Pk.*
Lachnella flammea (*A. & S.*) *Fr.*
Lactarius rimosellus *Pk.*
Lentinus spretus *Pk.*
Leptosphaeria substerilis *Pk.*
Marasmius longistriatus *Pk.*
Melanogaster durissimus *Cke.*
Melanthium latifolium *Desr.*
Merulius pruni *Pk.*
M. ulmi *Pk.*
Oligonema nitens (*Lib.*) *Rost.*
Panus fulvidus *Bres.*
Perichaena quadrata *Macb.*
Phyllosticta pallidior *Pk.*
Physoderma menyanthis *DeBy.*
Pluteus grandis *Pk.*
Polyporus underwoodii *Murr.*
Psathyra vestita *Pk.*
Russula subsordida *Pk.*
R. viridella *Pk.*
Sporotrichum anthophilum *Pk.*
Stropharia melasperma (*Bull.*)
Tilmadoche compacta *Wing.*
Tricholoma paeonium *Fr.*
T. unifactum *Pk.*
Uredinopsis atkinsoni *Magn.*
U. osmundae *Magn.*
Verbascum phlomoides *L.*
Veronica chamaedrys *L.*
Zygodesmus pallidofulvus *Pk.*

Not new to the herbarium

Acer pennsylvanicum *L.*
A. saccharum *L.*
Aecidium pentstemonis *Schw.*
Agaricus abruptibulbus *Pk.*
A. arvensis *Schaeff.*
A. campester *L.*
Amanita frostiana *Pk.*
A. phalloides *Fr.*
A. rubescens *Fr.*
A. russuloides *Pk.*
A. solitaria *Bull.*

Amanitopsis vaginata (*Bull.*) *Roze*
A. volvata (*Pk.*) *Sacc.*
Amelanchier oligocarpa (*Mx.*)
Aralia nudicaulis *L.*
Arctium lappa *L.*
Artemisia caudata *Mx.*
Asplenium eben. hortonae *Dav.*
A. eben. incisum *Howe*
Betula lenta *L.*
B. papyrifera *Marsh.*
B. populifolia *Marsh.*
Bidens bipinnata *L.*
Boletus aureipes *Pk.*
B. bicolor *Pk.*
B. castaneus *Bull.*
B. chromapes *Frost*
B. chrysenteron *Fr.*
B. felleus *Bull.*
B. frostii *Russ.*
B. rugosiceps *Pk.*
B. russellii *Frost*
B. subaureus *Pk.*
Bovista plumbea *Pers.*
Bulgaria rufa *Schw.*
B. rufa magna *Pk.*
Cassia chamaecrista *L.*
C. nictitans *L.*
Chimaphila umbellata (*L.*) *Nutt.*
Cicuta maculata *L.*
Clitocybe ochropurpurea *Berk.*
Clitopilus noveboracensis *Pk.*
C. prunulus (*Scop.*) *Fr.*
Collybia dryophila (*Bull.*) *Fr.*
Cornus amomum *Mill.*
C. candidissima *Marsh.*
C. circinata *L'Her.*
Cortinarius amarus *Pk.*
C. bolaris (*Pers.*) *Fr.*
C. corrugatus *Pk.*
C. heliotropicus *Pk.*
C. semisanguineus (*Fr.*)
C. torvus *Fr.*
Crataegus acclivis *Sarg.*
C. champlainensis *Sarg.*
C. coccinea *L.*
C. durobrivensis *Sarg.*
C. ferentaria *Sarg.*
C. gemmosa *Sarg.*
C. oxyacantha *L.*
C. succulenta *Lk.*
Drosera rotund. comosa *Fern.*
Elatine americana (*Pursh*) *Arn.*
Entomosporium maculatum *Lev.*
Epipactis viridiflora (*Hoffm.*)
Equisetum hyemale *L.*
E. variegatum *Schleich.*
Fomes conchatus (*Pers.*) *Fr.*
F. rimosus *Berk.*
Gentiana quinquefolia *L.*
Gyromitra esculenta (*Pers.*) *Fr.*
Gyrostachys gracilis (*Bigel.*)
Hibiscus moscheutos *L.*
Hicoria glabra (*Mill.*) *Britton*
Hordeum hexastichon *L.*
Hydnum albonigrum *Pk.*
H. aurantiacum *A. & S.*
H. caput-ursi *Fr.*
H. mucidum *Pers.*
H. rufescens *Pers.*
H. schiedermayeri *Heuf.*
H. scrobiculatum *Fr.*
H. septentrionalis *Fr.*
H. spongiosipes *Pk.*
H. vellereum *Pk.*
Hygrophorus peckii *Atk.*
Hypholoma perplexum *Pk.*
Hypocrea citrina (*Pers.*) *Fr.*
Hypomyces lactifluorum (*Schw.*)
Ilex vert. cyclophylla *Robins.*
Inocybe flocculosa *Berk.*
Iris pseudacorus *L.*
Irpex nodulosus *Pk.*
Juglans cinerea *L.*
Juncus brachycephalus (*Engelm.*)
Lactarius brevis *Pk.*
L. camphoratus (*Bull.*)
L. fuliginosus *Fr.*
L. indigo *Schw.*
L. parvulus *Pk.*
L. scrobiculatus (*Scop.*)
L. serifluus (*DC.*) *Fr.*
L. sordidus *Pk.*
L. subdulcis (*Bull.*) *Fr.*
L. trivialis *Fr.*
L. vellereus *Fr.*
Lathyrus maritimus (*L.*) *Bigel.*
L. ochroleucus *Hook.*
Lentinus cochleatus *Fr.*
Lenzites sepiaria *Fr.*
Lychnis chalcedonica *L.*
Lysimachia quadrifolia *L.*
L. vulgaris *L.*

Marasmius oreades *Fr.*
M. salignus *Pk.*
M. scorodonius *Fr.*
M. siccus *Schw.*
M. subnudus (*Ellis*) *Pk.*
Monarda mollis *L.*
Monilia fructigena *Pers.*
Onosmodium carolinianum (*Lam.*)
Otidea onotica ochracea *Fr.*
Panus torulosus *Fr.*
Peramium repens (*L.*) *Salisb.*
Peltigera aphthosa (*L.*) *Hoffm.*
Phallus duplicatus *Bosc*
Pholiota comosa *Fr.*
P. squarrosoides *Pk.*
P. vermiflua *Pk.*
Phytolacca decandra *L.*
Phylloporus rhodoxanthus (*Schw.*)
Picea brevifolia *Pk.*
P. rubens *Sarg.*
Pleurotus cornucopioides *Pers.*
P. ostreatus (*Jacq.*) *Fr.*
Polyporus berkeleyi *Fr.*
P. frondosus *Fr.*
P. schweinitzii *Fr.*
P. sulphureus (*Bull.*) *Fr.*
Polystictus circinatus *Fr.*
P. simillimus *Pk.*
Prunus americana *Marsh.*
P. virginiana *L.*
Pterospora andromedea Nutt.
Pyrola secunda *L.*
Rhus glabra *L.*
Ribes prostratum *L'Her.*
Roestelia aurantiaca *Pk.*
Rhynchospora glomerata (*L.*) *Vahl*
Rubus neglectus *Pk.*
Russula albida *Pk.*
R. decolorans *Fr.*
R. emetica *Fr.*
R. flavida *Frost*
R. mariae *Pk.*
R. sordida *Pk.*
R. sororia *Fr.*
R. uncialis *Pk.*
R. variata *Banning*
R. virescens (*Schaeff.*)
Salix lucida *Muhl.*
S. serissima (*Bail.*) *Fern.*
Solenia villosa *Fr.*
Stereum sericeum *Schw.*
Strobilomyces strobilaceus (*Scop.*)
Stropharia semiglobata (*Batsch*)
Thelephora intybacea *Pers.*
T. laciniata *Pers.*
Tilia vulgaris *Hayne*
Trametes pini (*Brot.*) *Fr.*
T. trogii *Berk.*
Tricholoma portentosum *Fr.*
T. radicatum *Pk.*
T. subacutum *Pk.*
Triosteum aurantiacum *Bickn.*
Trillium grandiflorum (*Mx.*)
Verticillium enecans *Speg.*
Vicia caroliniana *Walt.*
Viola arenaria *DC.*
V. conspersa *Reichen.*
V. cucullata *Ait.*
V. fimbriatula *J. E. Smith*
V. palmata *L.*
V. rotundifolia *Mx.*
V. selkirkii *Pursh*

CONTRIBUTORS AND THEIR CONTRIBUTIONS

Miss H. C. Anderson, Lambertville N. J.

Coprinus comatus *Fr.*
Tricholoma personatum *Fr.*
Volvaria bombycina *Pers.*

Mrs E. B. Blackford, Boston Mass.

Hydnum blackfordae *Pk.*

Miss G. S. Burlingham, Binghamton

Epipactis viridiflora (*Hoffm.*) *Reichb.*

Mrs M. S. DeCoster, Little Falls

Asplenium ebeneum hortonae *Dav.*

Mrs P. H. Dudley, New York
Melanthium latifolium *Desr.*

Miss Alice Eastwood, San Francisco Cal.
Hirneola polytricha *Mont.* | Montagnites candollei *Fr.*

Mrs L. L. Goodrich, Syracuse
Hydnum caput-ursi *Fr.* | Trillium grandiflorum (*Mx.*) *Salisb.*

Mrs T. J. Leach, Syracuse
Iris pseudacorus *L.*

Miss J. A. Moses, Jamestown
Hordeum hexastichon *L.*

Mrs F. W. Patterson, Washington D. C.
Lentinus spretus *Pk.*

Mrs F. C. Sherman, Syracuse
Tricholoma paeonium *Fr.* | Boletus chrysenteron *Fr.*

Miss T. L. Smith, Worcester Mass.
Corticium lilacino-fuscum *B. & C.* | Hydnum cinnabarinum *Schw.*
Phlebia radiata *Fr.*

Miss M. L. Sutliff, Sacramento Cal.
Galera reticulata *Pk.* | Marasmius sutliffae *Pk.*
Hypholoma incertum *Pk.* | Rhizopogon luteolus *Fr.*

Miss A. E. Tilton, Seal Harbor Me.
Hydnum suaveolens *Scop.*

Miss Adeline VanHorne, Montreal Can.
Armillaria imperialis *Fr.*

Mrs Elizabeth Watrous, New York
Pterospora andromedea *Nutt.*

Mrs M. S. Whetstone, Minneapolis Minn.
Clitocybe candicans *Pers.* | Lentinus obconicus *Pk.*

F. H. Ames, Brooklyn
Clitocybe trullisata *Ellis*

J. C. Arthur, Lafayette Ind.
Coleosporium campanulae (*Pers.*) *Lev.* | Puccinia andropogonis *Schw.*
C. vernoniae *B. & C.* | P. schedonnardi *K. & G.*
Peridermium holwayi *Syd.* | Uredo panici *Arth.*
P. ornamentale *Arth.* | Uromyces hedysari paniculata *Schw.*

H. J. Banker, Greencastle Ind.
Hydnum versipelle *Fr.* | Polyporus underwoodii *Murr.*
Thelephora intybacea *Pers.* | P. berkeleyi *Fr.*
Craterellus clavatus (*Pers.*) *Fr.* | P. poripes *Fr.*

F. S. Boughton, Pittsford

Cortinarius rubripes *Pk.*
Hypomyces lateritius (*Fr.*) *Tul.*
Pholiota comosa *Fr.*

F. J. Braendle, Washington D. C.

Boletus albellus *Pk.*

S. H. Burnham, Sandy Hill

Aecidium trientalis *Tranz.*
Asplenium eben. incisum *Howe*
Hydnum mucidum *Pers.*
H. septentrionale *Fr.*
Merulius ulmi *Pk.*
Peltigera aphthosa (*L.*) *Hoffm.*
Polyporus cuticularis (*Bull.*) *Fr.*
Poria fuscocarnea *Pers.*
Puccinia helianthi *Schw.*
Secotium acuminatum *Mont.*
Stropharia melasperma (*Bull.*)
Tricholoma unifactum *Pk.*
Verticillium enecans *Speg.*

H. P. Burt, New Bedford Mass.

Cortinarius heliotropicus *Pk.*
Geoglossum farlowi *Cke.*

A. K. Cole, Albany

Lycoperdon giganteum *Batsch*

Simon Davis, Boston Mass.

Cortinarius violaceus (*L.*) *Fr.*
Hygrophorus laurae *Morg.*
H. marginatus *Pk.*
H. purus *Pk.*
Mycena epipterygia (*Scop.*) *Fr.*
Pholiota praecox minor (*Batt.*)
Psilocybe foenisecii (*Pers.*) *Fr.*
Stropharia albocyanea *Desm.*

Frank Dobbin, Shushan

Boletus chrysenteron *Fr.*

P. H. Dudley, New York

Pinus palustris *Mill.* (wood specimen)

W. W. Eggleston, New York

Amelanchier arguta *Nutt.*
Crataegus blanchardi *Sarg.*
C. dissona *Sarg.*
C. foetida *Ashe*
C. frizzelii *Sarg.*
Crataegus contigua *Sarg.*
C. paddockae *Sarg.*
C. praecoqua *Sarg.*
C. rhombifolia *Sarg.*
C. robbinsiana *Sarg.*

C. E. Fairman, Lyndonville

Coccospora aurantiaca *Wallr.*
Erinella raphidospora (*Ellis*)
Geopyxis nebulosa (*Cke.*) *Sacc.*
Lachnella flammea (*A. & S.*)
Oligonema nitens (*Lib.*) *Rost.*
Perichaena quadrata *Macb.*
Zygodesmus pallidofulvus *Pk.*

W. G. Farlow, Cambridge Mass.

Stropharia formosa *Farl.* ined.

E. P. Felt, Nassau

Polystictus perennis (*L.*) *Fr.*
Tricholoma portentosum *Fr.*

O. E. Fischer, Detroit Mich.

Amanita cothurnata *Atk.*
Annularia sphaerospora *Pk.*
Bulgaria rufa *Schw.*
Peziza odorata *Pk.*

B. D. Gilbert, Clayville

Webera acuminata *Schp.*

N. M. Glatfelter, St Louis Mo.

Inocybe desquamans *Pk.*
Lentinus microspermus *Pk.*
Lepiota nudipes *Pk.*
Russula nigrescentipes *Pk.*

W. R. Griffiths, Douglaston

Calochortus umbellatus *Wood*

Cephas Guillet, Toronto Can.

Galera later. albicolor *Pk.*
Psilocybe fœnisecii (*Pers.*)

J. V. Haberer, Utica

Achroanthes unifolia (*Mx.*) *Raf.*
Alsine gram. lanceolata *Fenzl.*
Antennaria arnoglossa *Greene*
Betula populifolia *Marsh.*
Botrychium obliq. habereri *Gilb.*
Callitriche heterophylla *Pursh*
Carex albicans *Willd.*
C. castanea *Wahl.*
C. muhlenbergii *Schk.*
C. schweinitzii *Dew.*
Ceanothus americanus *L.*
Corallorhiza multiflora *Nutt.*
C. mult. flavida *Pk.*
Drosera intermedia *Hayne*
D. rot. comosa *Fern.*
Elatine americana (*Pursh*) *Arn.*
Equisetum hyem. affine *Eaton*
E. hyem. intermedium *Eaton*
E. littorale *Kuehl.*
E. varieg. nelsoni *Eaton*
Galium aparine *L.*
Hieracium venosum *L.*
Hypericum canadense *L.*
Ilex vert. cyclophylla *Robins.*
Juncus tenuis anthelatus *Wieg.*
Lathyrus maritimus *L.*
Lemna minor *L.*
L. trisulca *L.*
Limnorchis huronensis *Rydb.*
Lycopodium inundatum *L.*
Monarda mollis L.
Ranunculus repens *L.*
Rhynchospora fusca (*L.*) *R. & S.*
R. glomerata (*L.*) *Vahl*
Scirpus subterminalis *Torr.*
Sparganium angustifolium *Mx.*
Triosteum aurantiacum *Bickn.*
Vaccinium penn. angustifolium (*Ait.*)
Veronica chamaedrys *L.*
Xanthoxylon americanum *Mill.*
Xyris caroliniana *Walt.*
X. montana *Ries*

C. C. Hanmer, East Hartford Ct.

Agaricus arv. purpurascens *Cke.*
Craterellus pogonati *Pk.*
Irpex mollis *B. & C.*
Merulius tremellosus *Schrad.*

J. W. Harshberger, Philadelphia Pa.

Specimens of 190 species of Pocono plateau plants

M. E. Hard, Chillicothe O.

Armillaria nardosmia *Ellis*
Cordyceps herculea *Schw.*
Cyclomyces greenei *Berk.*
Hydnum adustum *Schw.*
H. spongiosipes *Pk.*
Trametes rubescens *A. & S.*

A. A. Heller, Los Gatos Cal.

Erysiphe polygoni *DC.*
Marsonia pot. helleri *Pk.*
Melasmia arbuticola *Vize*
Monilia avenae *Pk.*
Puccinia baccharidis *D. & H.*
P. menth. americana *Burr.*
Sphaerotheca humuli (*DC.*) *Burr.*
Uromyces trifolii (*Hedw.*) *Lev.*

C. P. Hoag, Albany

Lycoperdon giganteum *Batsch*

E. W. D. Holway, Minneapolis Minn.

Puccinia gigantispora *Bubak*
P. ostenta *Holway*
P. porteri *Coulter*
Puccinia salviicola *D. & H.*
P. scandica *Johans.*
Ravenelia spinulosa *D. & H.*

Edgar A. Houghtaling, Albany

An obconic nut, probably of some species of palm.

C. H. Kaufman, Ann Arbor Mich.

Cortinarius anfractus *Fr.*
C. annulatus *Pk.*
C. armillatus *Fr.*
C. bolaris *Fr.*
C. castanellus *Pk.*
C. collinitus *Fr.*
C. croceocolor *Kauff.*
C. cylindripes *Kauff.*
Cortinarius obliquus *Pk.*
C. pholideus *Fr.*
C. semisanguineus (*Fr.*)
C. sterilis *Kauff.*
C. subbivelus *Kauff.*
C. torvus *Fr.*
C. umidicola *Kauff.*

E. A. Lehman, Winston-Salem N. C.

Hexalectis aphyllus (*Nutt.*) *Raf.*

R. B. Mackintosh, Peabody Mass.

Agaricus micromegethus *Pk.*
Secotium acuminatum *Mont.*

E. R. Memminger, Flat Rock N. C.

Craterellus odoratus *Schw.*

G. E. Morris, Waltham Mass.

Boletinus cavipes *Opat.*
B. paluster *Pk.*
Boletus illudens *Pk.*
B. nobilis *Pk.*
Eccilia atrides *Lasch.*
Flammula squalida *Pk.*
Hygrophorus marginatus *Pk.*
H. speciosus *Pk.*

R. S. Phifer, Danville Va.

Boletus ravenelii *B. & C.*

William Richards, Albany

Lycoperdon giganteum *Batsch*

I. M. Shepherd, Trenton N. J.

Agaricus campester exannulatus *Cke.*

Perley Spaulding, St Louis Mo.

Daedalea ambigua *Berk.*
Fomes ribis (*Schum.*) *Fr.*
Polyporus obtusus *Berk.*
P. scruposus *Fr.*

E. B. Sterling, Trenton N. J.

Cantharellus aurantiacus *Fr.*
Cordyceps sinensis (*Berk.*) *Sacc.*
Panaeolus papilionaceus *Fr.*
Pleurotus bretschneideri *Kalchb.*

R. H. Stevens, Detroit Mich.

Guepinia bicolor *Pk.*

F. C. Stewart, Geneva

Gloeosporium riessii *S. & S.*
Sporotrichum anthophilum *Pk.*

D. R. Sumstine, Kittanning Pa.

Cordyceps capitata (*Holmsk.*) *Lk.*

W. B. Varnum, Albany

Stropharia melasperma (*Bull.*) *Fr.*

E. A. White, Storrs Ct.

Amanitopsis volvata (*Pk.*) *Sacc.*
Collybia tuberosa (*Bull.*) *Fr.*

T. E. Wilcox, Washington D. C.

Cortinarius anomalus *Fr.*

B. C. Williams, Newark

Polyporus frondosus Fr.

Osaka Mushroom Merchants Association, St Louis Mo.

Pleurotus bretschneideri *Kalchb.*

SPECIES NOT BEFORE REPORTED

Actaea eburnea Rydb.

Meadowdale and Karner, Albany co. May, in flower. July, in fruit. Formerly considered a form of Actaea alba with slender pedicels.

Aecidium trientalis Tranz.

On living leaves of star flower, Trientalis americana. East Lake George marsh. June. S. H. Burnham.

Anthostoma gastrina (Fr.) Sacc.

Dead bark of hickory. Crown Point, Essex co.

Boletus acidus n. sp.

PLATE T, FIG. 1–6

Pileus fleshy, rather thin, firm, convex, very glutinous when moist, yellowish white, the margin of young plants often appendiculate with fragments of the whitish floccose and glutinous veil, flesh whitish, taste acid and disagreeable; tubes short, adnate, concave in the mass in young plants, becoming plane with age, the mouths minute, subrotund, pale yellow, becoming darker with age; stem firm, equal or slightly tapering upward, subflexuous, solid, minutely dotted with brown or brownish glands, both above and below the slight, mostly glutinous and evanescent annulus; spores subferruginous, oblong elliptic, .0003–.0004 of an inch long, .00012–.00016 broad.

Pileus 1-2 inches broad; stem 1.5–3 inches long, 2–3 lines thick. Under pine and hemlock trees. Port Henry. August.

This species belongs to the section Viscipelles. It is closely related to Boletus punctipes and B. americanus from which it is separated by its slight but mostly evanescent annulus and by its acid taste.

Clavaria conjuncta Pk.

Among fallen leaves in woods. Bolton Landing, Warren co. July. For a description of the species, turn to the chapter on edible fungi.

Clitopilus squamulosus n. sp.

PLATE S, FIG. 5–8

Pileus thin, nearly plane, deeply umbilicate, floccose squamulose, specially in the center, grayish brown and shining, flesh whitish; lamellae close, adnate or slightly decurrent, tinged with flesh color; stem long, slightly tapering upward, hollow, fibrous striate and colored like or a little paler than the pileus in the upper part, even and white toward the base; spores flesh color, subquadrate, angular, .0005 of an inch broad, with a large shining nucleus.

Pileus 1-1.5 inches broad; stem 3-4 inches long, 2-3 lines thick. Among fallen leaves in woods. Bolton Landing. July.

A species easily recognized by its squamulose deeply umbilicate pileus. The squamules in the center of the pileus are erect.

Coccospora aurantiaca Wallr.

Decayed wood. Lyndonville, Orleans co. C. E. Fairman.

Cortinarius rubripes n. sp.

Pileus thin, broadly convex becoming plane or nearly so, sometimes slightly depressed in the center, rarely slightly umbonate, minutely silky fibrillose, grayish ferruginous or pale alutaceous, flesh whitish; lamellae subdistant, emarginate, violaceous becoming cinnamon; stem enlarged or subbulbous at the base, hollow, bright red; spores elliptic, .0003–.0004 of an inch long, about .0002 broad.

Pileus 1-1.5 inches broad; stem 1-1.5 inches long, 2-4 lines thick. Woods. Pittsford, Monroe co. September. F. S. Boughton.

The color of the stem of this species indicates a relationship with such species as Cortinarius sanguineus and C. cinnabarinus. The discoverer of the species describes the colors of the cap and gills as very similar to those of Clitocybe ochropurpurea. The red stem and violet or purplish violet gills of the young plant make it a beautiful and very attractive species.

Crataegus acuminata Sarg.[1]

The acuminate thorn is closely related to C. streeterae and C. glaucophylla, but it may be separated from the first by the absence of wrinkles from the leaves, and from the second by the absence of glaucous hues from them.

Crataegus ambrosia Sarg.

The ambrosial thorn is so closely allied to the Hall thorn that they are not readily distinguished from each other when in flower, but with the full development of the leaves and fruit they are easily separated, the leaves being broader and the fruit of the ambrosial thorn being much larger and fewer in a cluster. It also persists later in the season. The bushes are red with fruit to the end of November.

Crataegus asperifolia Sarg.

The roughish-leaved thorn is similar in its general characters to the rubicund thorn, C. rubicunda, from which it may be separated by its glabrous calyx tube, which is also less reddish, more glandular calyx lobes and shorter pointed leaves. The petioles in our specimens are also generally shorter. The fruit of typical C. asperifolia is described as having yellow flesh, but in our specimens it becomes tinged with red late in the season.

Crataegus beckiana Sarg.

The Beck thorn in some of its characters is suggestive of C. rhombifolia, but it is a much larger treelike shrub with thicker leaves, glabrous calyx tube and with large drooping clusters of fruit.

Crataegus caesariata Sarg.

The hairy thorn belongs to the group Coccineae and when in flower it might be taken to be a form of C. coccinea. Its

[1] The descriptions of this and other new species of this genus will be found in the chapter on species of Crataegus found within 20 miles of Albany.

fruit, however, is quite different from the fruit of that species and is much later in ripening. Spines are almost entirely absent from the branches. In the North Albany clump only two small ones were found; in the Wynantskill clump none was found on the living branches and only three on one dead twig. In a third clump no spines are present.

Crataegus casta Sarg.

The chaste thorn belongs to the large group Pruinosae and to a possible section in which the flowers have 20 stamens with pink anthers. The fruit is beautifully colored and its pointed base affords an available character by which to distinguish the species from its near allies.

Crataegus conspicua Sarg.

The conspicuous thorn is a large shrub quite distinct from our other species of this group by its very hairy inflorescence and by the hairy lower surface of the leaves. The fruit persists till late in the season and sometimes a considerable part of it hangs on the branches through the winter.

Crataegus contortifolia Sarg.

The twisted-leaved thorn takes its name from one of the easily recognized and distinguishing characters of the species. This consists in a peculiar folding or wavelike curving of the margin of the leaf, as if there was a superabundant formation of marginal tissue for which there was no room in the ordinary plane of the leaf. This results in the curving of the margin. Such leaves do not press flat and smooth in the plant press. The species has affinities with C. champlainensis, C. submollis, C. tatnalliana and C. arnoldiana, but with none of them does it satisfactorily agree. It was erroneously referred to C. tatnalliana in New York State Museum Bulletin 94, page 28.

Crataegus demissa Sarg.

The low thorn grows from 4 to 6 feet tall and has small leaves, small flowers and small fruit. It is quite diminutive in all its parts and easily recognized.

Crataegus divergens Sarg.

The divergent thorn was formerly considered a variety of the unshaven thorn, C. irrasa, but it is now deemed worthy of specific distinction. It grows in patches rather than in clumps.

Crataegus eatoniana Sarg.

The Eaton thorn is yet limited to a single locality and a single small thicket in that locality. It is a peculiar species which by its leaves simulates species of the group Tomentosae, but its nutlets with plane inner faces forbid its reference to that group. It makes a second species for us in the group Punctatae.

Crataegus edsoni Sarg.

The Edson thorn has been found in a single locality in our territory. There are two clumps of it growing near each other a short distance north of Lansingburg. The species normally has 20 stamens in its flowers, but in our form of it the number ranges from 10 to 19. The prevailing number is 10 to 16. The fruit ripens about the first of September and soon falls.

Crataegus flagrans Sarg.

The flagrant thorn is a large shrub which is peculiar to a single locality. Its prominent characters are its thin leaves, hairy inflorescence with many flowered clusters and 10 stamens with white anthers.

Crataegus genialis Sarg.

The genial thorn is one of the common species in the vicinity of Albany. It is somewhat variable and not always readily recognizable. Its ascending branches and the ovate leaves being scarcely lobed except on vigorous shoots and the fruit commonly longer than broad are some of the most notable characters.

Crataegus halliana Sarg.

The Hall thorn has flowers with 20 stamens and white or pale yellow anthers. Its fruit is rather small but forms large many fruited drooping clusters which are conspicuous when ripe.

Crataegus helderbergensis Sarg.

The Helderberg thorn is a small tree with nearly horizontal widespreading branches suggestive of the appearance of the dotted fruited thorn, C. punctata. Its broad leaves and hairy inflorescence are distinguishing characters of the species. It has been found at Thompson Lake only, and belongs to the group Crus-galli.

Crataegus howeana Sarg.

The Howe thorn has the characteristic fruit of many species of the group Pruinosae. It is globose or depressed globose and more or less angular. It is rounded at the base and in this respect differs from the fruit of C. casta. Its flowers have 20 stamens with pale pink anthers, and its branches are furnished with numerous short branchlets and rather small slender spines.

Crataegus hystricina Ashe

The hedgehog thorn is probably so named because of its numerous spines. It has been found in our territory at Thompson Lake only.

Crataegus illuminata Sarg.

The illuminated thorn, in habit and general appearance of its foliage, is similar to C. dodgei. Its fruit is usually a little longer than broad and ripens earlier than the fruit of C. dodgei.

Crataegus mellita Sarg.

The honey thorn is very closely related to the Brainerd thorn, C. brainerdi, to which I formerly referred it, but from which it may be separated by its thinner leaves. Its fragrant honey-producing flowers are suggestive of the specific name. It is yet limited to a single locality. It inhabits rocky soil. It is remarkable in retaining the freshness of its reddish filaments almost to the time of ripening of its fruit.

Crataegus menandiana Sarg.

The Menand thorn is a large shrub belonging to the group Tomentosae. Its flowers have 20 stamens, but it differs from all our other species with 20 stamens in having red anthers. They are more highly colored than in our specimens of C. gemmosa and C. succulenta.

Crataegus oblongifolia Sarg.

The oblong leaved thorn belongs to the group Molles and is related to C. exclusa. Its flowers have the anthers more highly colored than in the Albany form of C. exclusa, and some of the leaves are much longer than broad, a character suggestive of the specific name. It is at present limited to the Menands locality so far as is known.

Crataegus peckietta Sarg.

The second Peck thorn is a northern species. It has been found at Piseco and Lake Pleasant in Hamilton county, at Keene and Port Henry in Essex county and at Horicon in Warren county. It sometimes retains a part of its fruit through the winter. The fruit is so peculiar in shape that often it is recognizable even after the shriveling and discoloration it undergoes during the winter.

It is broadly rounded or almost truncate at the base and slightly narrowed toward the apex. The plants bear fruit abundantly when only 4 or 6 feet tall, but they sometimes become 12 to 16 feet tall. They grow on rather light but rocky soil.

Crataegus pentandra Sarg.

The five stamened thorn, in its typical form, is said to have five stamens and to be a tree. Our forms are mostly shrubs and the stamens vary from 5 to 10 in flowers on the same shrub.

Crataegus polita Sarg.

The polished thorn has been found in only one locality in our territory. It there grows in poor rocky soil.

Crataegus rhombifolia Sarg.

The rhombic leaved thorn belongs to the thin leaved section of the group Tomentosae. It is, with us, a shrub of moderate size and has flowers with 10 stamens and pink anthers. The pedicels are hairy and the calyx tube is also more or less hairy. The species is rather common in the vicinity of Albany.

Crataegus robbinsiana Sarg.

The Robbins thorn sometimes forms a small tree but in the vicinity of Albany it is more often a shrub. The appearance of the leaves suggests a relationship to such species of the group Intricatae as C. intricata and C. foetida, but the fruit is pruinose and the species is referable to the group Pruinosae.

Crataegus rubrocarnea Sarg.

The red fleshed thorn takes its name from the deep red color of the flesh of the fully ripened fruit. It is closely related to C. rubicunda but may be distinguished from it by its more globose fruit in fewer fruited clusters and more persistent calyx lobes. It is at present limited to a single locality.

Crataegus sejuncta Sarg.

The separated thorn is allied to the polished thorn, C. polita, from which it is separated by its short, stout, hairy pedicels, more numerous stamens and rather larger crimson fruit. It is a large shrub.

Entoloma flavifolium n. sp.

PLATE S, FIG. 9–15

Pileus thin but firm, broadly convex or nearly plane, glabrous, hygrophanous, watery white and sometimes slightly striatulate on the thin margin when moist, white when the moisture has disappeared, flesh-colored like the surface of the pileus, taste mild or slightly and tardily acrid; lamellae thin, close, rounded behind, adnexed, slightly eroded or uneven on the edge, pale yellow becoming pinkish; stem firm, equal, silky fibrillose, white mealy at the top, stuffed or hollow, whitish; spores bright pink, subglobose, slightly angular, .0003-.0004 of an inch broad, apiculate at one end.

Pileus 1-2 inches broad; stem 1.5-2 inches long, 2-4 lines thick. In dense woods among fallen leaves. Port Henry, Essex co. August. The species is well marked in the young plant by the clear pale yellow gills. Sometimes the margin of the pileus is wavy or irregular and the center tinged with brown when moist.

Erinella raphidospora (Ellis) Sacc.

Decaying wood. Lyndonville. C. E. Fairman.

Exoascus cecidomophilus Atk.

On fruit of chokecherry, Prunus virginiana. Bergen, Genesee co. July.

The diseased fruit is less elongated than when attacked by Exoascus confusus and is not curved. Moreover the calyx is not so conspicuously enlarged nor so persistent as when E. confusus is the parasite.

Geopyxis nebulosa (Cke.) Sacc.

Decaying wood. Lyndonville. July. C. E. Fairman.

Geranium sibiricum L.

The Siberian cranesbill is an introduced species but it was found growing plentifully and spontaneously at Wading River, Suffolk co. in August.

Gloeosporium riessii Schl. & Sacc.

On appletree bark. Geneva. October. Collected by D. B. Slight; communicated by F. C. Stewart.

Hydnum cyaneotinctum Pk.

The blue tinted hydnum has the peculiar structure of the pileus attributed by Professor Fries to the pileus of Polystictus circinatus. The upper stratum is of a soft spongy texture, the lower is hard and continuous with the stem. Both are usually slightly zonate. The stem is covered with a dense spongy tomentum. It is sometimes eccentric or even lateral, specially when the plant grows against a stump, stone or other obstruction which prevents the free development of the pileus. When young, the pileus is whitish or white tinged with yellow. It soon assumes a buff color, with the margin commonly tinged with blue and becoming a darker blue where bruised. In old specimens the center or sometimes the whole becomes ferruginous brown. The aculei are at first white but they become brown or ferruginous brown with age. The spores are purplish brown, subglobose or oval, .00016 of an inch in diameter.

The plant has a farinaceous odor when cut or bruised. It is sometimes cespitose. It grows under hemlock trees. Horicon, Warren co. July.

Hypomyces camphorati n. sp.

Subiculum thin, effused, overrunning and obliterating the hymenium of the host plant, yellow; perithecia numerous, minute, immersed in the subiculum, the ostiolum exposed, brown; asci very long, .005-.006 of an inch (sporiferous part), eight spored; spores monostichous, oblong fusiform, continuous, acute or slightly cuspidate at each end, .0005-.0006 of an inch long, .00016-.0002 broad.

On the hymenium of Lactarius camphoratus. Port Jefferson, Suffolk co. August.

Closely allied to H. volemi Pk. from which it is distinguished by its yellow subiculum, its longer asci and acute or cuspidate spores.

Hypomyces lateritius (Fr.) Tul.

On the hymenium of Lactarius indigo. Pittsford, Monroe co. F. S. Boughton.

Inocybe diminuta n. sp.

Pileus thin, hemispheric becoming convex or nearly plane, squamose with hairy, erect or squarrose scales in the center, fibrillose on the margin, grayish brown; lamellae subdistant, broadly sinuate, adnexed, ventricose, at first whitish, then brownish or rusty brown; stem short, firm, solid, silky fibrillose, whitish in the upper part, grayish brown and subsquamulose toward the base; spores subglobose, nodulose, .0003-.0004 of an inch long, .0003 broad.

Pileus 3-6 lines broad; stem 4-8 lines long, about 1 line thick. Bare compact soil in wood roads. Wading River. August.

A small but distinct species belonging to the section Lacerae.

Inocybe radiata Pk.

Port Jefferson. August. Smaller than the type form but otherwise like it.

Juncus brachycephalus (Engelm.) Buch.

Formerly considered a variety of Juncus canadensis, but now raised to specific rank. Jamesville, Onondaga co. Sevey, St Lawrence co. C. H. Peck. West Danby, Tompkins co. W. R. Dudley. Waverly, Tioga co. F. E. Fenno.

Lachnella flammea (A. & S.) Fr.

On decorticated maple wood. Lyndonville. C. E. Fairman.

Lactarius rimosellus Pk.

Wading River, Suffolk co. August. Edible. The description of this species will be found in the chapter on edible fungi.

Lentinus spretus n. sp.

Pileus thin, tough, convex becoming nearly plane, obtuse or umbonate, rimose squamulose, grayish brown or pale alutaceous, often more highly colored in the center than on the margin, flesh white; lamellae rather narrow, close, decurrent, whitish, lacerate serrate on the edge; stem usually rather long, equal or sometimes narrowed or sometimes thickened toward the base, substriate, solid, more or less squamose, often eccentric, whitish, sometimes brownish toward the base; spores white, oblong, .0003-.0004 of an inch long, .00016 broad.

Pileus 2-5 inches broad; stem 1-3 inches long, 3-6 lines thick. Decaying wood of pine. Horicon, Warren co. July. Railroad ties. Albia, Rensselaer co. September.

This species has probably been confused with Lentinus lepideus, from which it may be separated by its more slender habit, thinner pileus, smaller scales, more narrow decurrent lamellae without a sinus, and specially by its smaller spores. In our specimens there is no evidence of a veil.

Leptosphaeria substerilis n. sp.

Foliicolous; spots small, .5-1 line broad, numerous, suborbicular, often confluent, generally sterile, brown or blackish brown, surrounded by an elevated line; perithecia few, 1-6 on a spot, unequal, covered by the epidermis, black; asci subcylindric or clavate, slightly narrowed toward the base; spores crowded in the ascus, colored, triseptate, subfusiform, .001-.0012 of an inch long, .0003 broad.

Living leaves of peppermint, Mentha piperita. Lakeport, Madison co. July.

The diseased tissue shrinks below the level of the surrounding healthy tissue and eventually separates from it and falls away, leaving circular holes in the leaves.

Marasmius longistriatus n. sp.

PLATE S, FIG. 1–4

Pileus membranaceous, convex becoming plane with a central depression or sometimes broadly infundibuliform, moist when young and striate almost to the center, bay-brown when moist, reddish gray when dry; lamellae thin, narrow, close, adnate, unequal, whitish; stem equal, externally cartilaginous, stuffed or hollow, covered with a grayish downy pubescence which is sometimes longer at the base.

Pileus 3-6 lines broad; stem 8-12 lines long, .5 of a line thick. Under pine and hemlock trees. Bolton Landing. July.

This resembles M. subnudus in color but it is a much smaller plant with long fine striae on the pileus and with much closer lamellae. The central depression resembles that of Coprinus plicatilis.

Melanogaster durissimus Cke.

Menands, Albany co. September 1904. A single specimen, somewhat smaller than the type form and without the strong odor attributed to that form, was found. Its hardness is remarkable and proves the appropriate character of the specific name. The type form was found in India, but specimens of the species have been reported from California by Dr H. W. Harkness. It is manifestly a species rarely found, but one having a wide range.

Merulius pruni n. sp.

Effused, thin, separable from the matrix, soft, with a definite whitish or pallid scarcely byssin margin; folds forming angular or irregular pores with dentate or sometimes irpiciform dissepiments, ecru drab when fresh, darker or subcervine when dry.

Bark of wild red cherry, Prunus pennsylvanica. Horicon. July.

It forms patches several inches long and broad, but these appear as if formed by the confluence of many small orbicular patches, the hymenium being faintly marked by concentric ridges or elevated lines. The texture is soft and somewhat waxy yet slightly tenacious and the margin is nearly glabrous. The specimens are sterile.

Merulius ulmi n. sp.

Effused, thin, firm, suborbicular or by confluence, forming patches, the margin often free and narrowly reflexed, pubescent, sometimes concentrically sulcate, white; hymenium white or whitish when young, soon pale cervine, the folds forming orbicular or oblong shallow pores often beautifully and concentrically arranged; spores not seen.

Dead branches of elm, Ulmus americana. Vaughns, Washington co. November. S. H. Burnham.

Monarda mollis L.

Canadice, Ontario co. C. H. Peck. Frankfort, Herkimer co. July. J. V. Haberer. Formerly referred to M. fistulosa as a variety, but now regarded as a distinct species.

Oligonema nitens (Lib.) Rost.

Decaying wood. Lyndonville. C. E. Fairman. A beautiful species easily recognized by the swollen rings on the threads of the capillitium and by the bright shining yellow color of the heaps of peridia.

Panus fulvidus Bres.

Fence rails. Keene, Essex co. June. This is a beautiful species with the central stem squamulose and the bright tawny pileus adorned with erect or squarrose blackish scales and strongly sulcate striate margin. The edge of the lamellae in our specimens is slightly eroded or denticulate, thereby suggesting an approach to the genus Lentinus.

Perichaena quadrata Macb.

Decaying bark and dead leaves. Lyndonville. C. E. Fairman. This species may be distinguished from P. depressa by its smaller peridia.

Phyllosticta pallidior n. sp.

Spots elliptic or orbicular, 2-4 lines long, 1.5-3 lines broad, whitish or grayish white surrounded by a red or reddish margin; perithecia minute, epiphyllous, occupying the center of the spot, black; spores globose or broadly elliptic, .0004-.0006 of an inch long, .0003-.0004 broad.

Living leaves of star-flowered Solomon's seal, Vagnera stellata. Bergen swamp. July.

This species is closely allied to P. cruenta, from which it differs in the very narrow red or reddish margin of the spots and in the shape of the spores which are nearly globose and not at all curved as in P. cruenta.

Physoderma menyanthis DeBy.

Living leaves of buck bean, Menyanthes trifoliata. Bonaparte swamp, Lewis co. June. This species has been found as far north as Alaska.

Pluteus grandis n. sp.

Pileus fleshy, firm, convex with the thin margin sometimes curved upward, silky fibrillose, white or whitish, flesh white, taste farinaceous; lamellae thin, close, free, denticulate on the edge, whitish becoming flesh-colored; stem rather long, equal, firm, solid, silky fibrillose, white; spores subglobose, angular, uninucleate, .0003 of an inch broad.

Pileus about 4 inches broad; stem 4 inches long, 10 lines thick. Among fallen leaves in woods. Bolton Landing. July.

This is a fine large species, separable from Entoloma sinuatum by its free lamellae, and from white forms of Pluteus cervinus by the angular character of the spores and by its farinaceous taste.

Polyporus underwoodii n. sp. Murr.

Pileus varying from convex to deeply concave, 12-25 cm in diameter, averaging .5 cm in thickness; surface obscurely concentrically zonate, milk-white, pruinose, cremeous on drying, the center depressed and avellaneous; margin irregularly undulate lobed, either deflexed or recurved, very thin, not ciliate; context white, fleshy, tough, homogeneous, 2-5 mm thick; tubes milk-white, 2-3 mm long, five to six to a mm, cylindric, edges thin, entire to lacerate; spores ellipsoidal, hyaline, smooth, 3 x 6-7 μ; stipe short, central, solid, woody, equal or tapering downward, smooth, pruinose, white above, fuliginous below, 3 cm long, 2-3 cm thick.

The type of this species was collected by L. M. Underwood on buried decaying roots beneath birch trees at Cornwall Ct., August 1890. Specimens were also collected in Connecticut in 1902 by C. C. Hanmer. Fine specimens were again collected by H. C. Banker on the roots of a fallen, but living willow at Schaghticoke N. Y. in August, 1904. Plants were sent by Mr Banker to the State Museum at Albany and to the New York Botanical Garden. The nearest relative of this species in our flora is probably Polyporus fissus Berk. The specimen contributed to the State Museum has the stem wholly fuliginous.

Psathyra vestita n. sp.

Pileus thin, submembranaceous, ovate, conic or subcampanulate, obtuse, at first covered with white floccose fibrils, usually with a rufescent tint, soon paler or white and silky fibrillose, sometimes slightly striate on the margin; lamellae thin, narrow, close, adnate, white when young, becoming blackish brown; stem equal, hollow, flexuous, floccose fibrillose, becoming silky fibrillose, mealy and often striate at the top, white; spores purplish brown, elliptic, .0003-.0004 of an inch long, .0002-.00024 broad.

Pileus 4-8 lines broad; stem 1-1.5 inches long, 1-1.5 lines thick. Fallen leaves and grass. North Elba. September.

This species differs from P. semivestita in its color and in being wholly clothed when young with white floccose fibrils.

Russula subsordida Pk.

Horicon. July. Edible. A description of this species may be found in the chapter on edible fungi.

Russula viridella Pk.

Under hemlock trees in woods. Horicon. July. Edible.

A description of the species may be found in the chapter on edible fungi.

Sparganium fluctuans (Morong) Robins.

Deep water of lakes and ponds. Sand lake, Rensselaer co. and Big Moose lake, Herkimer co. July and August. This was formerly considered a variety of S. androcladum but it has now been raised to specific rank.

Sporotrichum anthophilum n. sp.

Hyphae creeping, interwoven, branched, continuous or sparingly septate, variable in thickness, .00008-.00024 of an inch in diameter, hyaline, forming a loose cottony stratum; spores globose or broadly ovate, .00016-.0003 of an inch long, borne on the tips of short branchlets which are usually narrowed toward the apex and pointed.

Parasitic on the filaments and petals of carnation pinks, discoloring them, destroying their vitality and spoiling the flowers. Bayside, Queens co. Collected by William Bell; contributed by F. C. Stewart.

Stropharia melasperma (Bull.) Fr.

Grassy ground. Observatory grounds. Albany. July. W. B. Varnum and S. H. Burnham.

Symphoricarpos pauciflorus (Robbins) Britton

This was reported as a variety of S. racemosus but it is now deemed worthy of specific rank.

Thelephora intybacea Pers.

Ground. East Schaghticoke, Rensselaer co. H. J. Banker.

Tilmadoche compacta Wing.

Much decayed wood of poplar. Loudonville, Albany co. August.

Tricholoma paeonium Fr.

Grassy places. Syracuse. August. "Growing after heavy rains," a habit which Professor Fries also ascribes to the European fungus. Mrs F. C. Sherman.

Tricholoma unifactum Pk.

Under hemlock trees. Horicon. July. Edible. For a description of the species see chapter on edible fungi.

Triosteum aurantiacum Bickn.

Along West Canada creek near East Herkimer and in bogs at Cedar lake. June and July. J. V. Haberer. A species separated from T. perfoliatum because of its orange-colored fruit and leaves not connate at the base.

Uredinopsis atkinsoni Magnus

Fronds of Dryopteris thelypteris. Ithaca flats. August. G. F. Atkinson.

Uredinopsis osmundae Magnus

Fronds of the cinnamon fern, Osmunda cinnamomea. Malloryville moor, Tompkins co. August. G. F. Atkinson.

Verbascum phlomoides L.

Near the railroad station. Wading River. August. The clasping leaved mullein is an introduced species. It resembles our common mullein but it has larger flowers, shorter and broader upper leaves of a greener hue and clasping at the base, but scarcely decurrent.

Veronica chamaedrys L.

Woods and steep banks along West Canada creek at Trenton falls, Oneida and Herkimer counties. June. J. V. Haberer.

Zygodesmus pallidofulvus n. sp.

Thinly effused, pale tawny; hyphae irregularly branched, the branches often short, suberect; spores globose, echinulate, .0004-.0005 of an inch in diameter.

Decaying wood. Lyndonville. August. C. E. Fairman.

REMARKS AND OBSERVATIONS

Agaricus arvensis purpurascens Cke.

Lawns. Fishers Island, Suffolk co. C. C. Hanmer.

Alsine graminea lanceolata Fenzl.

Rocky places. Little Falls. July. J. V. Haberer.

Amanita russuloides Pk.

Among fallen leaves in woods. Bolton Landing. July. This is larger than the typical form, having the pileus 4-6 inches broad, the stem 5-8 inches long and 5-12 lines thick. The annulus has a thick floccose edge which is sometimes grooved. The volva is definitely circumscissile, adnate to the bulb and furnished above with a short obtuse free margin. A smaller specimen, entirely white, was found at Wading River in August. The species is apparently a rare one. It was founded on specimens collected in Greenbush, and published in 1873, in *New York State Museum Report* 25, page 72. Since then it had not been observed by me, though extralimital specimens have occasionally been received from correspondents.

Asplenium ebeneum hortonae Dav.

Crevices of rocks. Little Falls. September. Mrs M. S. De-Coster. This is a rare variety. It has not yet been found fertile so far as I know.

Asplenium ebeneum incisum Howe

Hartford, Washington co. October. S. H. Burnham. This variety is included by Professor Eaton in *Ferns of North America* in his description of the species, and most botanists have followed him in this conception of the species. The difference between this form of the fern and the much more common form with narrower fronds and obscurely crenulate serrate pinnae is so strongly marked, that to one accustomed to notice the very fine distinctions now made by authors in describing plants, it seems more satisfactory to separate them. It is therefore noticed here under the varietal name published in the 22d *Annual Report of the New York State Cabinet of Natural History*, 1869, p.104.

Bulgaria rufa magna n. var.

Cups large, 3-4 inches broad, sessile, nearly plane, sometimes irregular or wavy, the broad base distended in wet weather with a watery dingy whitish gelatin; hymenium ochraceous brown; spores white, .0008-.0012 of an inch long, .0005 broad. Externally colored and venose rugulose or subreticulated as in B. rufa. North Elba. This variety differs from the type in its habitat, which is among fallen leaves under balsam fir trees or on the ground among mosses. It does not appear to be attached to wood and is not at all narrowed into a stemlike base, but is broad and rounded underneath and the lower part is filled with a dingy watery gelatinous substance. The hymenium is ochery brown rather than rufous and the spores average a little longer than in our specimens of B. rufa. Notwithstanding these differences it has seemed to be so closely allied to B. rufa that I have thought it to be a variety of it rather than a distinct species.

Cortinarius amarus Pk.

This species was founded on specimens collected in the Adirondack region. Much larger specimens were found near Wading River the past summer. These are better developed and show clearly that the species belongs to the section Myxacium.

Cortinarius bolaris (Pers.) Fr.

With us this pretty cortinarius is beautifully spotted with red scales when fresh, but in drying, both pileus and stem assume a reddish color.

Cortinarius corrugatus Pk.

This proves to be a very variable species, yet the variations are so slight that they never disguise the true character of the species nor lead to any perplexity in its identification. Near Wading River a form occurs in which the stem when fresh appears to be almost or wholly without any bulb. In drying, the base of the stem shrinks less than the rest, so that in the dried state the stem is more distinctly bulbous.

Crataegus baxteri Sarg.

It has been found that the law of priority requires that this name must give way to Crataegus foetida Ashe, and that Crataegus dodgei Ashe must take the place of Crataegus gravesii Sarg.

Six species of Crataegus described from material found in or near Rochester have also been found in the vicinity of Albany. They are Crataegus acclivis, C. foetida (C. baxteri), C. durobrivensis, C. ferentaria, C. spissiflora and C. verecunda.

Crataegus oxyacantha L.

This introduced species is found growing wild near Albany. Some plants have white flowers, others pink. On some, the fruit is globose, on others, oval.

Drosera rotundifolia comosa Fern.

Beaver meadows and margins of lakes. Forestport, Oneida co. July. J. V. Haberer. This is a well marked and easily recognized variety. It is dwarfish in size, has its flowers in capitate clusters and the petals of a reddish or pink color.

Elatine americana (Pursh) Arn.

This rare little waterwort grows in shallow places on the sandy bottom of White lake, near Forestport. July. J. V. Haberer.

Epipactis viridiflora (Hoffm.) Reichb.

Near Mexico, Oswego co. Miss G. S. Burlingham. This is the fourth locality in our State in which this rare plant has been found. The others are Syracuse, Buffalo and Otisco.

Equisetum hyemale intermedium Eaton

Head of Oneida lake. June. J. V. Haberer.

Equisetum variegatum nelsoni Eaton

Stony flats along West Canada creek. July. J. V. Haberer.

Gyromitra esculenta (Pers.) Fr.

Among damp mosses under balsam fir trees. North Elba. June. This has long been considered an edible species, but sometimes sickness is caused if old specimens or such as are on the point of decay are eaten. It is better to use only young, sound and freshly collected specimens for food.

Hordeum hexastichon L.

A very unusual and interesting form of six rowed barley was collected near Jamestown by Miss J. A. Moses and specimens with notes were contributed by her to the herbarium. In these specimens the usual long awns are replaced by flower buds, the essential floral organs being visible only on dissection. These buds are erect and in the best developed forms they are terminated by a reflexed flap or scale. On each side at the base is another smaller budlike projection which probably represents the lateral flower that ordinarily stands, one on each side of the central flower at each node. It looks like an effort on the part of the plant to increase the number of its seeds at the expense of its, to us, useless awns. The specimens were collected late in the season—in October—but whether this lateness of growth had anything to do with the peculiar development is uncertain. Other plants of normal form were found growing with these.

Hydnum schiedermayeri Heuf.

Dead trunk of a standing appletree. Keene, Essex co. September.

Ilex verticillata cyclophylla Robins.

Boggy margin of Otter lake, Oneida co. July. J. V. Haberer. Margin of Brant lake, Warren co. C. H. Peck.

Iris pseudacorus L.

This showy yellow flowered iris is an introduced species which is sometimes found growing spontaneously. Fine specimens were collected by Mrs T. J. Leach at the mouth of Salmon river, in Oswego county.

Lactarius brevis Pk.

The typical form of this species has a short stem. Specimens collected near Wading River the past season have stems from 2–2.5 inches long.

Lathyrus maritimus (L.) Bigel.

This seashore plant was reported by Dr Torrey many years ago as occurring at Oneida lake. Dr Haberer finds it still growing about the head of the lake.

Lychnis chalcedonica L.

The scarlet lychnis is often cultivated for its showy flowers and it sometimes escapes from cultivation to roadsides or waste places. But Dr Haberer has found it growing spontaneously on densely wooded slopes near White lake, Oneida co.

Lysimachia vulgaris L.

Along West Canada creek at East Herkimer. July. J. V. Haberer. This is a beautiful plant and is sometimes cultivated for ornament. The calyx lobes are red margined.

Marasmius salignus Pk.

This small mushroom usually grows on the bark of willows as its name implies, but specimens were found near Elm lake, Hamilton co. growing on the bark of alder, Alnus incana.

Marasmius siccus Schw.

A specimen of this species is preserved in the herbarium of Schweinitz in the rooms of the Philadelphia Academy of Science. By an inspection of this specimen it was found that Marasmius campanulatus Pk. is not specifically distinct, but this could not be satisfactorily ascertained from the description given of M. siccus. The species is very variable in the color of the pileus but quite constant in its other characters.

Otidea onotica ochracea Fr.

This peculiar cespitose variety was found in woods near Lake Placid in September.

Peltigera aphthosa (L.) Hoffm.

Clay soil. Tripoli, Washington co. October. S. H. Burnham. The upper surface of these specimens has a variegated appearance which is due to denuded places where the epidermis has apparently been eaten by some small creature thereby revealing the paler yellowish green inner tissues.

Polyporus simillimus Pk.

The name and distinguishing characters of this species were published in *New York State Museum Report* 32, page 34. Its nearest ally, P. parvulus Kl., is now referred to the genus Polystictus, to which genus this species also should be referred. The original specimens were found growing in the same locality as P. parvulus and were scarcely separable from it except by the much smaller pores and different spores. Since then it has been found in many places where no P. parvulus was seen.

Polyporus sulphureus (Bull.) Fr.

An apparent variety of this common species occasionally occurs in which the pores are white instead of sulfur-yellow. For the sake of convenience of reference I propose for it the name Polyporus sulphureus semialbinus Pk. Sometimes the hymenium of this variety is composed of closed cells as in the so called genus Myriadoporus.

Pterospora andromedea Nutt.

This rare saprophytic plant still lingers in a few northern localities. A specimen was collected near Hague, Warren co. by Mrs E. Watrous and contributed to the herbarium. Specimens were also found near Port Henry which were possibly growing in the same station in which the species was found more than 60 years ago.

Puccinia pyrolae Cke.

Horicon, Warren co. This is the second station in the State in which I have found this parasitic fungus. It is doubtless a rare species. No aecidial or uredo form of it was found in either station. The name was given on the supposition that the host plant is a species of Pyrola, but it is Polygala paucifolia.

Salix serissima (Bail.) Fern.

Lake Placid. June. Both staminate and pistillate plants were found growing side by side. In this instance the leaves become acuminate late in the season and more closely resemble the leaves of Salix lucida.

Trametes pini (Brot.) Fr.

The pine trametes was found near Albia, Rensselaer co. growing on pine ties of the electric railroad. The species is rare in our State and probably in this case the mycelium was introduced in the ties.

Trillium grandiflorum (Mx.) Salisb.

A singular monstrosity of the large flowered wake-robin was found near Syracuse and contributed by Mrs L. L. Goodrich. All the floral organs are petaloid or foliaceous, and instead of five whorls of three organs each, which is the usual number, there are 10 whorls of 3 in each. Beginning at the outside or exterior circle we find six green foliaceous organs, which may be taken to represent a double calyx. The next inner circle contains three white petaloid organs each with a green central stripe; then a circle of three green ones, one of which has its margins white. These two whorls may be taken to represent the petals. The third group consists of two circles containing three green organs in each, which represent the usual exterior row of stamens; then there are two circles of three white organs each, which correspond to the usual inner row of stamens. Finally the central group is composed of two circles of green foliaceous organs which may be taken to represent the three-parted pistil of the ordinary flower. This double flowered trillium is a good illustration of the old and well known theory that floral organs are simply modifications of leaves, for in this single example we find all the floral organs replaced by oblong leaves, some of which retain the usual green color of leaves wholly, some partly and some exhibit wholly the white color so often shown by petals.

Uromyces caricis Pk.

In my examination of the specimens on which this species was founded only single celled spores were found. Later examination by others revealed a few Puccinia spores. This led to the transfer of the species to the genus Puccinia and it now bears the name Puccinia caricis-strictae Diet. A second station in which this somewhat rare species has been found is Round Lake, Saratoga county.

Uromyces peckianus Farl.

Leaves of marsh spike grass, Distichlis spicata (L.) Greene. Port Jefferson. August. This parasitic fungus was formerly referred to Uromyces graminum Cke., but it has been separated and now bears the name here given.

Xyris montana Ries

Abundant in peat bogs along the outlet of White lake, where it forms continuous patches. Xyris caroliniana also occurs in the same locality. July. J. V. Haberer.

EDIBLE FUNGI

Tricholoma unifactum n. sp.

UNITED TRICHOLOMA

PLATE 94, FIG. 1–5

Pileus fleshy but thin, convex, often irregular, sometimes eccentric from its crowded mode of growth, whitish, flesh whitish, taste mild; lamellae thin, narrow, close, rounded behind, slightly adnexed, sometimes forked near the base, white; stem equal or thicker at the base, solid, fibrous, white, united at the base in a large fleshy mass; spores white, subglobose, .00016-.0002 of an inch broad.

The united tricholoma belongs to the section Guttata and is closely related to the northern tricholoma, Tricholoma boreale and to the whitish tricholoma, Tricholoma albellum. From the former it is separated by its different color, mode of growth and lack of odor, and from the latter by its color, the absence of spots on the cap and by its smaller subglobose spores. The stem and gills are white, the cap is nearly so. It has a watery white appearance when moist. The plants grow in clusters, several stems rising from a large whitish fleshy mass, by which character it is at once distinguished from all our other species of Tricholoma.

The taste is mild and there is no decided odor. The flesh is tender and of excellent flavor when properly cooked. The cap is 1-2 inches broad and the stem 1-2 inches long and 3-5 lines thick. It grows under hemlock trees and was found in Horicon, Warren co. in July.

Lactarius rimosellus n. sp.

RIMULOSE LACTARIUS

PLATE 95, FIG. 1–6

Pileus thin but firm, broadly convex, nearly plane or centrally depressed, dry, azonate, usually with a central papilla or minute umbo, minutely rimulose areolate, vinaceous cinnamon, flesh whitish, milk scanty, watery, taste mild; lamellae thin, narrow, close, decurrent, pallid or yellowish when young, colored nearly like the pileus when mature; stem slender, firm, equal or nearly so, glabrous, hollow, colored like the pileus; spores white, faintly tinged with yellow, subglobose, .0003-.00035 of an inch broad.

The rimulose lactarius is very closely related to the camphory lactarius, Lactarius camphoratus, resembling it in color, size and odor, but differing from it in the rimulose areolate cuticle and specially in its scanty watery milk. It is a small species having a cap that is 10-18 lines broad and a stem about 1 inch long and 2 lines thick. It grows on bare soil in woods or on banks of earth by roadsides. Wading River. August.

Lactarius serifluus (DC.) Fr.

THIN JUICED LACTARIUS

PLATE 95, FIG. 7–11

Pileus fleshy, firm, broadly convex becoming nearly plane or centrally depressed, dry, glabrous, azonate, vinaceous cinnamon, flesh whitish, milk watery, taste mild; lamellae thin, narrow, close, adnate or slightly decurrent, whitish when young, darker when mature; stem mostly short, equal or slightly tapering upward, solid, glabrous, colored like or a little paler than the pileus; spores globose or nearly so, white faintly tinged with yellow, .0003-.0004 of an inch broad.

The thin juiced lactarius has been found by me on Long Island only. It grows among fallen leaves in woods and shaded places and occurs in July and August. Its cap is firm in texture, broadly convex or nearly plane, usually becoming centrally depressed with age. It is dry, evenly colored of a peculiar brownish fawn or pale vinaceous cinnamon. The European plant is described as having a brownish tawny cap and no odor is attributed to it. In our plant there is a slight pleasant aromatic odor, but in all essential characters the agreement with the description of the European plant is so close that we consider them both to be specifically the same.

The cap is 1.5-3 inches broad, the stem 1-1.5 inches long and 4-6 lines thick.

Russula albida Pk.

WHITISH RUSSULA

PLATE 96, FIG. 1-7

Pileus fleshy, thin, fragile, hemispheric or very convex when young, becoming nearly plane or slightly depressed in the center, slightly viscid when moist, white, often tinged with yellow in the center, even or slightly striate on the margin, flesh white, taste mild or slightly and tardily bitterish and unpleasant; lamellae moderately thin, close, entire, occasionally forked at the base, adnate or subdecurrent, white or whitish, the interspaces often venose; stem equal or slightly tapering upward, glabrous, stuffed or hollow, white; spores white with a faint yellowish tinge, subglobose, .0003-.00035 of an inch long, nearly or quite as broad.

The whitish russula is readily recognized by its color which is wholly white or sometimes varied only by a slight yellowish tinge in the center of the cap, and in the mature or old gills. The thin margin of the cap is sometimes curved upward in old plants and the interspaces between the gills are usually venose. The pellicle of the cap is separable, indicating with the equal gills and fragile texture that the species belongs to the section Fragiles. The slowly developed bitterish or unpleasant flavor of the fresh plant disappears in cooking.

The cap is 1-2 inches broad, the stem 1-3 inches long and 3-5 lines thick. The plants grow among fallen leaves in woods. Specimens have been collected in Rensselaer and Suffolk counties.

Russula flavida Frost

YELLOWISH RUSSULA

PLATE 97, FIG. 1-6

Pileus fleshy, firm, convex or broadly convex becoming nearly plane or centrally depressed, dry, at first even, often becoming slightly striate on the margin when old, chrome-yellow, sometimes cadmium-yellow or orange in the center, flesh white, taste mild; lamellae rather thick, moderately close, entire or nearly so, adnate, white; stem equal or slightly tapering upward, solid, sometimes becoming spongy within and occasionally cavernous, colored like or a little paler than the pileus; spores yellowish, subglobose, .0003 of an inch long, nearly or quite as broad.

The yellowish russula is a very beautiful and an attractive species and it is very gratifying to find it edible. It is easily recognized by its color, for, though other species have the cap yellow, not many have both the cap and stem yellow, and none of these has them of the same shade of yellow as this. The cap is dry and the epidermis frequently breaks into minute mealy or granular yellow particles, indicating that the species belongs to the section Rigidae. The color often fades with age and sometimes the margin becomes white. The gills in the fresh plant are white but with age or in drying they often become dingy or assume a clay color. The interspaces are uneven with transverse veins. The stem is often a little paler than the cap, but it is usually more highly colored at the base than elsewhere. The mycelium appears to be of an orange color.

The caps are 2-3 inches broad, the stem 1.5-3 inches long and 4-8 lines thick. This mushroom grows in grassy places, among bushes or in woods and may be found in July and August. It is not common.

Russula sordida Pk.

SORDID RUSSULA

PLATE 98, FIG. 1-5

Pileus fleshy, firm, convex becoming centrally depressed, dry, even on the margin, sordid white becoming smoky brown with age, flesh grayish white becoming blackish brown where cut or broken, taste mild or sometimes tardily acrid; lamellae about equal in width to the thickness of the flesh, close, adnate or slightly decurrent, unequal, sometimes forked, white; stem short, firm, equal, solid, white, changing color like the pileus; spores white, globose, .0003 of an inch broad.

The sordid russula is a large unattractive species, but when fresh specimens free from larvae are fried in butter they make an excellent and relishable dish. It belongs to the section Compactae of which we have no species with a truly red cap, though the cap of Russula compacta Frost makes an approach to it. The cap of this species in young plants is nearly white, but it is soon stained with smoky brown patches, and with advancing age the whole surface assumes this color. In old age or in drying the whole plant becomes black. The flesh is compact but brittle, grayish white quickly changing to blackish brown when cut or broken and exposed to the air. The white gills and stem also undergo the same change in color as the cap when subjected to the same conditions. In comparatively young specimens it often happens that when the stem is split longitudinally the center will be found full of the perforations of insect larvae and the injured tissues all blackened. This mushroom closely resembles two other nearly related species, Russula nigricans and R. densifolia. From the first it may be separated by its dry cap, its closer gills and by its wounded places assuming a blackish color without any intervening reddish hue. From the second also this last character will distinguish it, for in both these species wounded places first change to a reddish color and afterward to a black or blackish color.

The cap is 3-6 inches broad, the stem 1-2 inches long and 6-12 lines thick. This mushroom grows under hemlock trees and appears during July if the weather is sufficiently rainy.

Russula subsordida n. sp.

SUBSORDID RUSSULA

PLATE 99, FIG. 1–5

Pileus fleshy, firm, convex becoming nearly plane or centrally depressed, glabrous, viscid when moist or young, even on the margin, whitish becoming smoky brown with age, sometimes with an olive-green tint, flesh grayish white, slowly changing to a darker or smoky brown color when cut or broken, taste mild or tardily and slightly acrid; lamellae thin, close, adnate, with many short ones intermingled, whitish; stem short, firm, glabrous, spongy within or sometimes cavernous, white slowly becoming smoky brown where wounded; spores white, globose, .0003 of an inch broad.

The subsordid russula is very similar to the sordid russula and grows in similar places. It is sometimes associated with it, growing in the same locality and at the same time. Hitherto it has been found in Horicon only, but occurred there in several stations. It may be distinguished from the sordid russula by its viscid cap which is also less white when young, by its less white gills and by its wounds more slowly assuming the smoky brown hue. Both are equally good to eat and equally unattractive in appearance. Both are apparently equally acceptable to insect larvae and both become black or nearly so in drying.

Russula viridella n. sp.

PALE GREEN RUSSULA

PLATE 100, FIG. 1–7

Pileus firm, subglobose, hemispheric or very convex, becoming nearly plane or centrally depressed, sometimes nearly funnelform, even on the margin, dry, soon minutely squamulose or furfuraceous, specially toward the margin, pale grayish green, generally smooth and paler or subochraceous in the center, flesh white, taste acrid; lamellae thin, narrow, close, some of them forked, occasionally anastomosing at the base, a few short ones intermingled, white; stem equal or nearly so, even, solid or spongy within, white; spores white tinged with yellow, globose or subglobose, .00024-.0003 of an inch long, nearly as broad; cystidia subfusiform, .0025-.003 of an inch long, .0006 broad.

The pale green russula is related to the greenish russula, Russula virescens, and has nearly the same colors, but it may be separated from the greenish russula by the minute squamules or fragments of the epidermis of the cap, the thinner and closer gills and by its acrid taste. When the cap is viewed in a certain light it has a pruinose appearance. The white gills are closely placed side by side and are sometimes connected with each other by transverse branches near the base. The stem is nearly cylindric, solid and white. It is very susceptible to the attacks of insect larvae and is often found perforated by them even in young plants. The acrid flavor of the fresh mushroom is destroyed by cooking.

The cap is 2.5-4 inches broad, the stem 2-3 inches long, and 5-8 lines thick. This species grows under hemlock trees and appears in July. It is gregarious and Horicon is at present the only locality where it has been found. It belongs to the section Rigidae. It is a fine addition to our mycological flora and to our list of edible mushrooms.

Russula variata Banning

VARIABLE RUSSULA

PLATE 101, FIG. 1–5

Pileus firm, convex becoming centrally depressed or somewhat funnelform, viscid, even on the thin margin, reddish purple or brownish purple often variegated with green, pea-green sometimes varied with purple, flesh white, taste acrid or tardily acrid; lamellae thin, narrow, close, often forked, tapering toward each end, adnate or slightly decurrent, white; stem equal or nearly so, solid, sometimes cavernous, white; spores white, subglobose, .0003-.0004 of an inch long, .0003 broad.

The variable russula is appropriately named for its caps are very variable in color. They are dark purple or reddish purple variously intermingled or variegated with green, or wholly pale green. The viscid pellicle is closely attached to the cap in the center but it is separable on the margin. In drying it sometimes forms obscure spots. Notwithstanding the variations in the color of the caps, the species is easily recognized for the gills are very constant in their characters. Their narrowness, closeness and numerous bifurcations are peculiar and very constant features. They are sometimes slightly decurrent, specially in mature specimens whose upcurved margin gives the cap a more or less funnel shape. The stem is white and solid or sometimes with central cavities arranged one above another.

The cap is 2-4 inches broad, the stem 1.5-3 inches long, 5-8 lines thick. This mushroom grows in woods and appears during July and August. It belongs to the section Furcatae, as shown by the even margin of the cap and the gills tapering toward each end. The acrid taste of the fresh cap is destroyed in cooking and the flavor is then very good.

Clavaria conjuncta n. sp.

CONJOINED CLAVARIA

PLATE 102, FIG. 1-3

Stems united at the base, forming tufts 3-5 inches tall and nearly as broad, fragile, solid, glabrous, white or whitish, divided above into numerous erect, crowded, solid branches which are whitish or pale buff, ultimate branchlets terminating in two or more blunt points which are pale pink, sometimes with a yellowish tinge, flesh white, taste mild; spores dingy yellow in a thin stratum, subochraceous in a thick one, oblong, .0004-.0005 of an inch long, .00016-.0002 broad.

The conjoined clavaria is a large tufted and attractive species closely related to Clavaria flava on one hand and to C. botrytoides on the other. From the first it may be distinguished by the pinkish tips of the branchlets, from the second by their paler color and greater permanence and from both by the larger spores. It is similar to both in its fragile tender flesh and pleasant flavor. It grows among fallen leaves in woods. It was found at Bolton Landing, Warren co. which yet remains its only known locality.

Hypomyces lactifluorum (Schw.) Tul.

RED HYPOMYCES

PLATE 103, FIG. 1-7

Subiculum thin, at first whitish, soon orange or cinnabar-red, effused over the surface of the host plant, transforming, hardening and deforming it and changing its color so that it is rarely recognizable; perithecia minute, abundant, sunk in the subiculum and appearing like minute red dots on the surface, becoming brown or blackish with age or in drying; asci slender, linear; spores white in the mass, monostichous, oblong fusiform, pointed or cuspidate at each end, uniseptate, .0015-.0018 of an inch long, .0003 broad.

The red hypomyces is a puzzling fungus to the young mycologist. It is one very frequently received at the office with inquiries concerning its name and nature. Its bright color makes it an attractive object, but its very irregular and inconstant shape makes it difficult to locate in any known genus of mushrooms. It really is a parasitic fungus and it and its host plant are so intimately united that they are taken by the inexperienced to be one thing. The parasite attacks and lives upon some of the fleshy mushrooms, changing their form, color and texture so much as to obliterate or disguise their characters and render them almost unrecognizable. The original specimens described by L. D. Schweinitz are said by him to be parasitic on species of Lactarius, specially L. piperatus. It is now known that the parasite sometimes attacks also the chantarelle, Cantharellus cibarius Fr. as shown by specimens but partly developed and slightly changed.

The parasite hardens the flesh of the host plant and makes it more dry, firm and crisp, but it is not tough. It is generally free from insect larvae, inviting in appearance and, though not highly flavored, is relishable and perfectly harmless. It needs thorough cooking and proper seasoning to make it most satisfactory. The host plant really furnishes the most of the material eaten. The parasite, the red hypomyces, forms but a thin layer over the surface of the host plant. By peeling away all the red part and cooking only the white interior the dish would be composed entirely of the flesh of the host. By utilizing the red part only, that is the hypomyces, the quantity would be so small as scarcely to be worthy of consideration.

The attack by the parasite must be made early in the development of the host, for it is already discolored and deformed when it has but partly emerged from the ground. The spores of the parasite probably pass the winter in the ground and germinate when, by the early development of the host or by other causes, they are brought in contact with it. Usually the parasite fruits on the hymenium and stem of the host and these parts therefore are dotted by the mouths of the perithecia of the parasite and more highly colored than the upper surface. Still, the change of color of the upper surface shows that the influence of the parasite extends to it.

SPECIES OF CRATAEGUS FOUND WITHIN TWENTY MILES OF ALBANY

BY C. S. SARGENT AND C. H. PECK

Early in 1902 Prof. C. S. Sargent informed the writer that he had noticed some fine patches of thorn bushes a short distance west of Albany and suggested that it might be well to examine them. The suggestion was promptly adopted and this paper is one of the results of that suggestion. At that time three species and their supposed varieties constituted the known Crataegus flora of the territory now under consideration. At the present time 54 native and one introduced species are known to be included in it. This territory is bounded by a circumference which has Albany for its center and a line 20 miles long for its radius. Only certain portions of the northern half of this circle have been carefully explored. These parts or localities may be named and described as follows.

North Albany lies just north of the city and is bounded on the north by Ford road, east by Troy road, south by North First street and west by the road running north from Loudonville road to the junction of Ford road with Northern boulevard.

West Albany includes Tivoli hollow and its adjoining hillsides. It lies on both sides of the New York Central & Hudson River Railroad tracks between the city of Albany and the railroad shops at West Albany.

Menands includes the territory between the outlet of Little's pond on the north and Ford road on the south, and between the Erie canal on the east and the northern extension of the Boulevard from Ford road to Little's pond on the west. It includes the canal lot, Troy road and tollgate localities, Golf ground and Boulevard pasture.

North Greenbush lies east of the Hudson river and extends north from Forbes avenue 1 mile and east from the river about ½ mile. It includes Forbes manor grounds.

Greenbush includes the hillsides east of Rensselaer and between Nassau road on the south and the old red mill creek on the north. It is divided into two parts by a ravine and small stream.

Watervliet is used to designate the hills and valley of Dry river just west of the city of Watervliet. It has not been thoroughly explored.

Lansingburg is a small area extending north from the car barns about ½ mile and east from the Hudson river scarcely more than 2 furlongs. It is a small area but one rich in species. It contains one species not yet found elsewhere, and two found in no other place within the limits covered by this essay.

Albia is used to designate a small strip of land lying between the electric road and the Wynantskill creek about 2 furlongs south of the Albia car station.

Wynantskill designates a strip of land along the Sand Lake turnpike, beginning at the junction of the Poestenkill road and running south about 1 mile.

Sand Lake is used in this article to designate a comparatively small part of the town of that name, lying near its center and about 10 miles east of Albany. One species is peculiar to this locality and four are found in a single rocky pasture.

Thompson Lake designates a narrow strip of territory lying along the western and southeastern shore of the lake of that name. It is about 18 miles in a direct line west from Albany. Crataegus dilatata Sarg. occurs here, but is not known to be elsewhere in our present limits.

Hillsides, ravines and the margins of lakes and streams are favorite habitats of species of Crataegus. Those in the immediate vicinity of Albany grow for the most part in clayey soil. A few grow apparently in sandy soil but in some places the sand forms a thin stratum over clay and it is possible that the roots of the thorn bushes may penetrate to the clay. In the Lansingburg locality the soil is a shaly loam formed by the disintegration of Hudson River shales. This soil is apparently very suitable to species of the group Intricatae. All of the five species of this group known to occur in our State are found here. One of these has yet been found in no other place.

The peculiar tendency of species of Crataegus to flock together is strikingly illustrated in our territory. It is rare to find any large area occupied by a single species. Where many thorn trees and bushes grow together there are usually many species. A remarkable example of this kind is found in a narrow strip of pasture land bordering the Erie canal near Menands. Here 10 species are growing in an area of about 1 acre. The closest condensation of numerous species that I have seen anywhere is near Albia where nine of our native species are growing in a kind of irregular row along the west bank of the Wynantskill creek. The length of the row is about 100 feet. It is also worthy of remark that three of these species, Crataegus ferentaria, C. rhombifolia and C. succulenta, belong to the group Tomentosae. Such close associations of members of a single group as this and the one at Lansingburg are very significant and when more fully understood may possibly throw some light on the interesting problem of the development of species.

Rochester and its vicinity, with 41 species, are justly thought to be unusually prolific in species of Crataegus, but Albany and its vicinity surpass even that rich Crataegus center in the number of its known species.

From the synoptic table here given, the range of each species and the number of species in each locality can easily be ascertained.

Crataegus tomentosa, which has not recently been found in our limits, and Crataegus oxyacantha, which is growing spontaneously in the North Albany locality, but which is an introduced species, are omitted from the table.

SYNOPTIC TABLE

	North Albany	West Albany	Menands	North Greenbush	Greenbush	Watervliet	Lansingburg	Albia	Wynantskill	Sand Lake	Thompson Lake
Crataegus											
acclivis	+	...	+	...	...	...	...	...	...	...	...
acuminata	+	+	...	...	...	...	...	...	...	...	...
ambrosia	...	...	+	...	...	...	...	...	...	...	...
ascendens	...	...	...	...	...	...	...	...	...	...	+
asperifolia	...	...	+	...	...	...	...	...	...	...	...
beckiana	...	...	...	+	...	...	...	...	...	...	...
casta	...	...	...	+	...	...	...	...	...	...	...
caesariata	+	...	...	...	...	...	...	...	+	...	...
champlainensis	+	...	+	+	...	...	...	...	...	...	...
coccinea	+	...	...	...	...	...	...	...	...	...	...
" rotundifolia	...	...	...	...	...	+	...	+	+	...	...
conjuncta	+	+	+	+	+	...	+	...	...	...	...
conspicua	...	...	+	...	...	...	...	...	...	...	...
contortifolia	+	+	+	+	...	...	...	...	...	...	...
crus-galli	+	+	+	+	+	+	...	...	...	...	...
delucida	+	+	+	...	...	...	...	...	...	...	...
demissa	...	+	+	...	+	...	...	+	...	...	...
dilatata	...	...	...	...	...	...	...	...	...	...	+
dissona	+	+	...	...	+	+	+	...	...	...	+
divergens	...	...	...	+	...	...	...	...	...	...	...
dodgei	+	+	+	...	...	...	+	...	...	...	...
durobrivensis	+	+	...	...	...	...	...	...	...	...	...
eatoniana	...	...	+	...	...	...	...	...	...	...	...
edsoni	...	...	...	...	...	...	+	...	...	...	...
exclusa	+	...	+	...	+	...	...	+	...	...	...
ferentaria	+	...	...	...	...	...	...	+	...	...	...
flagrans	...	...	...	+	...	...	...	...	...	...	...
foetida	+	...	...	...	...	+	+	...	...	...	...
gemmosa	...	...	+	...	...	...	...	...	...	...	...
genialis	+	+	+	+	+	+	...	+	+	+	...
halliana	+	...	+	...	...	...	...	...	...	...	...
helderbergensis	...	...	...	...	...	...	...	...	...	...	+
holmesiana	+	+	+	+	...	+	...	+	...	...	+
howeana	+	...	+	...	...	...	...	...	...	...	...
hudsonica	...	+	+	...	+	...	...	...	...	...	...
hystericina	...	...	...	...	...	...	...	...	...	...	+
illuminata	+	+	...	+	...	...	...	...	...	...	...
intricata	+	+	+	...	+	+	+	...	...	...	...
lobulata	...	...	+	...	...	...	...	...	...	...	...
mellita	...	...	...	...	...	...	...	...	...	+	...

SYNOPTIC TABLE (*continued*)

	North Albany	West Albany	Menands	North Greenbush	Greenbush	Watervliet	Lansingburg	Albia	Wynantskill	Sand Lake	Thompson Lake
Crataegus (*continued*)											
menandiana	...	...	+	...	...	...	...	...	...	...	...
modesta	+	+	+	...	+	+	+	...	...	...	...
oblongifolia	...	...	+	...	...	...	...	...	...	...	...
peckii	...	...	...	...	...	...	+	...	...	...	...
pentandra	...	...	+	+	+	...	...	...	...	...	...
polita	...	...	...	...	...	...	...	...	...	+	...
pruinosa	+	+	+	...	...	...	+	...	...	...	...
punctata	+	+	+	+	+	+	+	+	...	+	...
" aurea	+	+	+	+	...	...	...	...	...	...	...
" canescens	...	...	...	+	...	...	...	...	...	...	...
rhombifolia	+	+	...	...	...	...	...	+	...	...	+
robbinsiana	...	+	...	...	+	...	...	...	...	+	...
rubrocarnea	+	...	...	...	...	...	...	...	...	...	...
sejuncta	...	+	...	...	...	...	...	...	...	...	+
spissiflora	...	...	+	...	...	...	...	...	...	...	...
succulenta	+	...	...	...	...	...	...	+	...	...	...
verecunda	...	...	...	...	...	...	+	...	...	...	...
54	27	20	28	13	12	9	11	9	3	5	8

CRUS-GALLI

Stamens 10

Anthers rose color

Crataegus crus-galli Linnaeus

Spec. 476 (1753).—Sargent, Silva N. Am. iv. 91, t. 178; Man. 368, f. 286.

North Albany, West Albany, Menands, North Greenbush, Greenbush and Watervliet. Common. Charles H. Peck.

Stamens 10-14

Anthers white, sometimes faintly tinged with pink

Crataegus helderbergensis n. sp. Sarg.

Leaves obovate, to nearly oval on leading shoots, rounded or rarely acute or short-pointed at the apex, gradually narrowed downward from near the middle, concave cuneate and entire below, coarsely and often doubly serrate above, with straight glandular teeth, more than half grown when the flowers open during the first week in June, and then membranaceous, dark yellow green and covered on the upper surface with short pale hairs and sparingly villose pubescent below along the midribs and veins, at maturity subcoriaceous to coriaceous, glabrous, dark green and very lustrous above, pale yellow green and still pubescent below, 4-6 cm long and 3-4 cm wide, with narrow prominent orange-colored midribs often tinged with red below toward the base, and four or five pairs of slender primary veins without the parenchyma and extending obliquely to above the middle of the leaf; petioles stout, wing-margined to below the middle, villose along the upper side while young, becoming nearly glabrous, occasionally glandular, with bright red stipitate caducous glands, 1-1.2 cm in length, leaves on vigorous shoots mostly obovate, rather broader in proportion to their length, often 7-8 cm long and 5 cm wide. Flowers 1.3-1.5 cm in diameter, on slender elongated densely villose pedicels, in usually 15 to 20-flowered hairy corymbs, with linear bracts and bractlets, fading red and mostly deciduous before the flowers open; calyx tube narrowly obconic, covered specially toward the base, with long matted white hairs, the lobes slender, acuminate, glandular serrate, with minute dark red stipitate glands, bright green and glabrous on the outer and villose pubescent on the inner surface, reflexed after anthesis; stamens 10 to 14, usually 10; anthers white, rarely faintly tinged with pink; styles two or three. Fruit ripening from the first to the middle of October and persistent till after the leaves have fallen, on long slender villose pedicels, in few-fruited drooping clusters, short-oblong to obovate, full and rounded at the apex, gradually narrowed to the base, crimson, lustrous, marked by occasional dots, about 1 cm long and 8 mm wide; calyx little enlarged, with a short tube, a narrow deep cavity, and spreading or reflexed glandular serrate lobes pubescent on the upper side and often deciduous from the ripe fruit; flesh thin, dry and mealy, yellow or orange color; nutlets 2 or 3, full and rounded at the ends, ridged on the back, with a broad often grooved ridge, 8-9 mm long and 4-5 mm wide.

A tree 2-3 m high, with a short stem 5-10 cm in diameter, widespreading mostly horizontal branches forming a flat topped head, the stout zigzag branchlets bright orange color and coated with long matted white hairs when they first appear, becoming glabrous, orange or reddish brown and lustrous during their first season and ashy gray the following year, and armed with many slender straight or slightly curved bright purplish or chestnut-brown shining spines often pointing toward the base of the branch and 4.5-7 cm long.

Near Thompson Lake, Helderberg region, Charles H. Peck (#76n, type), June and September 1903, 1904.

Easily distinguished from the other northern species of this group by the nearly white anthers, by the exceedingly villose pedicels, the villose pubescent underside of the midribs and veins, and from several southern and southwestern species with hairy inflorescence, by the shape of the leaves and the character of the fruit.

PUNCTATAE

Stamens 20

Anthers rose color or yellow

Crataegus punctata Jacquin

Hort. Vind. i. 10, t. 28 (1770).—Sargent, Silva N. Am. iv. 103, t. 184; Man. 389, f. 308.

North Albany, West Albany, Menands, Albia, Greenbush, North Greenbush, Watervliet and Sand Lake. Very common. Charles H. Peck.

Crataegus punctata var. **aurea** Aiton

Hort. Kew. ii. 170 (1789).

North Albany, West Albany, Greenbush, North Greenbush, Menands, Charles H. Peck.

Crataegus punctata var. **canescens** Britt.

Bul. Torrey Bot. Club, xxi. 231 (1894).—Sargent, Man. 389.

North Greenbush, Charles H. Peck.

Anthers pale pink

Crataegus eatoniana n. sp. Sarg.

Leaves ovate to obovate, acute and often short-pointed at the apex, gradually or rarely abruptly narrowed to the concave cuneate entire base, finely doubly serrate, with straight or incurved glandular teeth, and usually slightly divided into four or five pairs of narrow acuminate lateral lobes, nearly fully grown when the flowers open the middle of May and then membranaceous, light yellow green, smooth and glabrous on the upper surface with the exception of a slight pubescence along the midribs and veins, pale and slightly hairy along the midribs and veins below, at maturity thin but firm in texture, dark bluish green and glabrous above, pale yellow green and almost glabrous below, 5.5-8 cm long and 4.5-5.5 cm wide, with stout yellow midribs and slender primary veins extending obliquely to the points of the lobes; petioles slender, wing-margined at the apex, slightly grooved and puberulous on the upper side, becoming glabrous, 1.5-3 cm in length. Flowers about 1.5 cm in diameter, on stout glabrous pedicels, in wide many-flowered corymbs, the lower peduncles from the axils of upper leaves, with obovate to linear obovate or linear bracts and bractlets glandular serrate toward the apex and persistent till after the flowers open; calyx tube narrowly obconic, glabrous, the lobes slender, red and glandular at the acuminate apex, entire or occasionally sparingly glandular toward the base, glabrous on the outer and slightly hairy on the inner surface; stamens 16 to 20; anthers pale pink; styles two or usually three. Fruit on slender drooping red pedicels, in usually 5 to 10-fruited clusters, short-oblong to depressed-globose, full and rounded at the apex, slightly narrowed and rounded at the base, bright cherry-red, lustrous, marked by small pale dots, 1.2-1.4 cm long and 1-1.2 cm wide; calyx prominent, with a broad deep cavity and spreading appressed lobes mostly deciduous from the ripe fruit; flesh thick, dry and mealy, tinged with red; nutlets two or three, full and rounded at the apex, ridged on the back, with a broad rounded ridge, 6-7 mm long and about 5 mm wide.

A shrub 3-4 m high, with many erect stems covered with dark brown bark and spreading into thickets, stout branches, the lower spreading, the upper ascending, and slender nearly straight branchlets marked by oblong pale lenticels, dark orange color and slightly hairy when they first appear, soon glabrous, bright red brown and lustrous during their first winter and dull gray brown the following year, and armed with slender straight or slightly curved bright chestnut-brown shining ultimately gray spines 3-4.5 cm long, much elongated and branched on old stems and large branches.

Menands, Golf grounds, Charles H. Peck (♉ 3. tgm, type). May and October.

This species is named in memory of Amos Eaton (1776-1842)-principal and senior professor in the Rensselaer Polytechnic Insti. tute of Troy and author of the *Manual of Botany of North America*,

PRUINOSAE

Stamens 20

Anthers rose color

Crataegus pruinosa K. Koch

Verhandl. Preuss. Gart. Verein. neue reihe, i, 246 (1874).—Sargent, Silva N. Am. xiii. 61, t. 648; Man. 411, f. 331.

Lansingburg, Peck and Sargent, August 1905.

Anthers pale pink

Crataegus howeana n. sp. Sarg.

Leaves ovate, acute or acuminate, full and rounded or gradually narrowed and cuneate at the entire base, finely and often doubly serrate above, with straight glandular teeth, and usually slightly divided into three or four pairs of spreading acuminate lateral lobes, nearly half grown when the flowers open about the middle of May and then membranaceous, light yellow green, smooth and sparingly pubescent along the midribs above and pale and glabrous below, at maturity thin, glabrous, blue green, dark and dull on the upper and paler on the lower surface, 3-4 cm long and 2.5-3 cm wide, with slender midribs and thin primary veins extending to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular, with occasional minute, dark, often persistent glands, 1.4-2 cm in length; stipules linear, acuminate, finely glandular serrate, fading red, caducous; leaves on vigorous shoots broadly ovate to nearly orbicular, full and rounded or truncate at the base, more coarsely serrate and more deeply lobed, 5-6 cm long and wide, with reddish, often conspicuously glandular petioles 2-3 cm in length. Flowers 1.3-1.8 cm in diameter, on slender glabrous pedicels, in 5 to 10-flowered corymbs, with linear to linear obovate glandular rose-colored bracts and bractlets often persistent till after the flowers open; calyx tube broadly obconic, glabrous, the lobes abruptly narrowed from wide bases, acuminate, short, entire, tipped with dark red glands, reflexed after anthesis;

stamens 20; anthers pale pink; styles three to five. Fruit ripening about the 20th of October and soon falling, on long slender drooping pedicels, usually in five to seven-fruited clusters, globose to depressed-globose, angular reddish and pruinose when fully grown, becoming scarlet and lustrous at maturity, 1.3-1.5 cm in diameter; calyx prominent, with a short tube, a wide shallow cavity, and spreading lobes dark red on the upper side below the middle, their tips usually deciduous from the ripe fruit; flesh thin, reddish, of a pleasant flavor; nutlets three to five, full and rounded at the base, acute or rounded at the apex, very prominently ridged on the back, with a broad deeply grooved ridge, 7-8 mm long and about 5 mm wide.

An intricately branched shrub 3-5 m high, with several stout ascending and spreading stems covered below with dark brown scaly bark, and stout zigzag branchlets marked by numerous small lenticels, dark orange-green and glabrous when they first appear, becoming light red brown in their first winter and brown or ashy gray the following year, and armed with many small straight red brown spines 2-3 cm long.

Menands, Troy road, Albany co., Charles H. Peck (# 75, type), May and October 1903; North Albany, (# 4 B), May and October 1903, June 1904.

This species is named in memory of Elliot C. Howe (1828-1899), author in connection with Dr H. C. Gordinier of a *Flora of Rensselaer County* [*see* Bul. Torrey Bot. Club, xxvi. 251].

Crataegus casta n. sp. Sarg.

Leaves ovate to oval, acuminate, gradually or abruptly narrowed and concave cuneate or broad and rounded at the entire base, sharply doubly serrate above, with straight glandular teeth, and slightly divided into numerous small acuminate spreading lobes, nearly half grown when the flowers open the middle of May and then membranaceous, light yellow green and glabrous with the exception of a few hairs at the base of the upper side of the midribs, at maturity thin, light blue green, smooth and lustrous on the upper and dull blue green on the lower surface, 5-6 cm long and 4-5 cm wide, with thin yellow midribs, and four or five pairs of slender primary veins extending obliquely to the points of the largest lobes; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, soon glabrous, 2-3.5 cm in length. Flowers about 1.5 cm in diameter, on slender glabrous pedicels, in usually five to six-flowered compact corymbs, with lanceolate acuminate glandular rose-colored bracts and bractlets; calyx tube broadly obconic, glabrous, the lobes gradually narrowed from wide bases, acuminate, entire or slightly glandular serrate near the middle, glabrous, reflexed after anthesis; stamens 20; anthers pale pink; styles usually 3. Fruit ripening early in October, on short stout erect or drooping pedicels, in usually three or four-fruited clusters, obovate, rounded at the apex, narrowed toward the usually pointed base, bright cherry-red, covered with a glaucous bloom, marked by occasional small pale dots, 1-1.3 cm long and 8-10 mm wide; calyx prominent, with a short distinct tube, a broad shallow cavity, and spreading closely appressed lobes dull red on the upper side below the middle and mostly persistent on the ripe fruit; flesh thin, light yellow, dry and mealy; nutlets three, full and rounded at the base, gradually narrowed and acute at the apex, rounded and sometimes slightly and irregularly ridged on the back, light colored, 6-7 mm long and about 5 mm wide.

A shrub 2-3 m high, with numerous ascending stems and slender nearly straight branchlets marked by small dark lenticels, dark orange color when they first appear, becoming bright chestnut-brown and very lustrous in their first winter and dull gray brown the following year, and armed with slender nearly straight purplish shining spines 2.5-3 cm long.

Borders of woods at the margins of the bottom lands of the Hudson river at North Greenbush, Charles H. Peck (# 23ng, type) May and October 1904; Peck and Sargent, August 1905.

Anthers white

Crataegus conjuncta Sarg.

Rhodora, v. 57 (1903).

North Albany, West Albany, Greenbush, North Greenbush, Lansingburg, Menands, Charles H. Peck (# 14, 18, 57), May, June and October 1903 and 1904. Common; also southern New England to Illinois.

Stamens 10 or less

Anthers rose color

Crataegus dissona Sarg.

Rhodora, v. 60 (1903).

North Albany, West Albany, Greenbush, Lansingburg, Thompson Lake, Watervliet, Charles H. Peck (# 171), May and October 1903; also southern New England to eastern Pennsylvania and northern Illinois.

Crataegus robbinsiana Sarg.

Rhodora, vii. 197 (1905).

West Albany, Greenbush, Sand Lake, Charles H. Peck (# 32, 112), May and October 1903 and 1904; also in western and southern Vermont and western New Hampshire.

TENUIFOLIAE

Stamens 5-10

Anthers rose color

Crataegus pentandra Sarg.

Rhodora, iii. 25 (1901); Silva N. Am. xiii. 129, t. 681.

West Albany (# 100), North Greenbush (# 152 with very narrow long stalked leaves and small fruit on long pedicels), Menands, Troy road (# 58 tr), Charles H. Peck, May and September 1903; also common in western New England.

Crataegus genialis Sarg.

Rhodora, v. 148 (1903).

North Albany, West Albany, Greenbush, North Greenbush, Menands, Sand Lake, Albia and Watervliet. Common. Charles H. Peck (# 13, 19, 88), May and September 1902; also in western New England.

Crataegus demissa Sarg.

Rhodora, v. 139 (1903).

West Albany, Greenbush, Albia. Rare. Charles H. Peck (# 89), May and September 1904; also in Gansevoort, Saratoga co. and in western Massachusetts and Vermont.

Crataegus delucida Sarg.

Rhodora, v. 139 (1903).

Hills; North Albany, West Albany and Menands. Very common and the prevailing species. Charles H. Peck (# 3 B, 36), May, September and October 1902; also in western Vermont.

Crataegus rubrocarnea n. sp. Sarg.

Leaves ovate, acute, gradually or abruptly narrowed and cuneate or occasionally broad and rounded at the base, finely, often doubly serrate, with straight slender glandular teeth, and slightly divided into four or five pairs of narrow acuminate lateral lobes, about half grown when the flowers open from the 10th to the 15th of May and then membranaceous, light yellow green and covered above by short white hairs, pale and glabrous below, at maturity thin, dark yellow green and glabrous on the upper and pale or glaucous on the lower surface, 5-7 cm long and 4-6 cm wide, with slender yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, nearly terete, sparingly glandular, 2-3 cm in length; leaves on vigorous shoots more coarsely serrate and more deeply lobed, usually 7-8 cm long and 6-7 cm wide. Flowers 1.5-1.7 cm in diameter, on short slender pedicels, in long-branched many-flowered compact corymbs; calyx tube narrowly obconic, glabrous, the lobes slender, acuminate, glabrous, minutely glandular serrate, reflexed after anthesis; stamens seven or eight, or occasionally 10; anthers purple; styles two or three, surrounded at the base by a broad ring of pale tomentum. Fruit ripening and falling early in October, on slender drooping reddish pedicels, in few-fruited clusters, short-oblong to subglobose, scarlet, lustrous, marked by occasional dark dots, 1.2-1.4 cm in diameter; calyx little enlarged, with a deep narrow cavity and closely appressed lobes, dark red on the upper side toward the base and mostly persistent on the ripe fruit; flesh thick, juicy, dark red; nutlets two or three, gradually narrowed and acute at the ends, ridged on the back, with a high broad deeply grooved ridge, 6-7 mm long and about 5 mm wide.

A shrub 3-4 m high, with erect stems covered below with blackish or grayish black bark, widespreading and ascending branches, and slender nearly straight branchlets marked by small pale lenticels, orange-green and glabrous when they first appear, becoming bright chestnut-brown and lustrous in their first winter and dull gray brown the following year, and armed with numerous stout slightly curved bright chestnut-brown and shining spines, 3.5-4 cm long.

Hillsides in clay soil; North Albany, Charles H. Peck (#56, type), May, August and September 1904, 1905.

Well distinguished by its large nearly globose fruit with red succulent flesh.

Crataegus acuminata n. sp. Sarg.

Leaves ovate or oblong-ovate, long-pointed and acuminate at the apex, gradually narrowed and concave cuneate or broad, rounded or subtruncate at the entire base, finely doubly serrate above, with incurved glandular teeth, and deeply divided into three to five pairs of narrow acuminate mostly spreading lateral lobes, more than half grown when the flowers open from the middle to the 20th of May and then membranaceous, light yellow green and covered above by short white hairs, pale and glabrous below, at maturity thin, glabrous, dark yellow green and somewhat lustrous on the upper and pale on the lower surface, usually 4.5-5 cm long and

2-3 cm wide, or occasionally 6-7 cm long and 4-5 cm wide, with thin yellow midribs and slender primary veins arching obliquely to the points of the lobes; petioles very slender, slightly wing-margined at the apex, nearly terete, glandular, with occasional scattered glands, glabrous, 1.5-2 cm in length; leaves on vigorous shoots rounded, truncate or abruptly cuneate at the broad base, coarsely serrate, more deeply lobed, often 7-8 cm long and 5-6 cm wide. Flowers on slender glabrous pedicels, in usually five to eight-flowered corymbs; calyx tube narrowly obconic, glabrous, the lobes slender, acuminate, glabrous, entire or sparingly glandular near the middle, reflexed after anthesis; stamens seven or eight; filaments persistent in fruit; anthers dark red; styles three or four, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening from the first to the middle of September, on elongated slender pedicels, in few-fruited drooping clusters, short-oblong to subglobose, full and rounded at the ends, crimson, lustrous, 1-1.2 cm long, 8-9 mm wide; calyx little enlarged, with a wide deep cavity and narrow closely appressed entire or slightly serrate lobes dark red on the upper side below the middle and usually persistent on the ripe fruit; flesh yellow, juicy, of excellent flavor; nutlets three or four, usually three, gradually narrowed and rounded at the ends, slightly ridged on the back, with a low rounded ridge, about 6 mm long and 4 mm wide.

A shrub 3-4 m high, with slender suberect or diverging stems, slender nearly straight branchlets marked by numerous small dark lenticels, light orange-green and glabrous when they first appear, light chestnut-brown and lustrous during their first winter, becoming dull gray brown in their second year, and armed with numerous slender curved chestnut-brown shining spines 2-3 cm in length.

West Albany (east side) and North Albany, Charles H. Peck (# 93 wa, type), May, August and October 1904.

Crataegus ascendens Sarg.

Rhodora, v. 141 (1903).

Thompson Lake, Charles H. Peck (# 76), May and September 1903; also in western Vermont.

Stamens 20

Anthers rose color or purple

Crataegus edsoni Sarg.

Rhodora, vii. 205 (1905).

Lansingburg, Charles H. Peck (# 15l), May and September 1903; also from western Vermont to western New Hampshire.

Crataegus mellita n. sp. Sarg.

Crataegus brainerdi Peck (not Sargent), N. Y. State Mus. Bul. 75. 1904. p. 12.

Leaves ovate, acuminate, rounded or occasionally cuneate at the glandular base, finely doubly serrate above, with slender glandular teeth, occasionally divided into four or five pairs of narrow acuminate lobes, about half grown when the flowers open the middle of May and then membranaceous, dark yellow green, villose pubescent along the midribs and slightly roughened by short white hairs above and pale and glabrous below, at maturity thin, dark bluish green and scabrate on the upper and pale blue green on the lower surface, 4.5-6 cm long and 3-5 cm wide, with slender yellow midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, grooved on the upper side, glabrous, glandular toward the apex, 2-4 cm in length. Flowers fragrant, about 1.5 cm in diameter, on short slender glabrous pedicels, in compact 6 to 12-flowered corymbs; calyx tube narrowly obconic, glabrous, the lobes usually entire or sparingly glandular serrate near the middle, often tinged with red, reflexed after anthesis; stamens 20; filaments elongated, becoming red or pink, persistent and conspicuous on the fruit; anthers light red; styles three or four, usually three, surrounded at the base by a few pale hairs. Fruit ripening late in September, on short erect reddish pedicels, in few-fruited clusters, oblong to oblong-obovate, full and rounded at the apex, gradually narrowed at the base, bright scarlet, lustrous, 1.2-1.4 cm long and 8-9 mm wide; calyx prominent, with a short tube, a narrow deep cavity, and reflexed lobes bright red on the upper side below the middle and persistent on the ripe fruit; flesh thin, yellow and edible; nutlets usually three, gradually narrowed and rounded at the ends, ridged on the back, with a low narrow ridge, about 7 mm long and 4 mm wide.

A shrub 2-3 m high, with ascending or suberect stems, and slender nearly straight branchlets marked by numerous small dark lenticels, dark orange colored tinged with red when they first appear, becoming light chestnut-brown, lustrous and pale gray brown in their second season, and armed with light chestnut-brown shining spines 3-3.5 cm long.

Rocky pastures. Rare. Sand Lake, Charles H. Peck (#23 sl, type), May and September 1903, June 1905.

The fragrant flowers are visited by large numbers of honeybees.

MOLLES

Stamens 10

Anthers pale yellow

Crataegus champlainensis Sarg.

Rhodora iii. 20 (1901); Silva N. Am. xiii. 105, t. 667; Man. 438, f. 356.

North Albany, Menands, North Greenbush, Charles H. Peck (# 2 gg), May and September 1904, 1905.

Crataegus contortifolia n. sp. Sarg.

Leaves ovate, acute, rounded, truncate or occasionally abruptly cuneate at the broad entire or glandular base, sharply doubly serrate above, with straight gland-tipped teeth, and slightly divided into four or five narrow acuminate lateral lobes, about half grown when the flowers open early in May and then membranaceous, light yellow green and roughened above by short white hairs, and villose below, specially along the midribs and veins, with long soft hairs mostly persistent during the season, at maturity thick and firm to subcoriaceous, with margins usually more or less contorted or twisted, yellow green, lustrous and scabrate on the upper and dull and pale on the lower surface, 7-8 cm long and nearly as wide, with stout rose-colored midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, thickly covered when they appear with hoary tomentum, becoming villose or pubescent, glandular while young, 3-3.5 cm in length; stipules linear, elongated, acuminate, glandular, fading rose color, caducous; leaves on vigorous shoots more coarsely serrate and more deeply lobed, thicker, often 9-10 cm long, with more prominent midribs and veins, and stout petioles bright rose color and conspicuously glandular above the middle, with dark stipitate persistent glands. Flowers 1.8-2 cm in diameter, on short, stout, hoary tomentose pedicels, in compact, usually 9 to 12-flowered, hoary-tomentose corymbs, with lanceolate acuminate glandular bracts and bractlets fading rose color; calyx tube narrowly obconic, coated with thick hoary tomentum, the lobes slender, acuminate, glandular serrate, villose pubescent, reflexed after anthesis; stamens 10; anthers pale yellow; styles four or five, surrounded at the base by a narrow ring of white hairs. Fruit ripening from the middle to the end of August and soon falling, on stout pedicels covered with matted pale hairs, in compact many-fruited drooping clusters, subglobose to short oblong, bright cherry-red, lustrous, marked by occasional large dark dots, covered with soft whitish hairs most abundant at the ends, about 1.5 cm in diameter; calyx little enlarged, hoary tomentose, with a broad shallow cavity, and spreading and appressed glandular serrate lobes dark red on the upper side below the middle; flesh thick, yellow, dry and mealy; nutlets four or five, usually four, full and rounded at the base, gradually narrowed and acute at the apex, rounded and slightly ridged on the back, 8-9 mm long and about 6 mm wide.

A shrub sometimes 6-7 m high, but usually much smaller, with diverging stems 12-15 cm in diameter, covered with dark brown scaly bark, stout spreading gray branches forming a roundtopped compact head, and thick zigzag branchlets marked by oblong dark lenticels, thickly covered with hoary tomentum when they first appear, light chestnut-brown, lustrous and sparingly villose during their first season, dull gray or grayish brown, duller and glabrous in their second year, and ultimately ashy gray, and armed with numerous stout or slender nearly straight purplish spines 4-7 cm long.

Hills; North Albany, Charles H. Peck (#53, type), May, June and September 1902; Peck and Sargent, October 1902, August 1905. Near the tollgate, Troy road, Charles H. Peck (#2), May and October 1904; Peck and Sargent, August 1905. Bottoms of the Hudson river, North Greenbush, Peck and Sargent, August 1905.

Anthers pink or rose color

Crataegus exclusa Sarg.

Rhodora, v. 108 (1903).

North Albany, West Albany, Menands, Albia, Greenbush, Charles H. Peck (#51), May and September 1902.

Crataegus oblongifolia n. sp. Sarg.

Leaves oblong-ovate, acute or acuminate, gradually narrowed and cuneate or rounded at the entire or glandular base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided into four or five pairs of small acuminate spreading lobes, more than half grown when the flowers open about the 20th of May and then thin, light yellow green, and covered above by short white hairs and villose below along the midribs and veins, at maturity thick and firm in texture, yellow green, glabrous on the upper, sparingly villose on the lower surface, reticulate-venulose, 5-7 cm long and 4-5 cm wide, with stout deep rose-colored midribs, and prominent primary veins extending obliquely to the points of the lobes; petioles stout, wing-margined at the apex, deeply grooved, covered with matted pale hairs more or less persistent during the season, sparingly glandular near the apex, deep rose color in the autumn, 1.5-2 cm long; stipules linear, acuminate, glandular, caducous; leaves on vigorous shoots rounded at the base, coarsely serrate, more deeply lobed, coriaceous, 7-8 cm long and 5-6 cm wide, with prominent midribs and veins. Flowers 1.8-2 cm in diameter, on short pedicels thickly clothed with long white hairs, in compact many-flowered hairy corymbs, with linear glandular bracts and bractlets fading rose color; calyx tube narrowly obconic, covered with long matted white hairs, the lobes slender, acuminate, glandular, villose pubescent, reflexed after anthesis; stamens 10; anthers rose color; styles three or four, surrounded at the base by a narrow ring of white hairs. Fruit ripening early in September, on short hairy pedicels, in 6 to 10-fruited erect or spreading clusters, pyriform till nearly grown, subglobose to short-oblong when ripe, dark crimson, lustrous, marked by numerous large pale dots, 1.2-1.5 cm in diameter; calyx little enlarged, with a broad deep cavity, and usually erect or incurved villose lobes mostly persistent on the ripe fruit; flesh thick, yellow, rather juicy; nutlets usually 3, gradually narrowed and rounded at the ends, slightly ridged on the back, with a low narrow ridge, about 7 mm long and 4 mm wide.

A round headed shrub 3-4 m high, with numerous stout stems covered below with dark brown scaly bark and light olive-green above, and slender slightly zigzag branchlets marked by many small oblong pale lenticels, thickly coated when they first appear with matted pale hairs, light chestnut-brown and very lustrous during the first season and darker colored the following year, and armed with numerous stout nearly straight purplish shining spines 2.5-3.5 cm long.

Low moist ground; Menands, near the Erie canal, Charles H. Peck (#51 me, type), May and September 1904, and on the Golf grounds, Peck and Sargent (#53), August 1905.

Crataegus spissiflora Sarg.

Proc. Rochester Acad. Sci. iv. 112 (1903).

Menands, Charles H. Peck (#77), May and September 1904; also at Rochester N. Y., and in Ontario.

FLABELLATAE

Stamens 5 to 7

Anthers rose color

Crataegus holmesiana Ashe

Jour. Elisha Mitchell Sci. Soc. xvi. pt ii. 78 (1900). Sargent, Silva N. Am. xiii. 119, t. 676; Man. 449, f. 366.

North Albany, West Albany, Menands, North Greenbush, Albia and Thompson Lake, Charles H. Peck (#2, 12), May and September 1902; also eastern Massachusetts to Canada, western New York and eastern Pennsylvania.

Crataegus sejuncta n. sp. Sarg.

Leaves ovate, acuminate, rounded or cuneate at the base, sharply and often doubly serrate above, with straight glandular teeth, and divided into four or five pairs of small acuminate spreading lobes, when they unfold deeply tinged with red and coated above with long white hairs, about half grown when the flowers open the middle of May and then thin, yellowish green, scabrate and slightly hairy above along the midribs and pale and sparingly villose along the midribs and veins below, at maturity thin, yellow green and rough on the upper, pale and nearly glabrous on the lower surface, 6-7 cm long, 5-6 cm wide, with stout orange colored midribs, and slender primary veins extending obliquely to the points of the lobes; petioles slender, nearly terete, glandular toward the apex, slightly villose through the season, often tinged with rose color, 2-2.5 cm in length; leaves on vigorous shoots broadly ovate, long pointed, truncate or slightly cordate at the base, coarsely serrate and more deeply lobed. Flowers about 1.5 cm in diameter, on short stout villose-pubescent pedicels, in very compact, hairy, usually 8 to 10-flowered corymbs, with oblong to linear acute glandular bracts and bractlets fading brown and mostly deciduous before the flowers open; calyx tube narrowly obconic, glabrous, the lobes slender, gradually narrowed, long-pointed and acuminate, glandular serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 7 to 10; anthers rose color; styles three or four. Fruit ripening about the middle of September, on short stout slightly hairy pedicels, in few-fruited clusters, subglobose to oval, crimson, lustrous, marked by numerous pale dots, 1.3-1.5 cm in diameter; calyx little enlarged, with a wide shallow cavity, and slender spreading closely appressed glandular serrate lobes slightly hairy on the upper side and mostly persistent on the ripe fruit; flesh thin, yellow, dry and mealy; nutlets three or four, narrowed and rounded at the ends, irregularly ridged on the back, with a broad low grooved ridge, 6-7 mm long and 4-5 mm wide.

A shrub or small tree 4-5 m high, with slender nearly straight branchlets marked by small pale lenticels, dark orange-green and glabrous when they first appear, becoming bright chestnut-brown and lustrous, and dull gray brown in their second year, and armed with stout nearly straight light chestnut-brown shining spines 2.5-3.5 cm long.

West Albany, Charles H. Peck (#22, type); Thompson Lake, Charles H. Peck (#77 tl), May and September 1904.

To this species probably belongs a common plant of western Massachusetts and western Vermont that has sometimes been referred to C. polita Sarg., a species with long slender glabrous pedicels and much smaller fruit.

Williamstown, Massachusetts, W. W. Eggleston (#2312); Bennington, Vermont (#2300, 2726); Cornwall, Vermont, Ezra Brainerd (# 20).

Crataegus acclivis Sarg.

Proc. Rochester Acad. Sci. iv. 115 (1903).

Menands, Charles H. Peck (# 53 bn), May, June and August 1904; North Albany, Charles H. Peck (# 51 nan), May and June 1905; also near Rochester, New York, and in southern Ontario.

Crataegus polita Sarg.

Rhodora, v. 112 (1903).

Sand Lake, Charles H. Peck (# 22), June and August 1902; also western Massachusetts to southern Connecticut.

Crataegus lobulata Sarg.

Rhodora, iii. 22 (1901); Silva N. Am' xiii. 117, t. 675; Man. 447, f. 364.

Menands, Golf ground, Peck and Sargent (# 22 gg), August 17, 1905; also western New England.

DILATATAE

Stamens 20

Anthers rose color

Crataegus dilatata Sarg.

Bot. Gazette, xxxi. 9 (1901); Silva N. Am. xiii. 113, t. 672; Man. 455, f. 371.

Thompson Lake, Charles H. Peck (#75), May, June and September 1903, July 1905; also in Gansevoort, Saratoga co. and from eastern Massachusetts to Canada.

Crataegus hudsonica Sarg.

Man. 457, f. 373 (1905).

Hills; West Albany and Menands, Charles H. Peck (# 188, type), May, September and October 1904; Greenbush, October 1905.

Crataegus durobrivensis Sarg.

Trees and Shrubs, i. 3, t. 2 (1902).

North Albany, West Albany, Charles H. Peck (#193); also western New York and Ontario.

ANOMALAE

Stamens 5-15

Anthers rose color

Crataegus asperifolia Sarg.

Rhodora, iii. 31 (1901).

Menands, Boulevard pasture, Charles H. Peck (# 58 bp), May and October 1903; also in western New England.

COCCINEAE

Stamens 5-10

Anthers pale yellow

Crataegus coccinea Linnaeus

Spec. 476 (1753).—Sargent, Silva N. Am. xiii. 133, t. 683; Man. 459, f. 375.

North Albany, Charles H. Peck (# 15), May and September 1904; also eastern New England and western Vermont to the St Louis valley.

Crataegus coccinea var. rotundifolia Sarg.

Bot. Gazette, xxxi. 14 (1901); Silva N. Am. xiii. 134; Man. 460.

Albia and Watervliet, Charles H. Peck (# 4), August 1905.

Crataegus dodgei Ashe

Jour. Elisha Mitchell Sci. Soc. xix. 26 (March 1903).—Sargent, Proc. Phil. Acad. Sci 632 (1905).

Crataegus gravesii Sarg., Rhodora, v. 160 (June 1903).

North Albany, West Albany, Menands and Wynantskill, Charles H. Peck (# 18), May, September and October 1903; also western and southern New England to Michigan and eastern Pennsylvania.

Crataegus caesariata n. sp. Sarg.

Leaves obovate to oval, short-pointed or acuminate at the apex, concave cuneate at the entire base, finely doubly serrate above, with incurved glandular teeth, and divided above the middle into three or four pairs of small acuminate spreading lobes, nearly half grown when the flowers open about the middle of May and then membranaceous, light yellow green, smooth and slightly hairy along the midribs above and pale and glabrous below, at maturity thin, glabrous, yellow green, 3.5-4.5 cm long and 2-3.5 cm wide, with thin slender midribs, and slender veins arching obliquely to the points of the lobes; petioles slender, wing-margined at the apex, sparingly hairy while young, becoming glabrous, tinged with rose color in the autumn, 1.5-2 cm in length; leaves on vigorous shoots nearly orbicular, coarsely serrate, and more deeply lobed, with broad acuminate lobes, subcoriaceous, 5-6 cm in diameter, with thick midribs and stout rose-colored petioles conspicuously glandular through the season. Flowers on long slender villose pedicels, in usually 10 to 12-flowered hairy corymbs, the lower peduncles from the axils of upper leaves; calyx tube narrowly obconic, slightly hairy, the lobes slender, elongated, acuminate, minutely glandular serrate above the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles two or three. Fruit ripening from the middle of September to the first of October, on long villose pedicels, in drooping usually five or six-fruited clusters, oval or slightly obovate, with a deep depression at the insertion of the stalk, dark crimson, lustrous, marked by numerous small dark dots, hairy specially at the ends, 1.2-1.5 cm long and 7-12 mm wide; calyx little enlarged, with a broad shallow cavity, and closely appressed lobes often persistent on the ripe fruit; flesh thick, firm, deeply tinged with red; nutlets usually three, gradually narrowed and rounded at the ends, rounded and only slightly ridged on the back, with a low broad ridge, 6-7 mm long and about 4 mm wide.

A shrub 2-3 m high, with intricately branched ascending stems covered below with dark scaly bark, and slender slightly zigzag branchlets marked by numerous oblong pale lenticels, dark orange-green and villose-pubescent when they first appear, soon becoming glabrous, dark orange-brown during their first season and lighter the following year, and armed with few spines or sometimes unarmed.

Roadsides, North Albany and Wynantskill. Not common. Charles H. Peck (#18 E, type), May, September and October.

Crataegus illuminata n. sp. Sarg.

Leaves rhombic to oblong obovate, acuminate, gradually narrowed and concave cuneate at the entire base, finely, often doubly serrate above, with glandular incurved teeth, and slightly divided above the middle into numerous short wide lobes, at maturity thin, glabrous, yellow green and very lustrous on the upper and pale on the lower surface, 4-6 cm long and 3.5-4 cm wide, with slender yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, narrowly wing-margined at the apex, grooved on the upper side, glabrous, 2-2.5 cm in length; leaves on vigorous shoots ovate, acuminate, concave cuneate at the base, thin, coarsely serrate, deeply lobed, with narrow acuminate lobes, often 8-10 cm long and 6-8 cm wide, with short broadly winged petioles and foliaceous lunate serrate stipules. Flowers not seen. Fruit ripening late in August and early in September, on slender sparingly hairy pedicels, in few-fruited erect or spreading clusters, oval to subglobose, bright cherry-red, lustrous, slightly hairy at the ends, 8-10 mm long and 7-8 mm wide; calyx prominent, with a broad deep cavity, and small acuminate reflexed and closely appressed nearly entire lobes slightly villose on the upper side and persistent on the ripe fruit; flesh thin, greenish yellow, dry and mealy; nutlets three or four, acute at the ends, ridged on the back, with a high narrow often grooved ridge, 6-7 mm long and 4-5 mm wide.

A round topped compact shrub 2-3 m tall, with numerous slender erect stems covered below with dark brown scaly bark and pale above, and slender slightly zigzag light orange-brown branchlets, armed with many slender straight or slightly curved bright chestnut-brown shining spines 3-4 cm long.

Dense thickets on rich bottom lands close to the banks of the Hudson river, North Greenbush, Peck and Sargent (# 72 ng, type), August 17, 1905; North Albany, Charles H. Peck, September 1905.

Stamens 10-18

Crataegus divergens n. sp. Sarg.

Crataegus irrasa var. divergens Peck, N. Y. State Mus. Bul. 75. p. 51. 1904.

Leaves oblong obovate to rhombic, acuminate, gradually narrowed and concave cuneate at the entire glandular base, finely crenately serrate above, with gland-tipped teeth, and divided above the middle into four or five pairs of slender acuminate lobes pointing toward the apex of the leaf, nearly fully grown when the flowers open about the 10th of May and then thin, yellow green, lustrous and sparingly hairy above, pale and slightly villose along the midribs and veins below, with short hairs persistent through the season, at maturity thin but firm in texture, dark yellow green, glabrous and very lustrous on the upper and pale on the lower surface, 4-6 cm long and 3.5-4 cm wide, with slender yel ow m drib , and thin veins arching obliquely to the points f the lobes; petioles slender, wing-margined at the apex, grooved on the upper side, villose-pubescent when they first appear, becoming glabrous, glandular toward the apex, with minute caducous glands, 2.5-3 cm in length; stipules linear-falcate, glandular, fading brown, caducous; leaves on vigorous shoots broadly ovate to rhombic, acuminate, gradually or abruptly cuneate at the base, coarsely serrate, more deeply divided into broad acuminate spreading lobes and often 7-9 cm long and 6-8 cm wide. Flowers 1.3-1.5 cm in diameter, on short stout pedicels coated with long matted white hairs, in very compact 5 to 10-flowered hairy corymbs; calyx tube narrowly obconic, covered at the base with long white hairs and nearly glabrous above, the lobes short, acuminate, laciniately glandular serrate, glabrous on the outer, densely villose on the inner surface, reflexed after anthesis; stamens 10-18; anthers pale yellow; styles usually three. Fruit ripening late in August or early in September, persistent for several weeks, on short slightly hairy pedicels, in usually five to seven-fruited drooping clusters, short oblong to subglobose, scarlet, lustrous, marked by large pale dots, about 1 cm in diameter; calyx little enlarged, with a narrow deep cavity, and spreading and appressed lobes mostly deciduous from the ripe fruit; flesh thin, greenish yellow, dry and mealy; nutlets usually three, full and rounded at the ends, ridged on the back, with a broad low slightly grooved ridge, light colored, 7-8 mm long and 4-5 mm wide.

A shrub 3-4 m high, with numerous small ascending stems, and thin slightly zigzag branchlets thickly coated when they first appear with matted pale hairs, becoming light orange-brown and nearly glabrous during their first season and dark reddish brown the following year, and armed with slender straight purplish spines 2.5-3.5 cm long.

Borders of woods in clayey soil at the margin of the bottoms of the Hudson river; North Greenbush, Charles H. Peck (# 70, type), May, July and October 1903; Peck and Sargent, August 1905.

INTRICATAE

Stamens 10

Anthers pale yellow

Crataegus intricata Lange

Bot. Tidskr. xix. 246 (1894).

North Albany, Menands and Lansingburg, Charles H. Peck (# 112na), May and June 1903; also southern and western New England.

Crataegus foetida Ashe

Ann. Carnegie Mus. i. pt. iii. 389 (1902).
Crataegus baxteri Sarg., Proc. Rochester Acad. Sci. iv. 107. (1903).

North Albany, Charles H. Peck (# 50), May and October 1903; Lansingburg, Charles H. Peck, 1904; also western Massachusetts to western New York and eastern Pennsylvania.

Crataegus modesta Sarg.

Rhodora, iii. 28 (1901); Proc. Phil. Acad. 635 (1905).
Crataegus premora Ashe, Ann. Carnegie Mus. i. pt. iii. 391, (1902).

North Albany, West Albany, Greenbush, Menands and Lansingburg, Charles H. Peck (# 111), May and October 1902; also western and southern New England to eastern Pennsylvania.

Crataegus verecunda Sarg.

Proc. Rochester Acad. Sci. iv. 109 (1903).

Lansingburg, Charles H. Peck, June and September 1904; also at Rochester, New York.

Anthers pink

Crataegus peckii Sarg.

Rhodora, v. 63 (1903).

Hills; Lansingburg, Charles H. Peck (# 11), May and October 1902.

TOMENTOSAE

Mature leaves thin

Stamens usually 20

Anthers dark rose color or red

Crataegus tomentosa Linnaeus

Spec. 476 (1753)—Sargent, Silva N. Am. iv. 101, t. 183; Man. 492, f. 406.

Watervliet, H. G. Jesup, June 18, 1869 (not seen in recent years); also westward to Michigan and Missouri, and south to eastern Pennsylvania and along the Appalachian mountains.

Crataegus menandiana n. sp. Sarg.

Leaves elliptic to rhombic or rarely obovate, acute or short-pointed at the apex, gradually narrowed and concave cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into five to seven small acuminate spreading lobes, nearly half grown when the flowers open at the end of May and then thin, yellow green, slightly roughened and villose-pubescent above along the midribs, pale and furnished below with small tufts of axillary hairs, at maturity thin, but firm in texture, glabrous, dull yellow green and very smooth on the upper, paler on the lower surface, 6-9 cm long and 4-6 cm wide, with stout yellow midribs, and slender primary veins deeply impressed on the upper side, petioles stout, broadly wing-margined nearly to the middle, grooved on the upper side, slightly villose while young, soon glabrous, sparingly glandular, with persistent glands, often rose-colored in the autumn, 1.5-2 cm in length. Flowers 1.5-1.7 cm in diameter, on long stout slightly villose pedicels, in usually 10 to 12-flowered wide lax corymbs, the lowest peduncle from the axil of an upper leaf; calyx tube narrowly obconic, glabrous or slightly hairy about the base, the lobes slender, acuminate, glandular on the margins, with minute stipitate glands, glabrous on the outer, villose on the inner surface; stamens 20; filaments elongated; anthers red; styles two to four, surrounded at the base by a few scattered white hairs. Fruit ripening early in October, on short stout slightly hairy reddish pedicels, in broad long-branched few-fruited drooping clusters, subglobose, scarlet, lustrous, marked by large pale dots, about 1.2 cm in diameter; calyx little enlarged, with a broad shallow cavity, and spreading or incurved coarsely serrate lobes mostly persistent on the ripe fruit; flesh yellow, soft and succulent; nutlets two or three, broad and rounded at the base, slightly narrowed and rounded at the apex, rounded and only slightly ridged on the back, penetrated on the inner faces by small shallow irregular cavities about 7 mm long, 4-5 mm wide.

A shrub 6-7 m high, with numerous ascending stems covered with dark scaly bark and spreading into large thickets, and slender nearly straight branchlets marked by small oblong pale lenticels, dark orange-green and puberulent when they first appear, becoming bright chestnut-brown, lustrous and bright red brown in their second year, and armed with very numerous slender nearly straight purplish shining spines 4.5-6 cm long.

Menands, Golf ground, Charles H. Peck (# 1 gg, type), May and October 1904; July and September 1905.

Anthers pale yellow

Crataegus ambrosia n. sp. Sarg.

Leaves ovate to elliptic or subrhomboidal, short-pointed or acuminate at the apex, rounded or abruptly and gradually concave cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and very slightly divided above the middle into four or five pairs of small acuminate spreading lobes, nearly half grown when the flowers open during the last week of May and then membranaceous, light yellow, very smooth and sparingly villose-pubescent along the midribs above, pale and glabrous below with the exception of occasional short axillary hairs, at maturity thin, glabrous, yellow green, darker on the upper than on the lower surface, 7-9 cm long and 5-6 cm wide, with the slender yellow midribs and thin primary veins extending obliquely to the points of the lobes; petioles slender, wing-margined at the apex, slightly grooved, glabrous, occasionally glandular above the middle, tinged with rose color, 2-3.5 cm in length. Flowers on stout elongated villose pedicels, the lowest peduncles from the axils of the upper leaves, in wide 6 to 12-flowered corymbs, with linear acute glandular rose-colored caducous bracts and bractlets; calyx tube narrowly obconic, sparingly villose at the base, the lobes foliaceous, acuminate, red and glandular at the apex, laciniately toothed, glabrous on the outer and villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles two or three. Fruit ripening late in September or early in October, on long slender drooping pedicels, in usually five or six-fruited clusters, short oblong, full and rounded at the ends, crimson, lustrous, marked by small dark dots, 1-1.4 cm long and 8-12 mm wide; calyx prominent, with a deep narrow cavity, and spreading erect or incurved coarsely serrate lobes, dark red at the base, conspicuously villose on the upper surface and mostly persistent on the ripe fruit; flesh thick, slightly tinged with red, dry and mealy; nutlets usually three, gradually narrowed and rounded at the base, narrowed and rounded or acute at the apex, ridged on the back, with a broad slightly grooved ridge, penetrated on the inner faces by wide shallow grooves, 7-8 mm long and about 5 mm wide.

A shrub 3-4 m high, with erect stems covered with dark brown scaly bark and forming broad thickets, wide-spread ng flexuose branches, and slender nearly straight branchlets marked by oblong pale lenticels, dark orange-green when they first appear, becoming chestnut-brown and very lustrous and dull red brown in their second season, and armed with numerous slender nearly straight purplish shining spines 3-5 cm long.

Menands, Golf ground, Charles H. Peck (# 3 tgn, type), May and October 1904, July and September 1905.

Stamens 10 or less

Anthers rose color

Crataegus rhombifolia Sarg.

Rhodora, v. 183 (1903).

Albia, North Albany, West Albany and Thompson Lake, Charles H. Peck (#80), June and September 1903; May and October 1904; also southern Connecticut to western Vermont.

Anthers white

Crataegus flagrans n. sp. Sarg.

Leaves oblong-ovate to oval, acuminate, gradually or abruptly narrowed and concave cuneate at the entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into five or six pairs of small acuminate lobes, when they unfold deeply tinged with red and coated with soft white hairs, about half grown when the flowers open from the 10th to the middle of May and then membranaceous, yellow green, lustrous and scabrate above, pale and sparingly villose along the midribs and primary veins below, with short hairs sometimes persistent through the season, at maturity thin, dull green and still slightly roughened on the upper and pale on the lower surface, 6-8 cm long and 4-6 cm wide, with slender yellow midribs, and thin primary veins extending obliquely to the points of the lobes; petioles stout, broadly wing-margined to below the middle, grooved on the upper side, villose-pubescent while young, becoming glabrous, 1-1.5 cm in length; stipules linear, acuminate, glandular, fading rose color, caducous. Flowers about 1.2 cm in diameter, on slender densely villose pedicels, in mostly 15 to 20-flowered hairy cormybs, the lower branches from the axils of upper leaves, with lanceolate to linear obovate glandular rose-colored bracts and bractlets; calyx tube narrowly obconic, coated with long matted pale hairs, the lobes slender, red, and acuminate at the apex, glandular serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers white; styles usually three. Fruit ripening early in October, on slender hairy reddish pedicels, in many-fruited drooping clusters, subglobose, dark crimson, lustrous, 8-10 mm in diameter; calyx little enlarged, with a deep narrow cavity, and closely serrate reflexed lobes mostly deciduous from the ripe fruit; flesh thin, orange color, soft and succulent; nutlets three, full and rounded at the base, gradually narrowed at the apex, ridged on the back, with a broad low slightly grooved ridge, irregularly penetrated on the inner faces by wide deep cavities, about 7 mm long and 5 mm wide.

A shrub 4-5 m high, with numerous erect and spreading stems, covered with dark brown scaly bark and forming a broad round topped head, and slender slightly zigzag branchlets marked by small oblong dark lenticels, orange-brown and sparingly villose when they first appear, becoming glabrous and dark red brown by midsummer and bright red brown and lustrous the following season, and armed with slender nearly straight chestnut-brown shining spines 3-4 cm long.

Rich bottom lands of the Hudson river; North Greenbush, Charles H. Peck (#68 ng, type), May, June and October 1904; Peck and Sargent, August 17, 1905.

Crataegus flagrans is interesting as the first species of the subgroup of the Tomentosae, with thin leaves glabrous or almost glabrous at maturity, that has been noticed with 10 stamens and white or yellow anthers.

Mature leaves coriaceous to subcoriaceous

Stamens 20

Anthers rose color

Crataegus succulenta Link

Handbk. ii. 78 (1831).—Sargent, Silva N. Am. xiii. 139, t. 101; Man. 497, f. 411.

North Albany, Charles H. Peck (# 12), May and September 1904; Albia, Charles H. Peck (# 1), May and June 1904, June 1905.

Crataegus gemmosa Sarg.

Bot. Gazette, xxxiii. 119 (1902); Silva N. Am. xiii. 141, t. 686; Man. 498, f. 412.

North Albany, near the tollgate, Troy road, Peck and Sargent (# 3 tg) October 1902; Charles H. Peck, May and October 1904; also western New York, Ohio, Ontario and Michigan.

The anthers of the Albany plant as described by Professor Peck are paler than those of the type trees which are at Grand Rapids, Mich. and the fruits, which were the largest and most beautiful I have seen on any plants of this group, were on October 2, 1902, about 1.5 cm in diameter. In later seasons, however, Professor Peck has found them somewhat smaller, and, except in the color of the anthers and in the size of the fruit and its larger calyx lobes, I can find nothing by which to distinguish the Albany plant from Crataegus gemmosa.

Anthers pale yellow

Crataegus halliana n. sp. Sarg.

Leaves oblong-obovate to oval, acute or acuminate, gradually narrowed and concave cuneate at the slender entire base, finely doubly serrate above, with minute glandular teeth, and very slightly divided above the middle into small acute lobes, about half grown when the flowers open the 1st of June and then thin, yellow green, scabrate and slightly hairy above along the midribs and pale and sparingly villose, with short persistent hairs below along the midribs and veins, at maturity subcoriaceous, conspicuously reticulate-venulose, dark green, smooth and lustrous on the upper and pale on the lower surface, 5-6 cm long, 3.5-4 cm wide, with thin yellow midribs and veins deeply impressed on the upper side; petioles slender, narrowly wing-margined to below the middle, grooved and villose while young along the upper side, soon glabrous, tinged with red in the autumn, 1.5-2 cm in length; leaves on vigorous shoots sometimes more deeply lobed, 6-7 cm long and 4-5 cm wide, with stout broadly winged petioles and slender falcate acuminate rose-colored caducous stipules. Flowers 1.2-1.3 cm in diameter, on long slender villose pedicels, in broad 8 to 16-flowered crowded corymbs, with long several-flowered peduncles from the axils of the two upper leaves; calyx tube narrowly obconic, villose at the base, glabrous above, the lobes slender, acuminate, laciniately glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; filaments short; anthers pale yellow; styles two or three. Fruit very abundant, ripening early in October, on long drooping reddish pedicels, in wide many-fruited corymbs, subglobose, crimson, lustrous, marked by large dark dots, 1-1.2 cm in diameter; calyx little enlarged, with a deep narrow cavity, and spreading closely appressed glandular-serrate lobes coated on the upper side with matted pale hairs; flesh thick, tinged with red, soft and very succulent; nutlets two or three, gradually narrowed and rounded at the ends, ridged on the back, with a broad grooved ridge, penetrated on the inner faces by large deep cavities, about 7 mm long and 4 mm wide.

A shrub 2-5 m high, with numerous widespreading or ascending stems covered with dark brown scaly bark, and slender nearly straight branchlets marked by small oblong pale lenticels, light orange-green and glabrous when they first appear, light chestnut-brown and very lustrous at the end of their first season, darker the following year, and armed with few slender more or less curved bright chestnut-brown shining spines 2.5-5 cm long and often pointing toward the base of the branch.

North Albany, Charles H. Peck (# 3 na, type), June and October 1904, June 1905. Menands, Golf ground (# 3 gg, with leaves sometimes narrow-rhomboidal), May, June and September 1905.

This species is named in memory of James Hall (1811–1898), the distinguished geologist and paleontologist, long a professor in the Rensselaer Polytechnic Institute of Troy and one of the authors of the *Catalogue of Plants in the vicinity of Troy*, published in 1837.

Stamens 10-20

Anthers pink

Crataegus conspicua n. sp. Sarg.

Leaves oblong-obovate, rounded, acute or acuminate at the apex, gradually narrowed to the concave cuneate entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided toward the apex into three or four pairs of short acute lobes, nearly one third grown when the flowers open about the 20th of May and then membranaceous, dark yellow green and glabrous above with the exception of a few short pale hairs along the midribs and veins, and covered below with pale tomentum most developed on the midribs and veins, at maturity coriaceous, dark green and glabrous on the upper and pale and tomentose on the lower surface, 7-9 cm long and 5-7 cm wide, with stout midribs deeply impressed on the upper side of the leaf and rose-colored below toward the base, and slender primary veins extending obliquely to the points of the lobes; petioles stout, wing-margined to below the middle, deeply grooved, slightly villose along the upper side while young, becoming glabrous and often rose-colored or purple below the middle, 2-3 cm in length; leaves on vigorous shoots oval to obovate, more coarsely serrate, 7-8 cm long and 5-6 cm wide. Flowers 1.2-1.3 cm in diameter, on slender densely hoary tomentose pedicels, in broad many-flowered tomentose corymbs, with large acuminate glandular rose-colored conspicuous bracts and bractlets deciduous before the flowers open; calyx tube narrowly obconic, coated with long matted pale hairs, the lobes long, slender, acuminate, coarsely glandular serrate usually only above the middle, puberulent on the outer and covered with matted hairs on the inner surface; stamens 10-20; anthers small, light pink; styles two to four. Fruit ripening the first of October, on slender drooping pedicels, in few-fruited clusters, subglobose to short oblong, full and rounded at the ends, crimson, lustrous, 8-10 mm in diameter; calyx conspicuous, with a narrow deep cavity and foliaceous spreading or reflexed coarsely glandular serrate lobes; flesh thick, orange color, sweet and succulent; nutlets two to four, full and rounded at the ends, ridged on the back, with a high narrow often irregular slightly grooved ridge, deeply penetrated on the inner faces by broad deep cavities, about 7 mm long and 4 mm wide.

A broad shrub 3-4 m high, with numerous erect stems and stout branchlets, light orange-green and glabrous when they first appear, bright chestnut-brown and very lustrous during their first winter, and dull dark reddish brown the following year, and armed with many stout nearly straight purplish shining spines 3-3.5 cm in length.

Near the tollgate on the Troy road, North Albany, Peck and Sargent (# 1, type), October 2, 1902; Charles H. Peck, May and October 1903; also near pulp mill station, New Haven, Addison co. Vt. Brainerd and Sargent (# 15 A), September 1900; Ezra Brainerd, October 1900 and May and September 1901.

In the Vermont plant the calyx lobes, specially before anthesis, are rather longer, the flowers are somewhat larger, and the leaves are broader in proportion to their length than those of the Albany plant, but the two appear to belong to one species peculiar in the tomentose covering of the entire lower surface of the leaves.

Stamens 10 or less

Anthers rose color

Crataegus beckiana n. sp. Sarg.

Leaves broadly ovate to obovate, acute and often short-pointed at the apex, concave cuneate at the entire base, finely doubly serrate above, with straight gland-tipped teeth, and slightly divided above the middle into four or five pairs of short acuminate lobes, about half grown when the flowers open during the last week of May and then membranaceous, light yellow green, smooth and glabrous on the upper surface with the exception of a few short hairs along the midribs and pale and glabrous on the lower surface, at maturity subcoriaceous, dark green and very smooth above, pale below, conspicuously reticulate-venulose, 6-7 cm long and 5-6 cm wide, with slender midribs and primary veins deeply impressed on the upper side of the leaf; petioles stout, wing-margined at the apex, deeply grooved, villose on the upper side while young, becoming glabrous, 1.5-2 cm in length. Flowers 1.2-1.4 cm in diameter, on slender slightly villose pedicels, in wide many-flowered corymbs; calyx tube narrowly obconic, glabrous, the lobes slender, acuminate, glandular-serrate below the middle, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers dark rose color; styles two or three. Fruit ripening early in September, in many-fruited drooping clusters, subglobose to obovate, full and rounded at the ends, crimson, lustrous, marked by numerous small pale dots; calyx enlarged and prominent, with a deep narrow cavity and foliaceous coarsely serrate reflexed and appressed lobes, dark red and villose on the upper side and mostly persistent on the ripe fruit; flesh thin, dry and yellow; nutlets usually two, rounded and obtuse at the ends, irregularly ridged on the broad back, deeply penetrated on the inner face by broad irregular cavities, 6-7 mm long and about 5 mm wide.

A tree or treelike shrub 6-7 m high, with a trunk sometimes 15-18 cm in diameter covered with dark gray scaly bark, large spreading and ascending ashy gray branches forming a round-topped symmetrical head, and stout branchlets marked by oblong pale lenticels, light orange-green and glabrous when they first appear, becoming bright chestnut-brown and very lustrous during their first winter and ultimately dull gray brown, and armed with numerous stout nearly straight purplish shining spines 2.5-4 cm long.

Rich bottom lands of the Hudson river; North Greenbush, Charles H. Peck (# 60, type), May and September 1903.

This species is named in honor of Louis C. Beck (1798-1853), a native of Schenectady, Professor of chemistry in the Medical College at Albany, and author of the *Botany of the Northern and Middle States*, published in 1833, and of numerous papers on botany and chemistry.

Anthers white

Crataegus ferentaria Sarg.

Proc. Rochester Acad. Sci. iv. 135 (1903).

North Albany, Albia, Charles H. Peck (# 19 n), May and August 1904; also southern New England, western New York and Ontario.

Crataegus hystricina Ashe

Bot. Gazette, xxxv. 433 (1903).

Thompson Lake, Charles H. Peck (# 81), June and September 1904; also at Stratford, Connecticut.

EXPLANATION OF PLATES

PLATE S1

Marasmius longistriatus Pk.

LONG STRIATED MARASMIUS

1, 2 Two moist plants, the larger showing gills beneath the pileus
3, 4 Three plants with dry caps, showing the long striations

Clitopilus squamulosus Pk.

SQUAMULOSE CLITOPILUS

5 Mature plant
6 Vertical section of the upper part of a mature plant
7 Transverse section of a stem
8 Four spores, x 400

Entoloma flavifolium Pk.

YELLOW GILLED ENTOLOMA

9 Young plant showing pale yellow gills
10 Immature plant after the gills have begun to change color
11 Mature plant
12 Vertical section of the upper part of a young plant
13 Vertical section of the upper part of a mature plant
14 Transverse section of a stem
15 Four spores, x 400

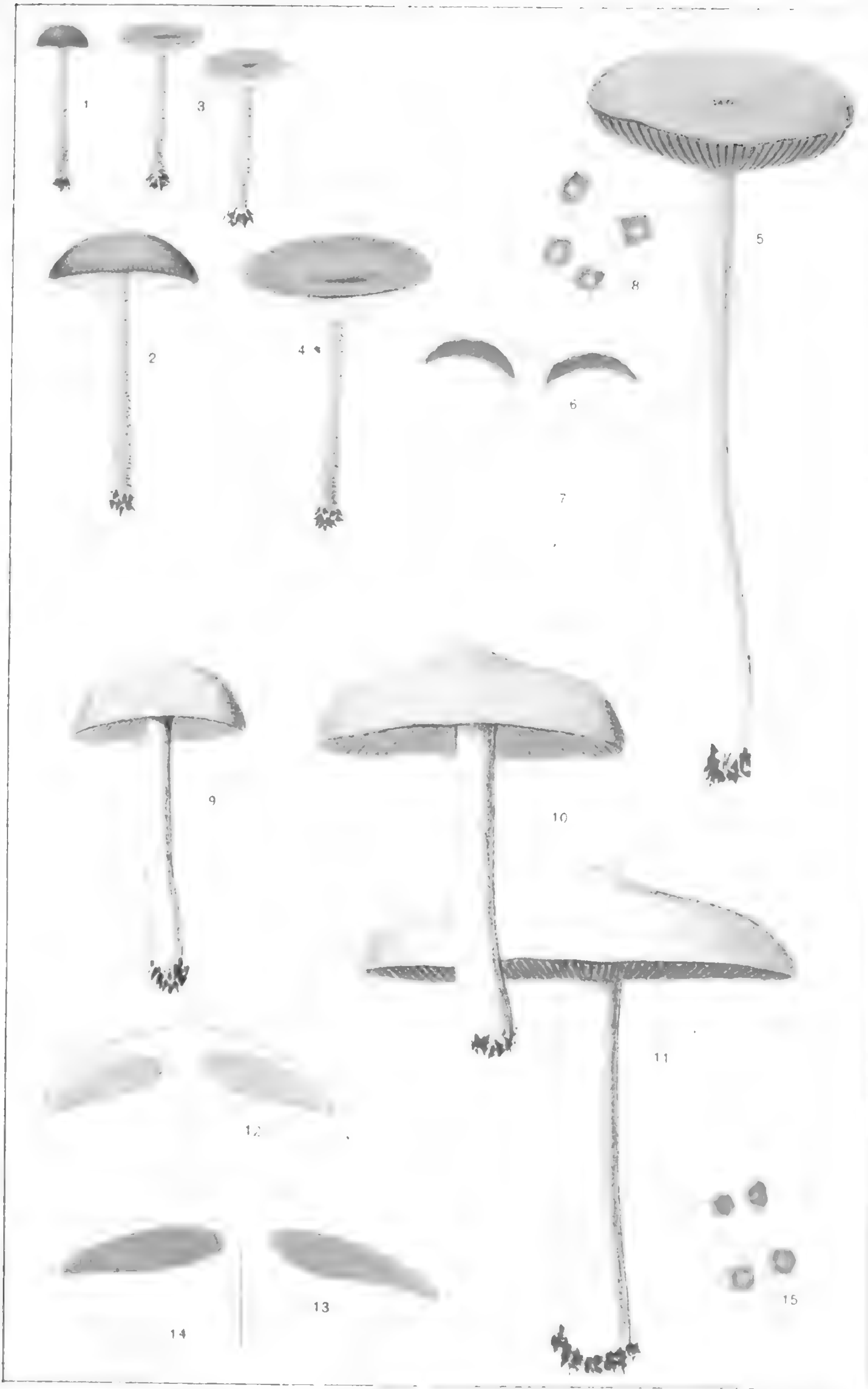


FIG. 1-4
MARASMIUS LONGISTRIATUS PK.
LONG STRIATED MARASMIUS

FIG. 5-8
CLITOPILUS SQUAMULOSUS PK.
SQUAMULOSE CLITOPILUS

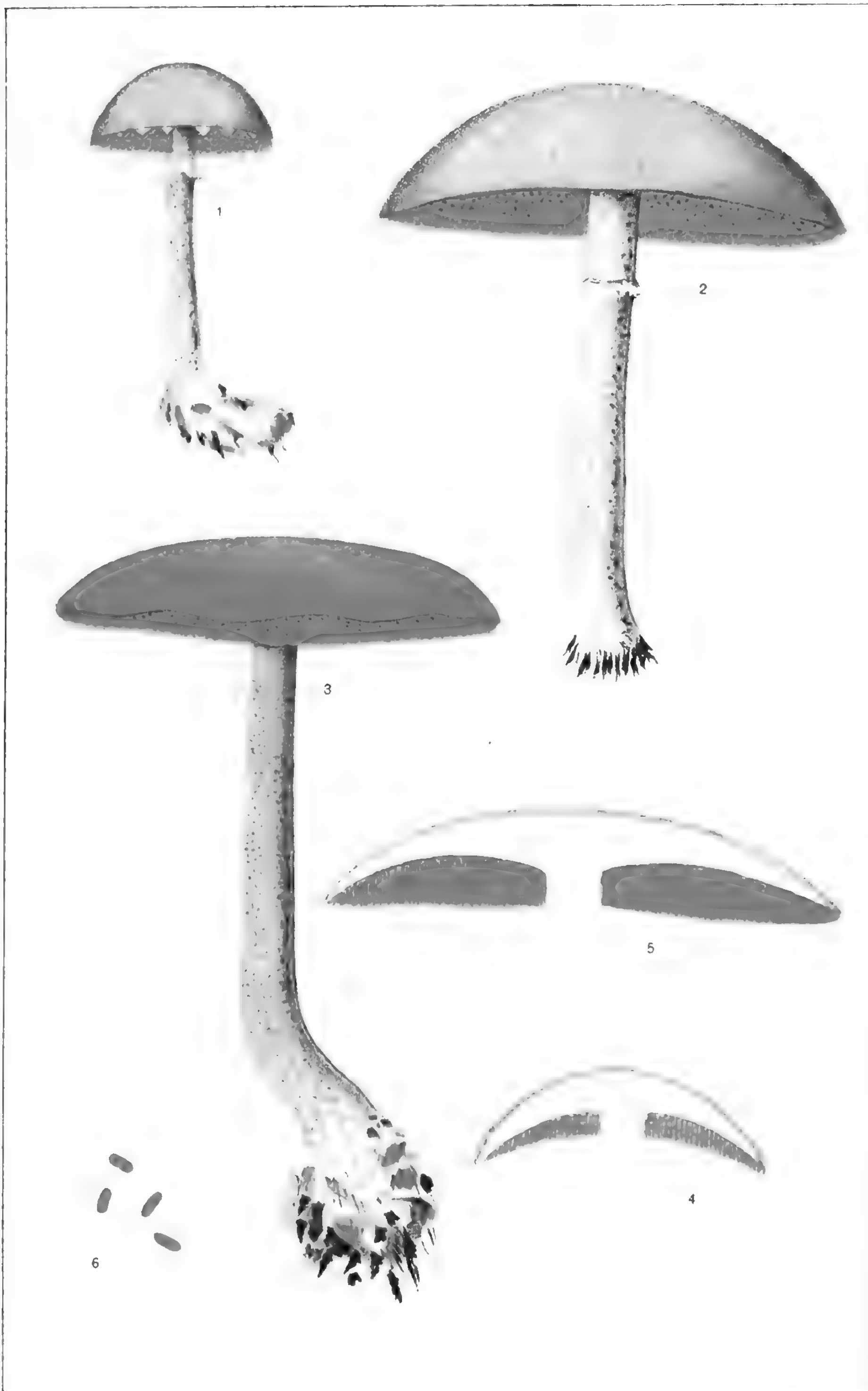
FIG. 9-15 ENTOLOMA FLAVIFOLIUM PK.
YELLOW GILLED ENTOLOMA

PLATE T

Boletus acidus Pk.

Acid Boletus

1 Young plant showing the appendiculate margin of the cap
2 Immature plant showing a collar on the stem
3 Mature plant
4 Vertical section of the upper part of a young plant
5 Vertical section of the upper part of a mature plant
6 Four spores, x 400



BOLETUS ACIDUS Pk

ACID BOLETUS

PLATE 94

Tricholoma unifactum Pk.

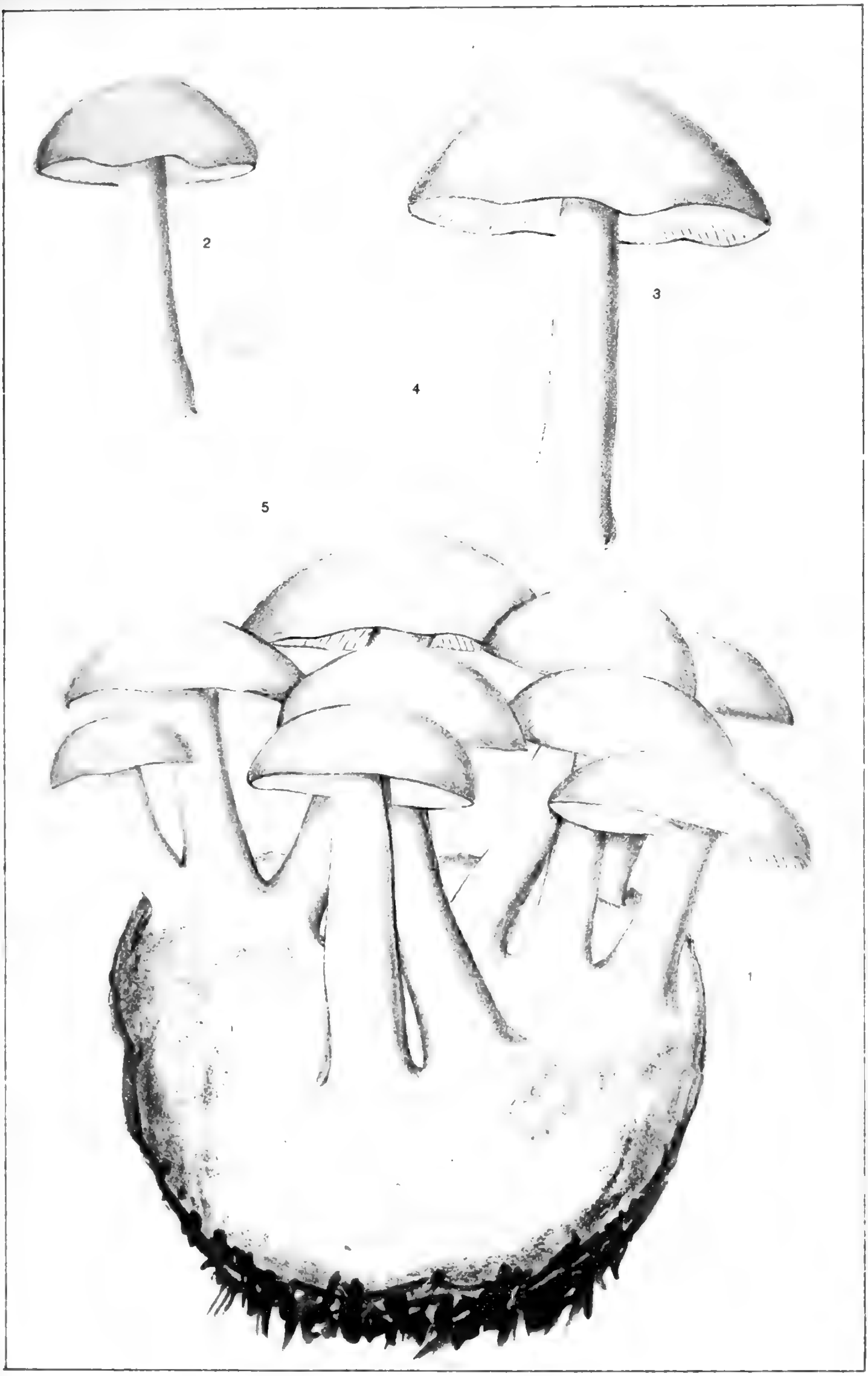
United Tricholoma

1 Cluster of plants united by a common fleshy base

2, 3 Two plants separated from the fleshy base

4 Vertical section of the upper part of a plant

5 Four spores, x 400



TRICHOLOMA UNIFACTUM Pk.
UNITED TRICHOLOMA

PLATE 95

Lactarius rimosellus Pk.

CRACKED LACTARIUS

1 Young plant showing central papilla of the cap
2 Young plant showing drop of milk from wound of gills
3 Mature plant
4 Vertical section of upper part of a mature plant
5 Transverse section of a stem
6 Four spores, x 400

Lactarius serifluus (DC.) Fr.

THIN JUICED LACTARIUS

7 Young plant showing whitish gills
8, 9 Two mature plants, one with cap centrally depressed
10 Vertical section of the upper part of a plant
11 Four spores, x 400

Fig. 1-6 LACTARIUS RIMOSELLUS Pk.
CRACKED LACTARIUS

Fig. 7-11 LACTARIUS SERIFLUUS Fr.
THIN JUICED LACTARIUS

PLATE 96

Russula albida Pk.

Whitish Russula

1 Young plant

2, 3 Mature plants, one showing center of cap tinged with yellow

4 Mature plant with margin of cap slightly curved upward

5 Vertical section of the upper part of a plant

6 Transverse section of a stem

7 Four spores, x 400

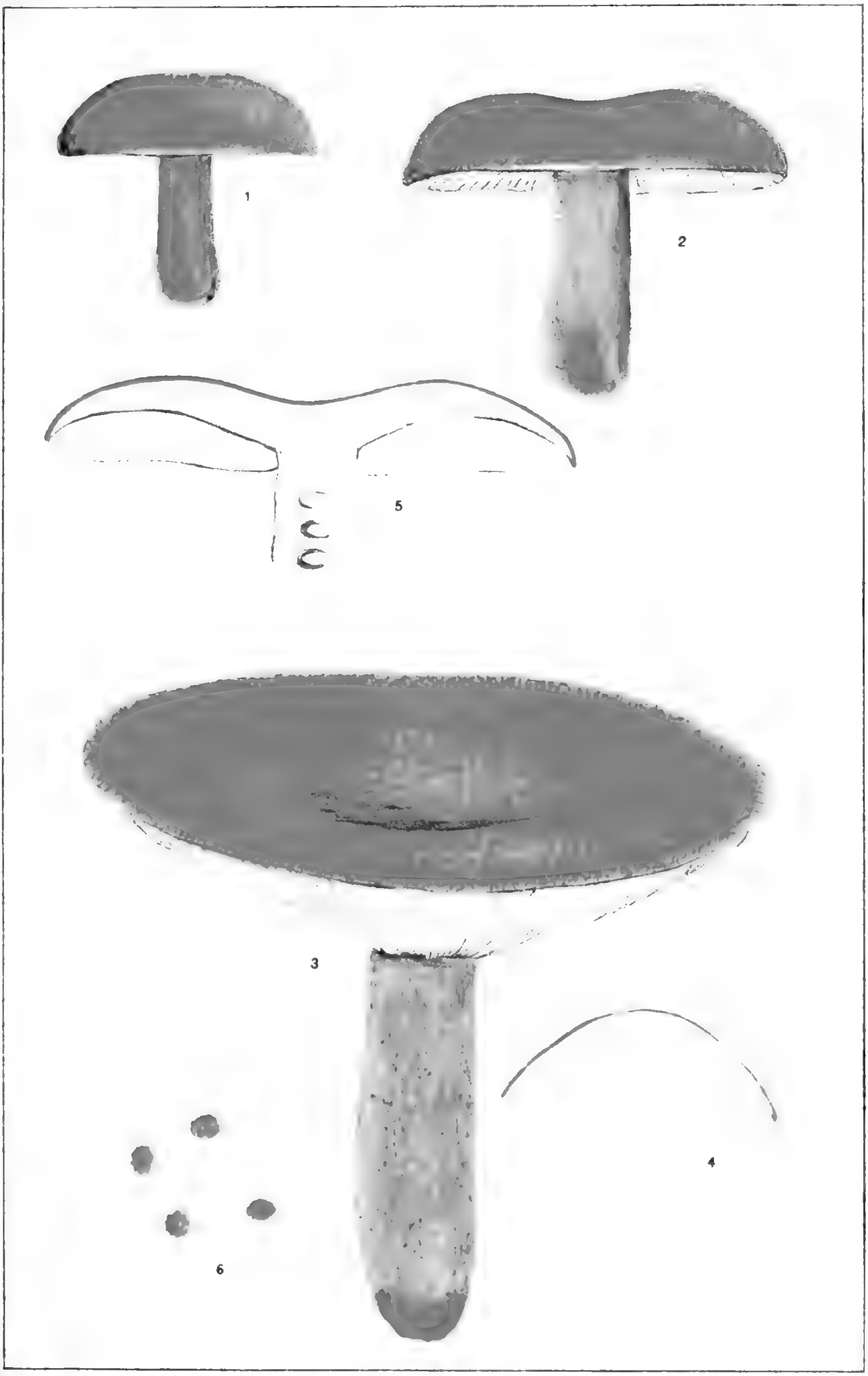
RUSSULA ALBIDA Pk.
WHITISH RUSSULA

PLATE 97

Russula flavida Frost

YELLOWISH RUSSULA

1 Young plant
2 Mature plant with convex cap
3 Mature plant with expanded cap centrally depressed
4 Vertical section of the upper part of a young plant
5 Vertical section of the upper part of a mature plant
6 Four spores, x 400



RUSSULA FLAVIDA Frost
YELLOWISH RUSSULA

PLATE 98

Russula sordida Pk.

SORDID RUSSULA

1 Young plant showing whitish cap
2 Immature plant with cap discolored
3 Mature plant with expanded cap centrally depressed
4 Vertical section of the upper part of a plant showing the pale color of the flesh when first cut in one part and the dark color soon assumed in another part
5 Four spores, x 400

RUSSULA SORDIDA Pk.

SORDID RUSSULA

PLATE 99

Russula subsordida Pk.

SUBSORDID RUSSULA

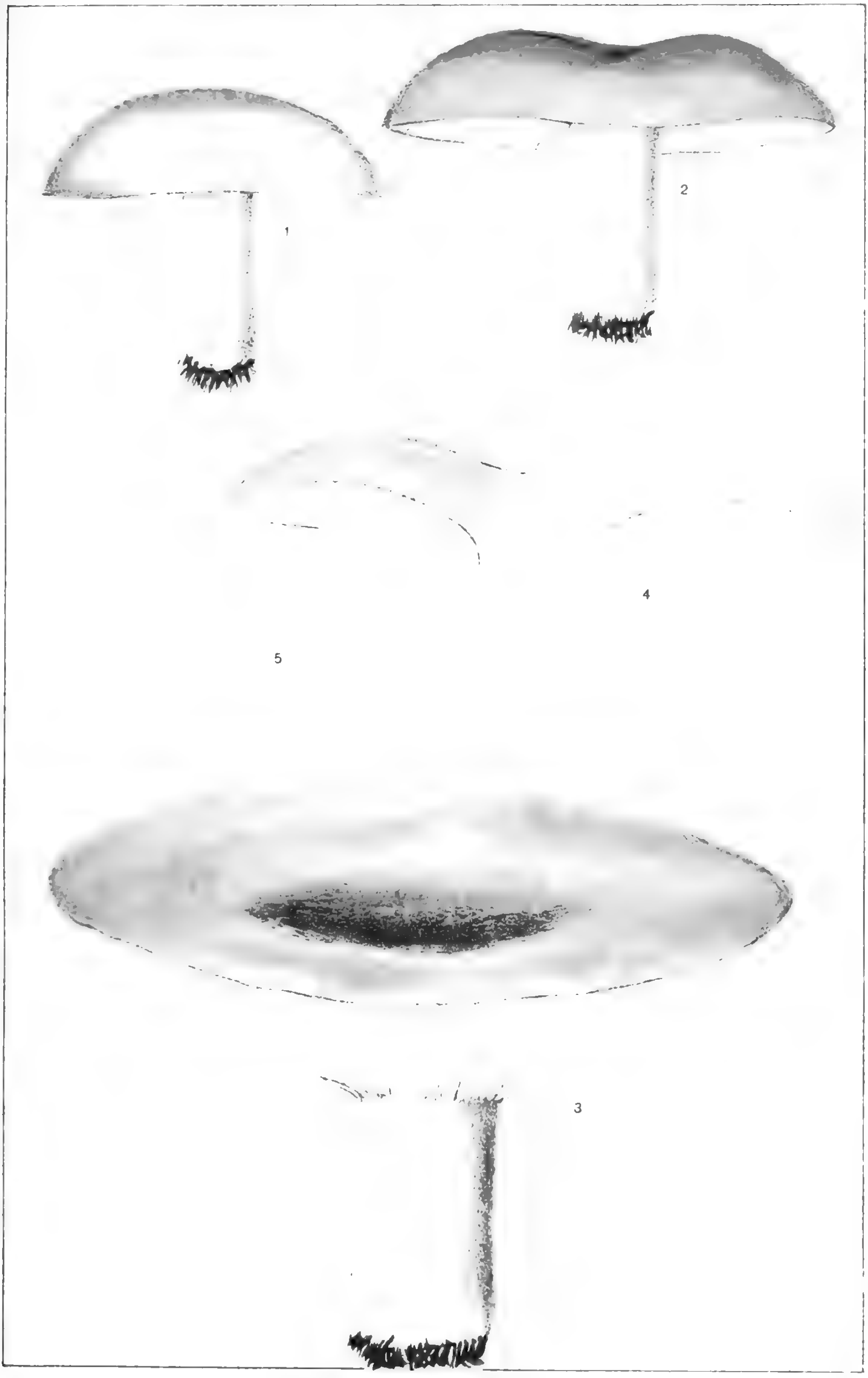
1 Young plant with whitish cap

2 Immature plant with cap discolored

3 Mature plant with expanded cap centrally depressed

4 Vertical section of the upper part of a plant showing the pale color of the flesh when first cut at the right and the dark color soon assumed at the left

5 Four spores, x 400



RUSSULA SUBSORDIDA Pk.
SUBSORDID RUSSULA

PLATE 100

Russula viridella Pk.

PALE GREEN RUSSULA

1 Very young plant with cap still closed

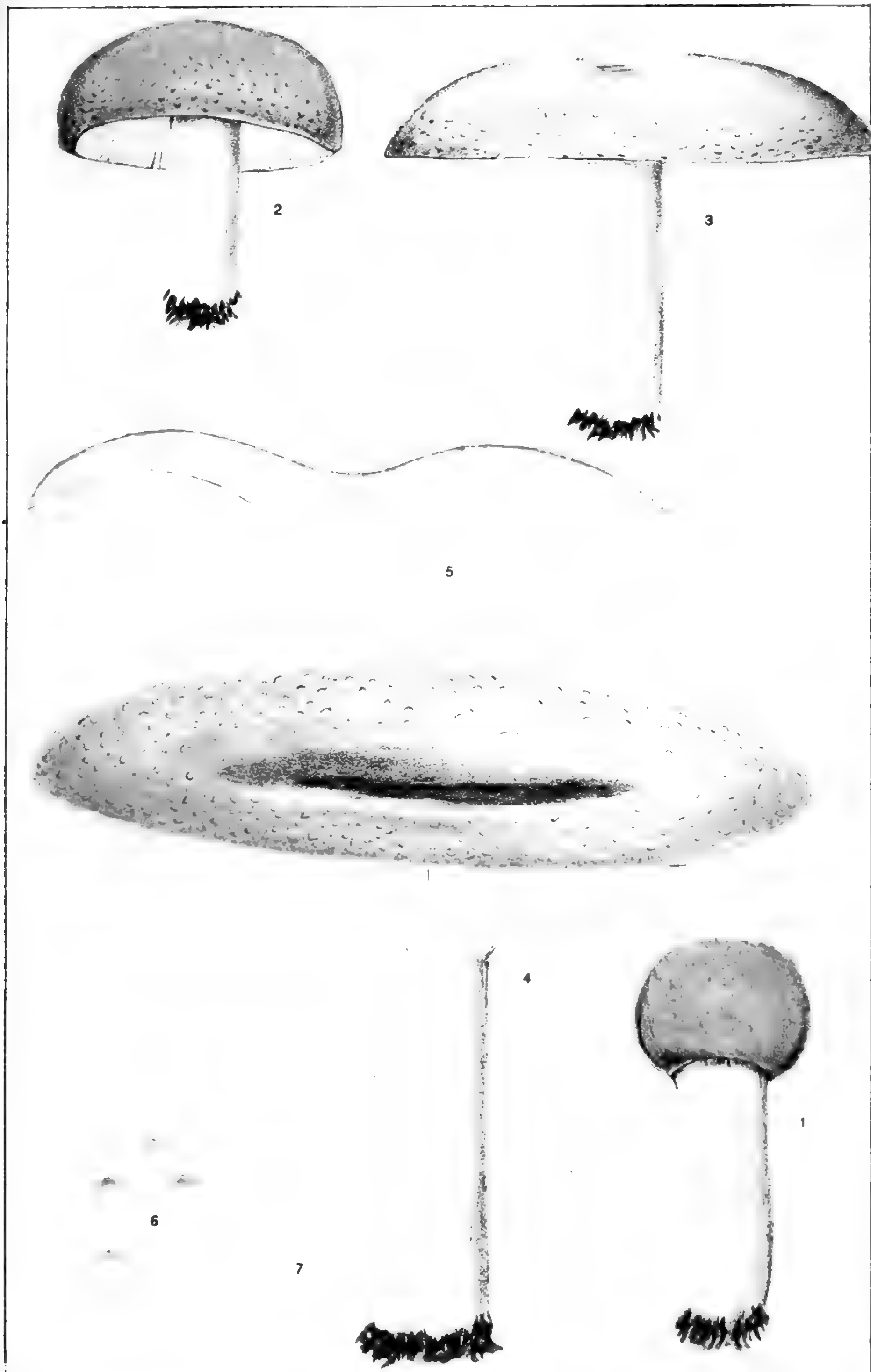
2, 3 Immature plants, one at the left showing the white gills

4 Mature plant

5 Vertical section of the upper part of a mature plant

6 Four spores, x 400

7 Cystidium, x 400



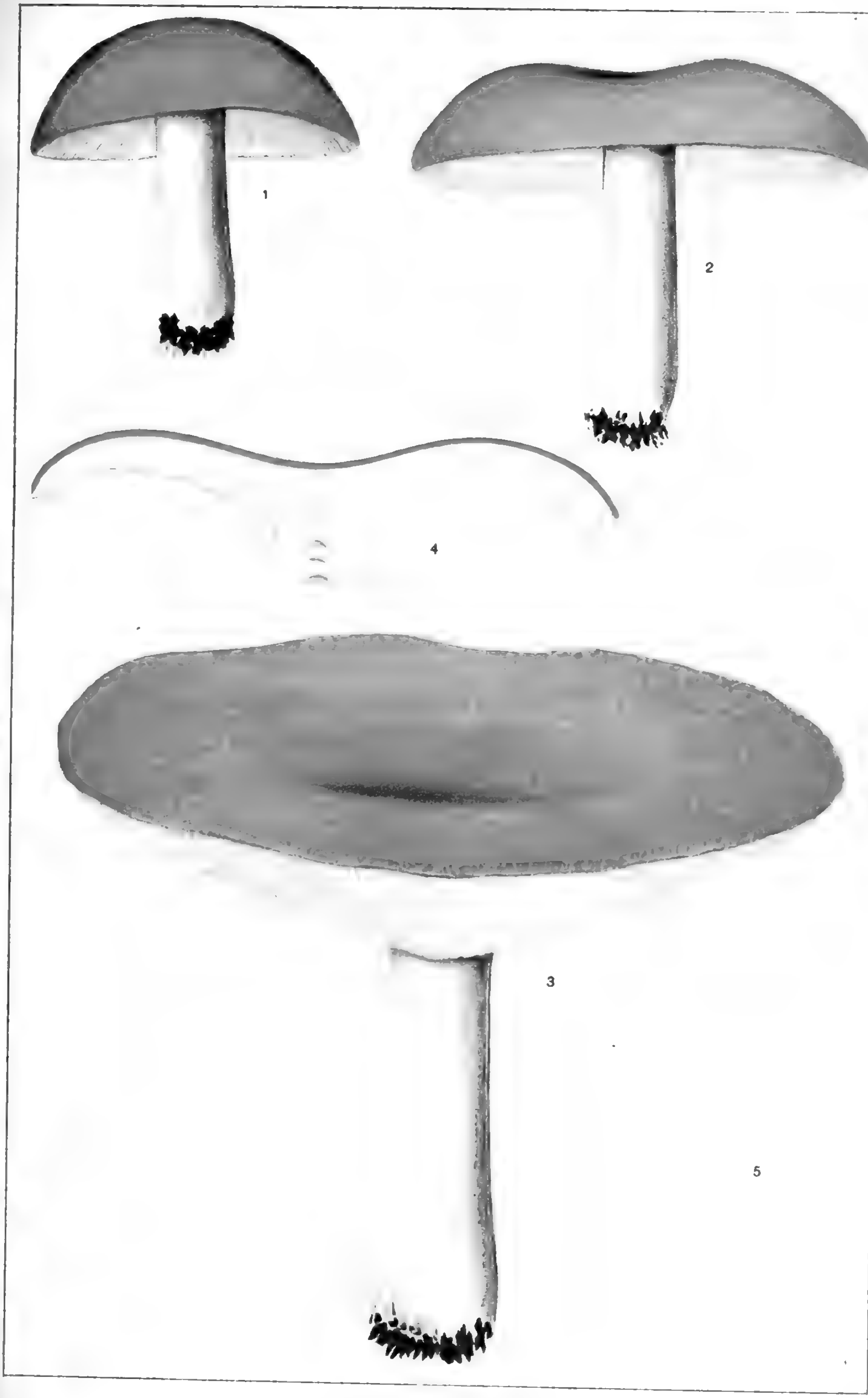
RUSSULA VIRIDELLA Pk.
PALE GREEN RUSSULA

PLATE 101

Russula variata Banning

VARIABLE RUSSULA

1 Young plant showing a green cap with purplish center
2 Mature plant with convex purplish cap
3 Mature plant with expanded green cap centrally depressed
4 Vertical section of the upper part of a mature plant
5 Four spores, x 400



RUSSULA VARIATA Banning
VARIABLE RUSSULA

PLATE 102

Clavaria conjuncta Pk.

Conjoined Clavaria

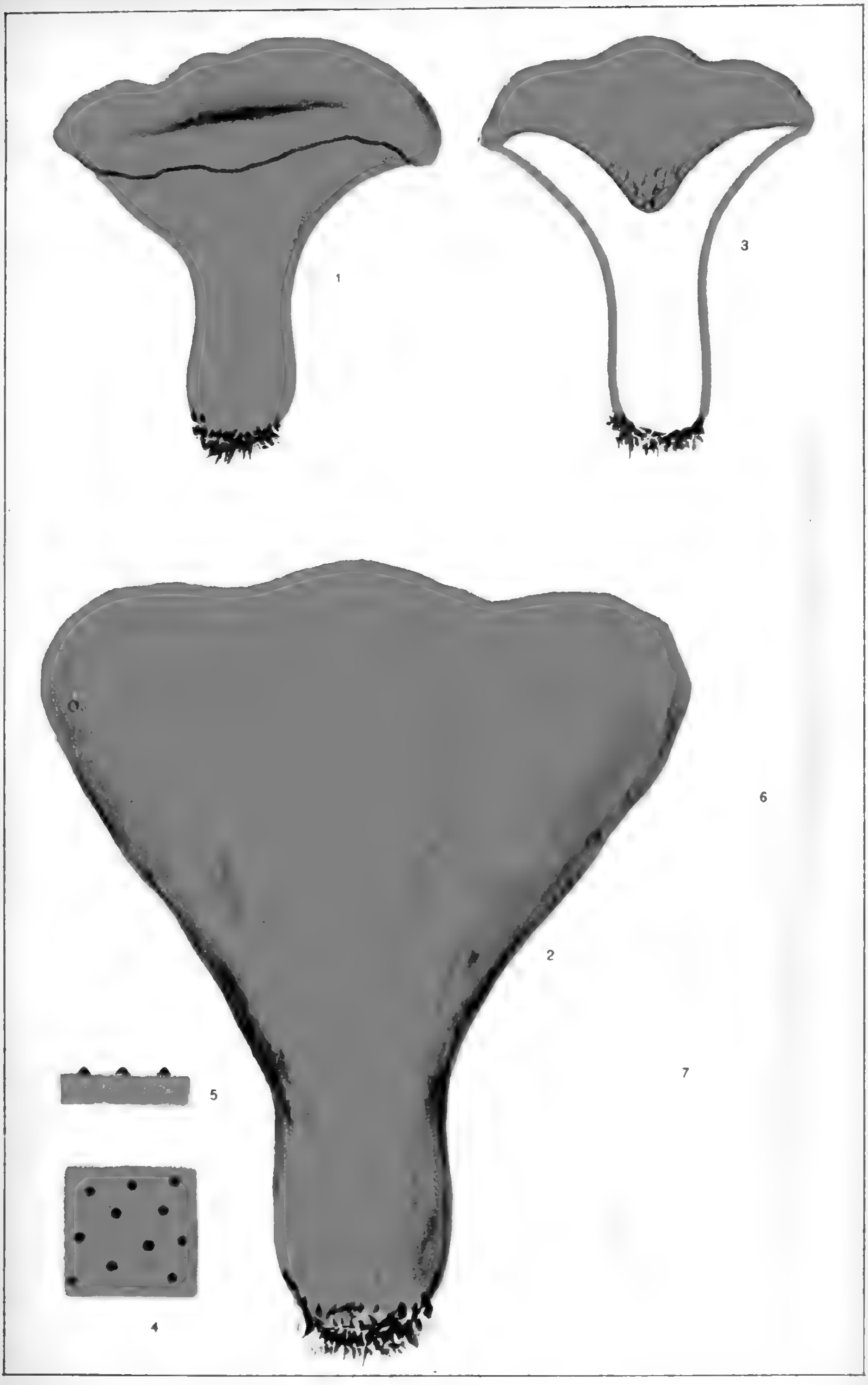
1 Cluster of plants united at the base
2 Upper part of a branch
3 Four spores, x 400

CLAVARIA CONJUNCTA Pk.
CONJOINED CLAVARIA

Hypomyces lactifluorum (Schw.) Tul.

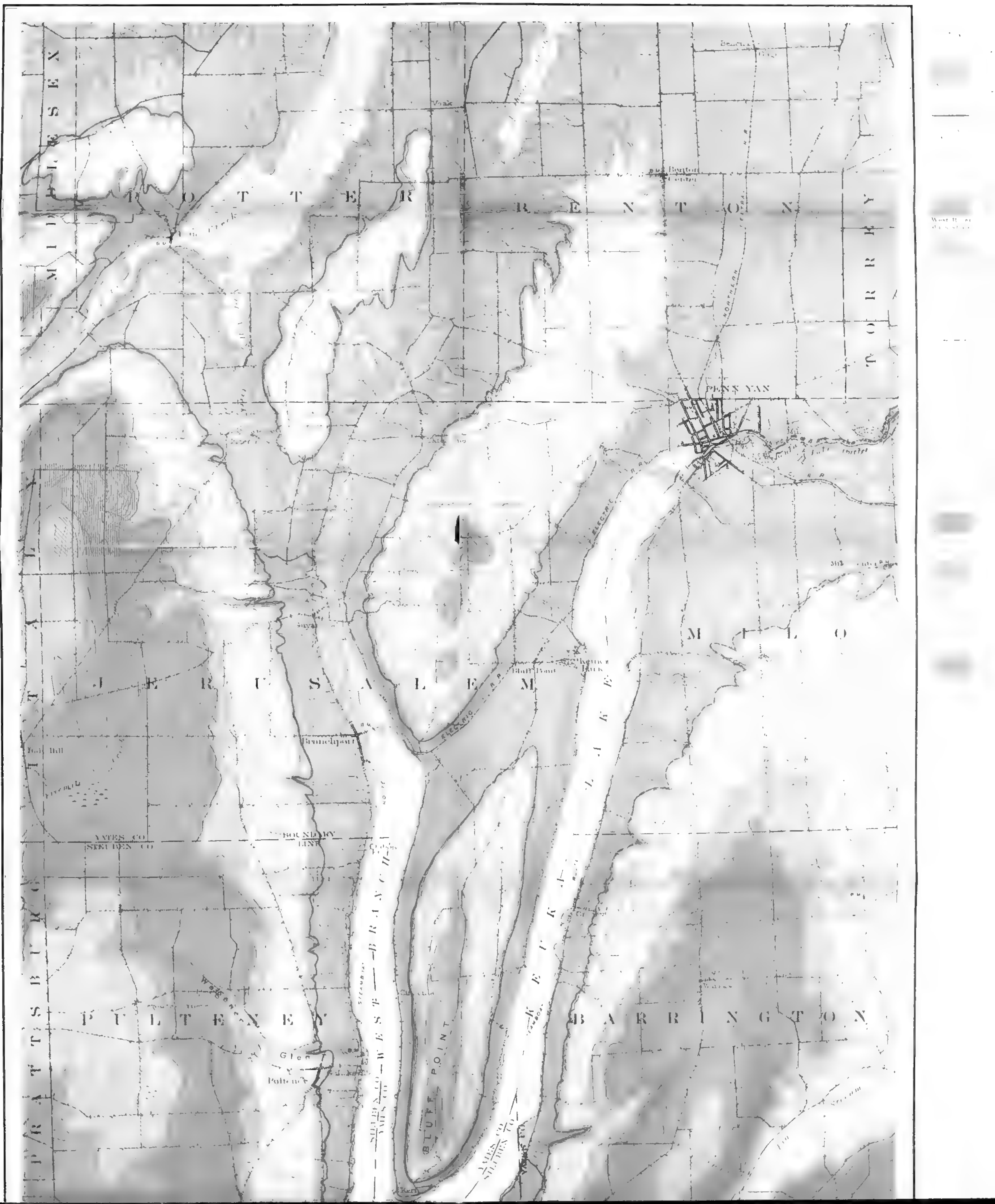
RED HYPOMYCES

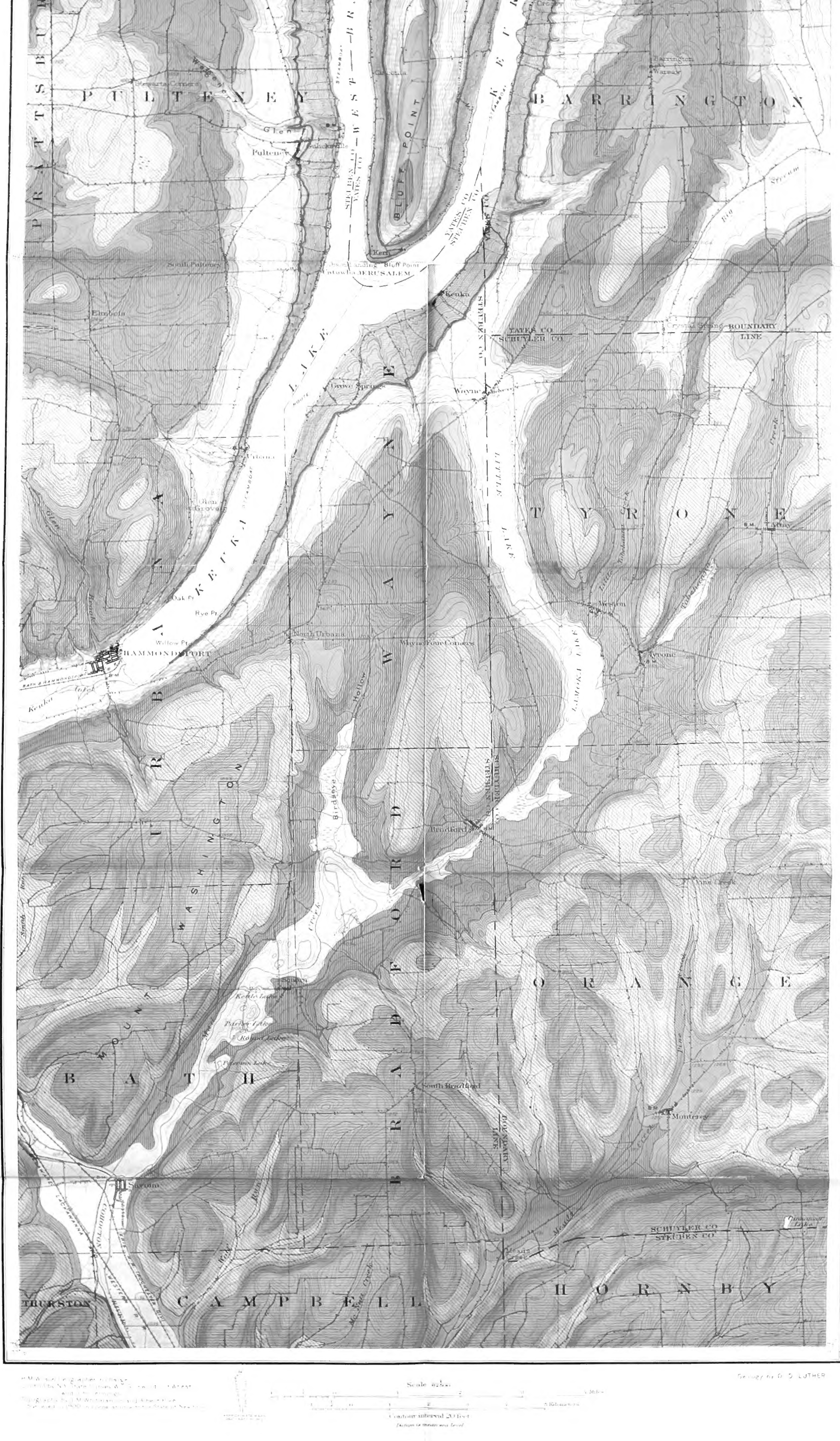
1 Small host plant discolored by the parasite
2 Large host plant discolored by the parasite
3 Vertical section of a small discolored host plant
4 Birdseye view of a small piece of the hypomyces enlarged to show the blackish mouths of the perithecia or spore vessels
5 Side view of a small piece of the hypomyces enlarged and showing three perithecia sunk in the red subiculum
6 A linear ascus or spore sac containing eight spores, x 400
7 Four spores, x 400



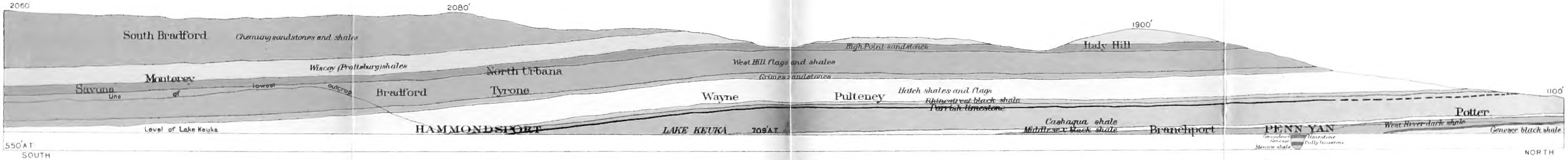
HYPOMYCES LACTIFLUORUM (Schw.) Fr.
RED HYPOMYCES

INDEX


MIDDLESEX
POTTER
BENTON
TORREY
Voak
PENN YAN
ITALY
JERUSALEM
MILO
Branchport
Bluff Point
YATES CO.
STEUBEN CO.
BOUNDARY LINE
WEST BRANCH
BLUFF POINT
KEUKA LAKE
PRATTSBURG
PULTENEY
BARRINGTON
Glen
Pulteney
ELECTRIC R.R.



PULTENEY
BARRINGTON
BLUFF POINT
WEST BRANCH
STEUBEN CO
YATES CO
Pulteney
South Pulteney
JERUSALEM
Bluff Point
Keuka
Kenka
Wayne
YATES CO
SCHUYLER CO
BOUNDARY LINE
KEUKA LAKE
Grove Springs
Gibson
Glen
Glen Grove
Oak Pt
Rye Pt
Willow Pt
HAMMONDSPORT
Keuka Inlet
North Urbana
Wayne Four Corners
LITTLE LAKE
LAMOKA LAKE
TYRONE
Weston
Tyrone
URBANA
WAYNE
BRADFORD
Bradford
Birdseye Hollow
Keuka Lake
Mud Lake
Round Lake
Peterson Lake
MOUNT WASHINGTON
BATH
South Bradford
ORANGE
Pine Creek
Monterey
Savona
SCHUYLER CO
STEUBEN CO
CAMPBELL
HORNBY
THURSTON
Meads Creek
Geology by D. D. LUTHER
Scale 1/62500
Miles
Kilometers
Contour interval 20 feet
Datum is mean sea level



PENN YAN-HAMMONDSPORT QUADRANGLES

North and south section

EDUCATION DEPARTMENT
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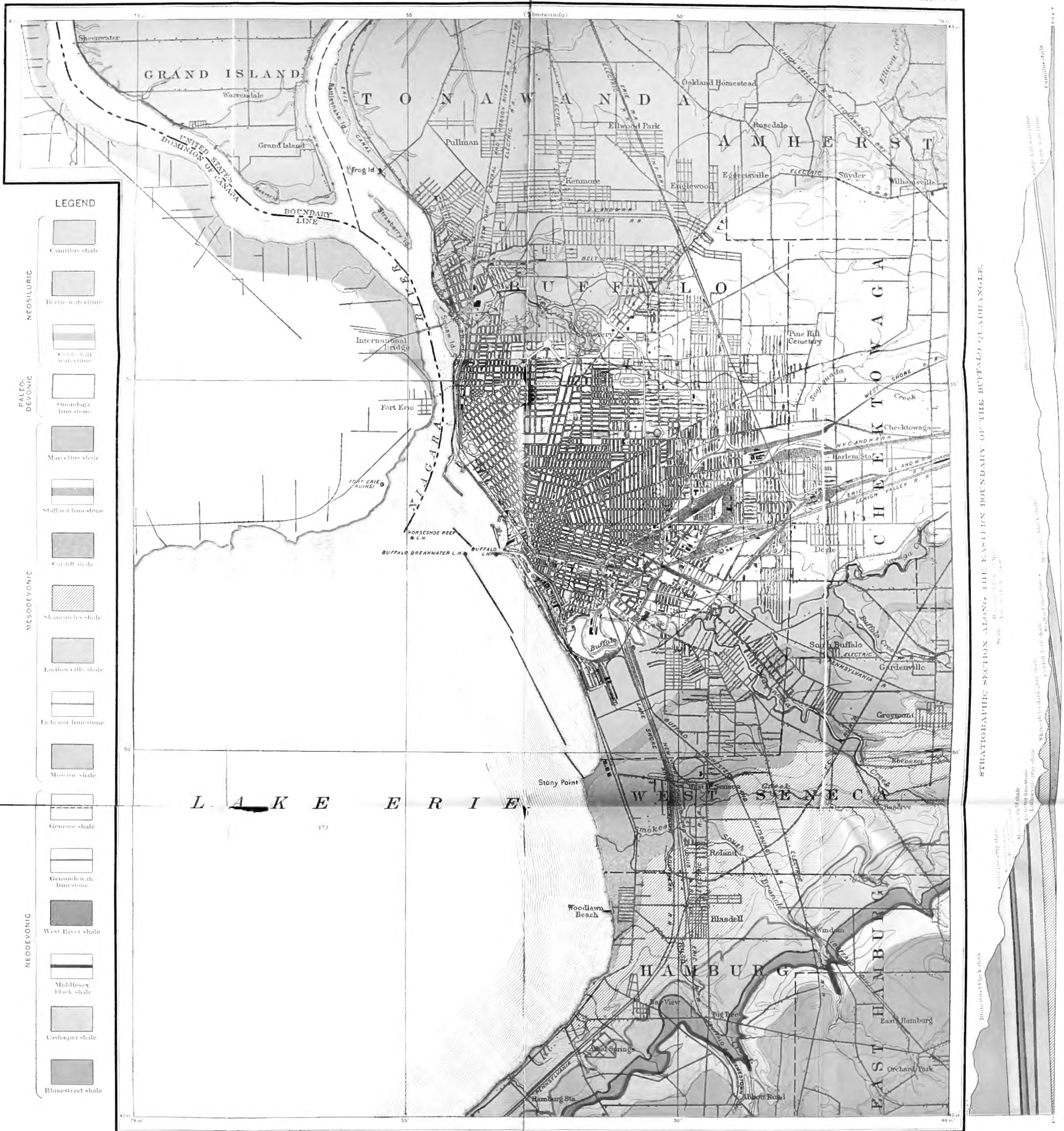
STATE GEOLOGIST

UNIVERSITY OF THE STATE OF NEW YORK
STATE MUSEUM

BUFFALO QUADRANGLE
BULLETIN 99



Henry Gannett, Chief Topographer.
H. M. Wilson, Geographer in charge.
Triangulation by U. S. Lake Survey.
Topography by U. S. Lake Survey, Frank Sutton, and W. W. Gilbert.
Surveyed in 1893 and 1900 in cooperation with the State of New York.

Scale: $\frac{1}{62500}$

Contour interval 20 feet.
Datum is mean sea level.

Brandow Printing Company,
State Printers, Albany, N. Y.

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