The University of the State of New York

NEW YORK STATE MUSEUM

67th ANNUAL REPORT

1913

In 1 volume

REPORT OF THE DIRECTOR 1913

AND

APPENDIXES 1–4

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NATIONAL MUSEUM

TRANSMITTED TO THE LEGISLATURE MARCH 12, 1915

ALBANY
THE UNIVERSITY OF THE STATE OF NEW YORK
1915

THE UNIVERSITY OF THE STATE OF NEW YORK

Regents of the University
With years when terms expire
October 1, 1915

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State of New York

No. 68

IN ASSEMBLY

March 12, 1915

67th 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 67th 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

John H. Finley
Commissioner of Education and
President of the University

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University of the State of New York Bulletin

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Published fortnightly

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 173

TENTH REPORT OF THE DIRECTOR OF THE STATE MUSEUM AND SCIENCE DEPARTMENT

INCLUDING THE 67th REPORT OF THE STATE MUSEUM, THE 33d REPORT OF THE STATE GEOLOGIST, AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1913

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The University of the State of New York
Department of Science, March 16, 1914

Dr John H. Finley
President of the University

Sir: I have the honor to transmit herewith my annual report as Director of the State Museum for the fiscal year ending September 30, 1913, and to recommend it for publication as a Museum bulletin.

Very respectfully
John M. Clarke
Director

Approved for publication this 18th day of March 1914

John H. Finley
President of the University

A restoration of one of the oldest trees of the earth
(*Archeosigillaria primeva*)

Recently erected in the State Museum and reconstructed from a specimen found in the Devonic rocks of Naples, N. Y.

University of the State of New York Bulletin

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New York State Museum

John M. Clarke, Director

Museum Bulletin 173

TENTH REPORT OF THE DIRECTOR OF THE STATE MUSEUM AND SCIENCE DEPARTMENT

INCLUDING THE 67TH REPORT OF THE STATE MUSEUM, THE 33D REPORT OF THE STATE GEOLOGIST AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1913

INTRODUCTION

This report covers all divisions of the scientific and other Museum work under the charge of the Regents of the University and concerns the progress made therein during the fiscal year 1912–13. It constitutes the 67th consecutive annual report of the State Museum, the 33d annual report of the State Geologist (consecutive since 1881) and the report of the State Paleontologist for 1913. It is introductory to all memoirs, bulletins and other publications issued from this Department during the year named.

The committee of the Board of Regents having supervision of the affairs of this Department are the Honorables: Charles B. Alexander M.A. LL.B. LL.D. Litt.D., Tuxedo; Francis M. Carpenter, Mount Kisco; Lucius N. Littauer B.A., Gloversville.

The subjects presented in this report are considered under the following chapters:

I Condition of the New Museum and Progress in Installation
II Report on the Geological Survey
III Report of the State Botanist
IV Report of the State Entomologist
V Report on the Division of Zoology

VI Report on the Division of Archeology and Ethnology
VII Report on the Publications of the Department for the Year
VIII Report on the Collection of Coins and Medals
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I
CONDITION OF THE NEW MUSEUM

The entire energy of this staff has been given, during the past year, almost without reserve, to the equipment of the Museum halls and offices. The transfer of the collections from the State Hall, Geological Hall, Universalist church, Taylor brewery (storehouse) and other buildings which had been utilized for storage, began in October last and the process of moving continued throughout the winter. It was unavoidable that in spite of every precaution in such removal, a state of confusion should ensue, and even the temporary arrangement of this great accumulation of scientific material in such form as to make it accessible for installation and orderly storage made the utmost demands on the industry and patience of the staff. Every man has given his best service to the relief of conditions which constantly exacted laborious manual work and unremitting good nature.

At the time of this removal there were no cases in which the collections could be installed or stored except the few brought over from other buildings, which it was the intention to use temporarily. Boxes, crates, barrels and drawers were piled up on the bare floors, with such attempts at arrangement as could be made under the urgent pressure of a moving contract. In March the parts of the new Musuem cases which have been under construction by George W. Cobb, jr, were delivered and final assembling of them has continued throughout the year. These conditions falling together made the problems of installation peculiarly trying, requiring the unpacking of the materials while there was no case room available for them. But the selection and preparation of the collections proceeded with such temporary expedients as could be devised while the construction of the cases went on with the deliberation essential to good workmanship.

NEW MUSEUM CASES

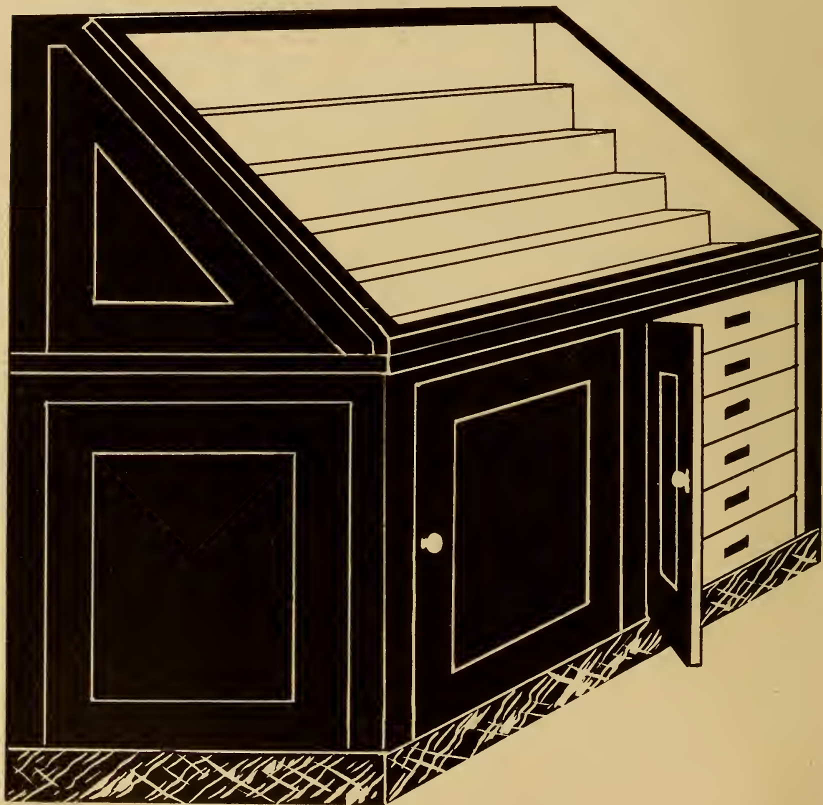
The contract for the new case equipment called for 384 cases of 28 different types. The general design and plans were worked out by the scientific staff with special reference to their adaptation to distinctive exhibits. These cases are now all completed and it may be well to give herewith, as a matter of record, a brief notice of the several types and styles of construction. In selecting the materials for these cases, it was determined to avoid, so far as possible, the use of metal. The action of the metal and the oak cases under the conflagration conditions of the Capitol fire left barely a choice in this matter, and after full consideration by the Regents committee specially charged with the letting of the contract, it was deemed wise to avoid metal except in the construction of the cases for the herbarium. Wood and plate glass, being determined upon as the essential construction materials, in order to avoid monotony of color, mahogany was selected for the wood in the cases for the Zoology, Paleontology and Archeology Halls, ebonized cherry for the Geology and Mineralogy Halls. The following brief exposition of their composition and projection has been prepared by Mr Whitlock.

EXHIBITION AND STORAGE TYPES

Type B. Cases of type B were designed primarily for the exhibition of the general collection of minerals. They have, however, been adopted throughout other sections of the Museum to such an extent that over 50 per cent of the exhibition cases are included under this type. Type B must therefore be regarded as a case adapted to the combined display and storage of small or medium sized objects which it is desirable to show in rows close enough to the eye to admit of the objects being seen in detail. This applies to small fossils, minerals, hand specimens of rock, shells, birds' eggs and small archeological objects, such as pipes, bone implements, etc. The design of this case was modified from one in use in the mineralogical museum of Columbia University, which in turn was derived from a style of case in the University Museum at Prague.

The exhibition space of this type case consists of a triangular prism 5 feet long by 2 feet 3 inches wide by 2 feet 3 inches high, the deck being raised to a level of 3 feet 1½ inches from the floor level. This exhibition space is accessible by one single-panel lid inclined, hinged at the top. Removable steps, in two sections to the case, are provided for the display of small specimens, giving five levels with about 25 feet of shelf length in each case.

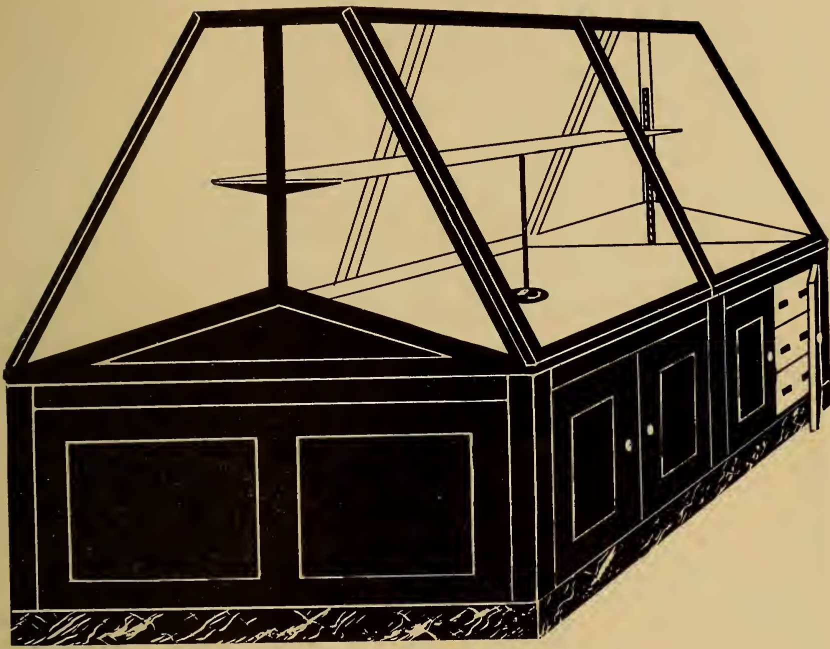
The space below the exhibition portion of the case is furnished with 12 drawers in 2 rows, inclosed by wooden doors which lock with the same key as the lid of the exhibition portion.



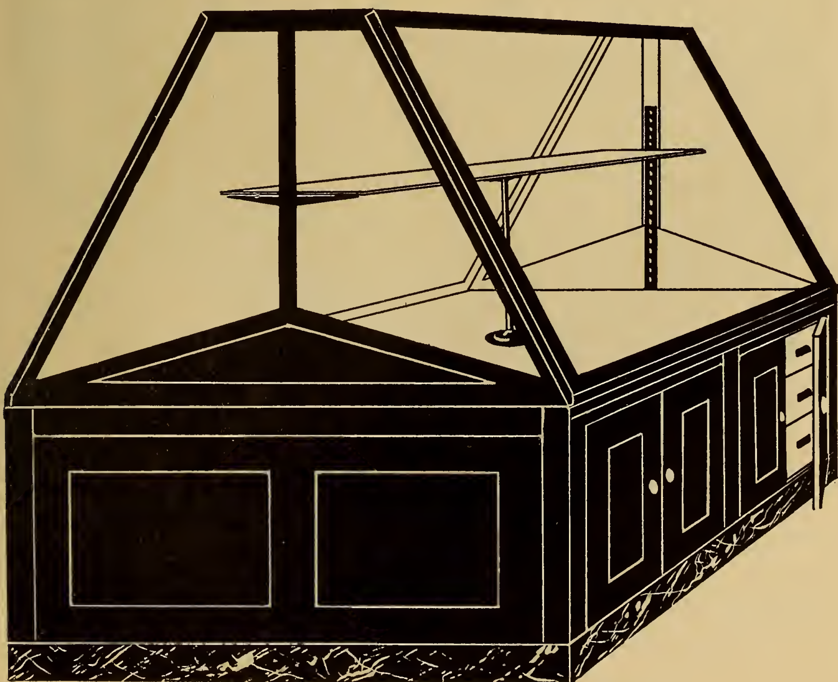
Type B

The type B cases are in most instances assembled back to back in blocks of four.

Types C and D. Types C and D are essentially the same, the only difference being that C is 2 feet longer than D. Both types are designed for the display of archeological specimens in definite groupings, such as articles from a grave, series of objects showing method of manufacture, comparison of the same sort of articles, etc.

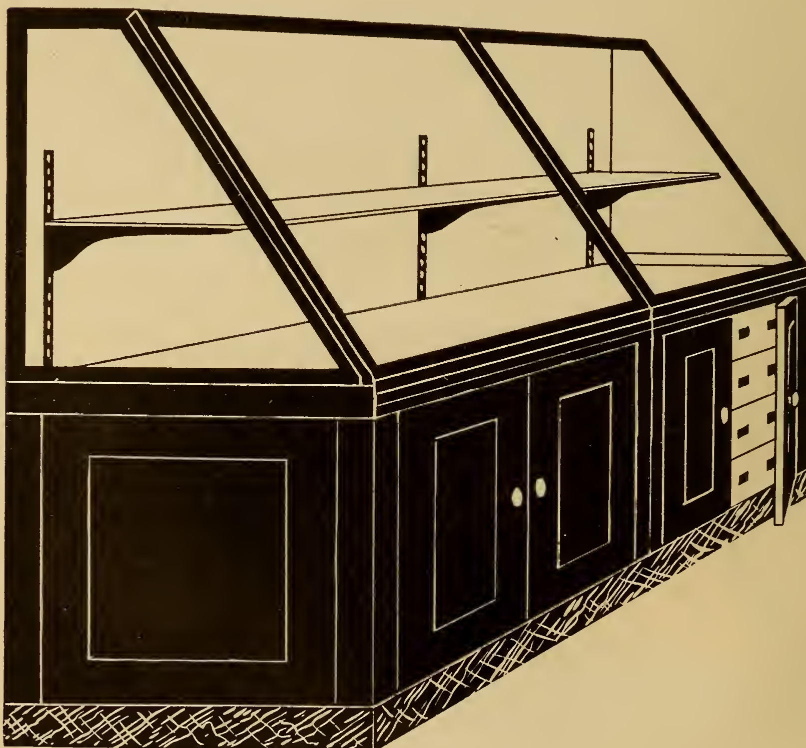


TYPE C



TYPE D

The exhibition space is in the form of a truncated wedge 8 feet (6 feet for D) long by 4 feet 6 inches wide by 2 feet 10 inches high with sloping sides on the long dimension and inclosed on the sides, the exposed ends and the top with glass. The deck of this exhibition space is raised 3 feet from the floor level, the space below being furnished with 24 drawers in 8 rows (12 drawers in 4 rows for D) inclosed by wooden doors. A removable glass shelf running the length of the exhibition space 1 foot 4 inches above the deck furnishes a second level upon which specimens may be displayed. Access to the exhibition space may be obtained on the two long



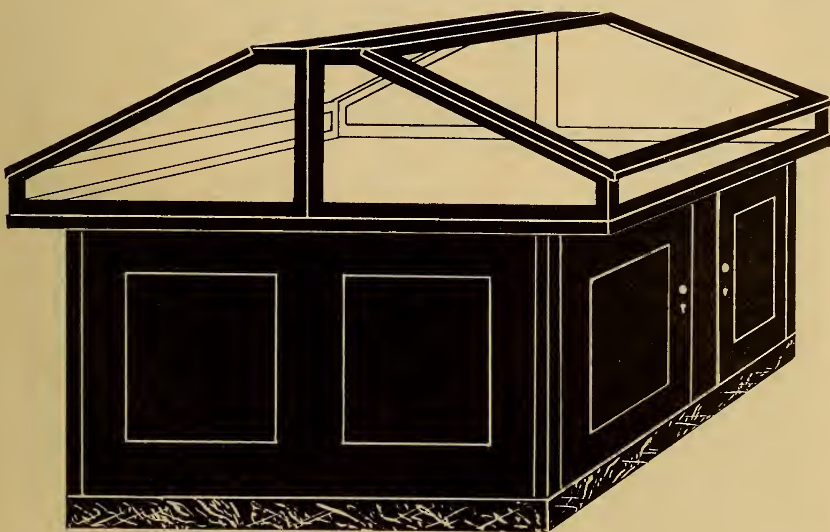
Type E

sides by means of doors hinged at the top. The cases are grouped in rows of three, giving aisles 24 feet and 16 feet for C and D respectively.

Type E. Type E is an adaptation of the type C intended to occupy space next to the wall. It is consequently constructed as the longitudinal half of C, somewhat widened (2 feet 9 inches wide) to give it proportion, and closed at the back where it comes in contact with the wall. It is designed to display the same series of objects as types C and D.

The storage space consists of 16 drawers arranged in 4 rows of 4. The cases as at present installed stand singly against the south wall of the west mezzanine.

Type F. Type F is specially adapted to the display of such groupings as lend themselves to a flat display treatment, such as feather ornaments, war clubs, wampum belts, etc. Consequently, the level of the exhibition space is somewhat lower with respect to the floor level and the space proportionately low to its length and width; in other words, type C has been flattened out to meet the needs for the display of flatter objects.



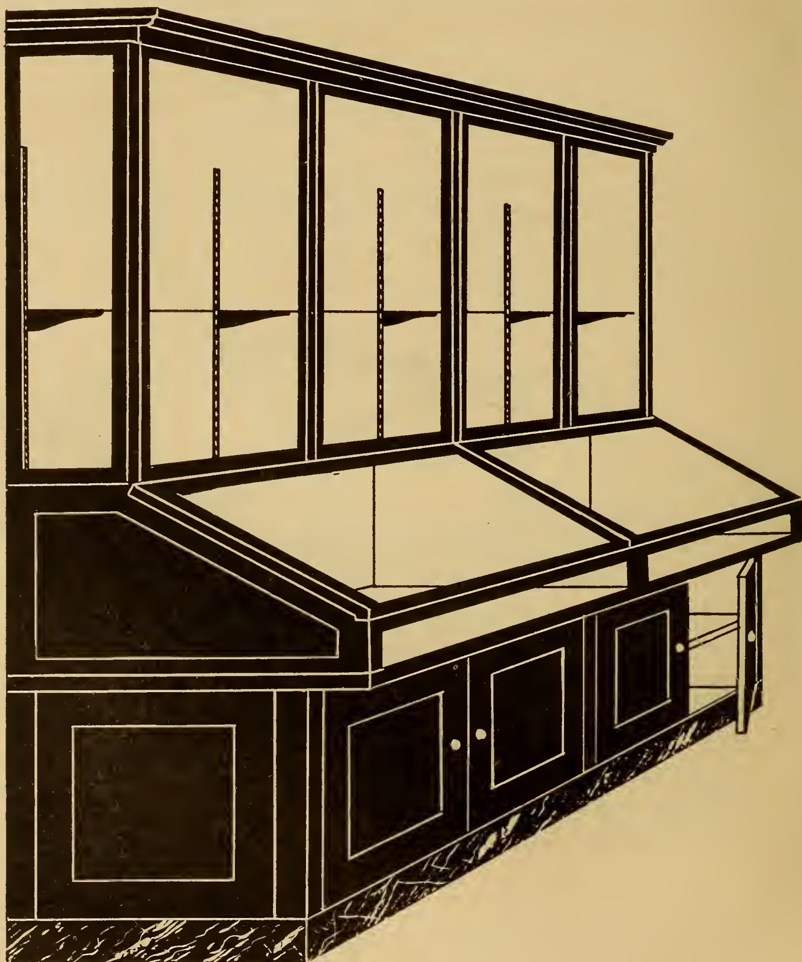
Type F

The exhibition space is in the form of a low wedge 5 feet long by 5 feet wide and 1 foot 3 inches high, the top, sides and ends of which are glazed. The inclined tops form the lids and the exhibition space somewhat overhangs the supporting storage portion to give better symmetry to the general case outline.

The storage portion is furnished with a bottom and one shelf on both sides of the case closed with wooden doors.

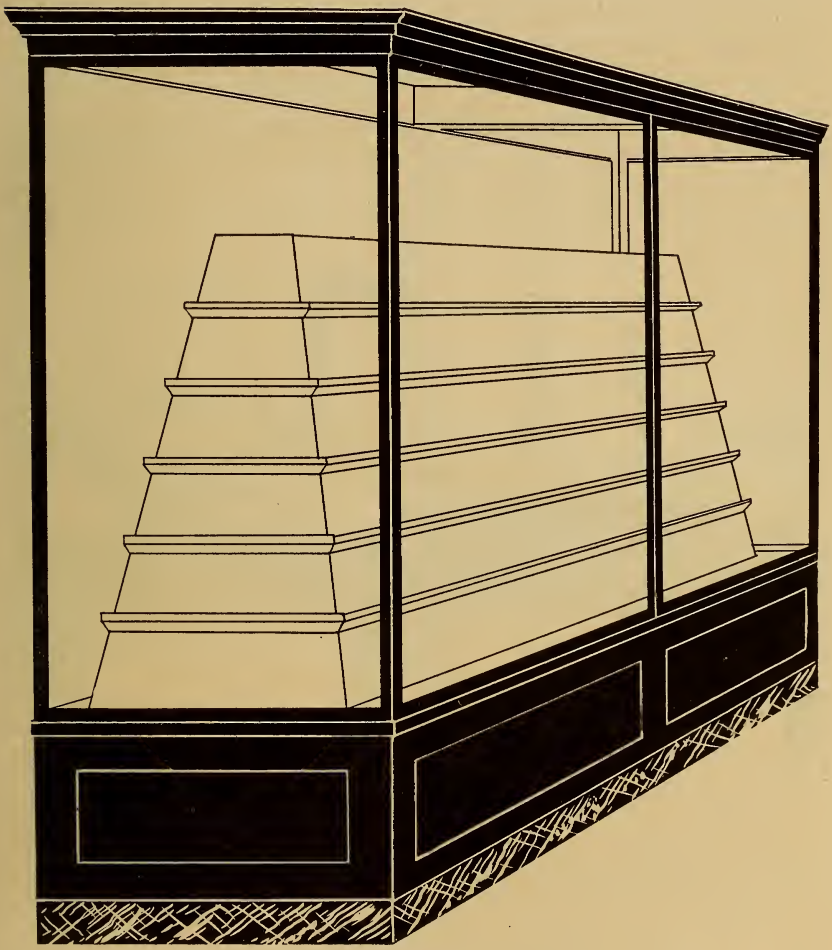
As installed at present, the type F cases are free standing, that is, accessible on all four sides.

Type G. Type G combines the longitudinal half of type F lengthened and adapted to the space next the wall, with a superposed wall case section. The object of this type of case is to show



Type G

in proximate relation objects which are more or less flat and those, such as garments, head dresses, etc., which require to be displayed on a vertical surface. This practically results in two exhibition spaces, the lower of which, corresponding to a longitudinal half of type F, is 8 feet long by 3 feet wide by 1 foot 4 inches high, opening in two single-panel glazed lids. The upper or vertical exhibition space is 8 feet long by 10 inches wide by 3 feet 9 inches



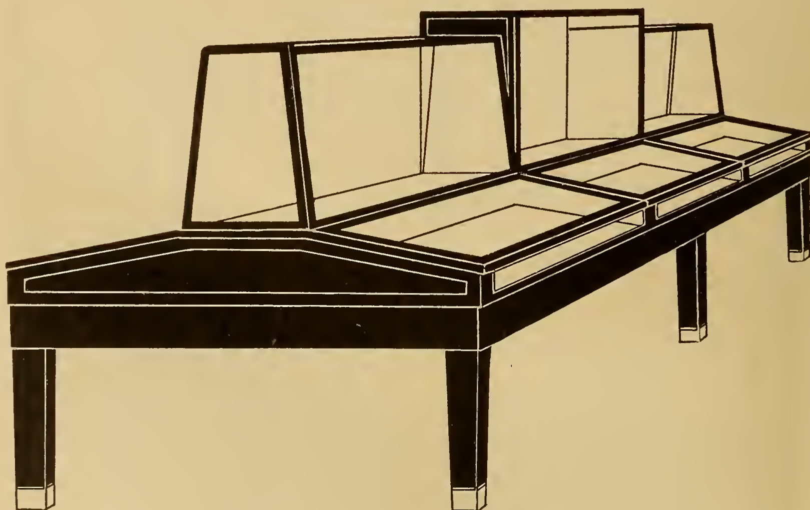
Type A

high, occupying a vertical space from the floor level of roughly from 4 to 8 feet, and opening by means of four single panel doors.

The storage space is shelved similar to type F.

Type A. Type A was designed to exhibit specimens of fossils and was adapted from a similar type of case in use in the National

Museum at Washington. The case is " free standing," that is, open to view on all four sides. It measures 8 feet long by 3 feet wide by 8 feet high and the deck or case flooring is 1 foot 11 inches above the general floor level. Access to the cases is obtained through double doors on both long sides which admit of the easy arrangement of specimens in every portion of the exhibition space. A wooden diaphragm for the support of slabs is fitted inside each case, attached in such a way as to be readily removable should the free case space be required for the display of large objects. The diaphragms are in the form of rectangular, truncated pyramids of steep inclination and are provided with narrow cleatlike projections, running continuously around the diaphragm at convenient



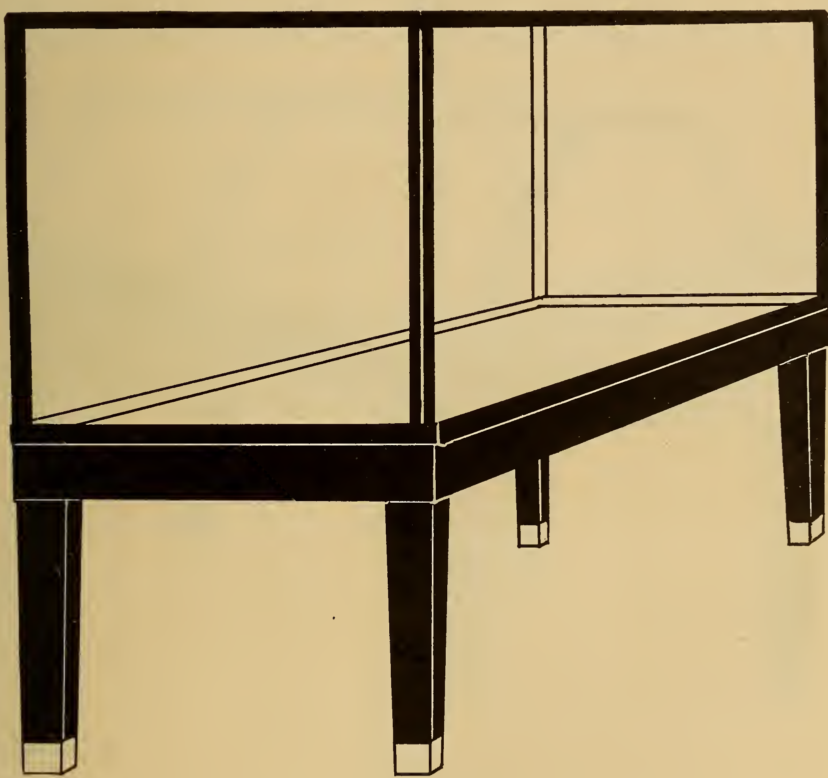
Type H

levels, to provide for the mounting of specimens on all four sides of the case.

SPECIAL ENTOMOLOGY TYPE

Type H. Type H was designed to exhibit insects mounted on flat surfaces in proximate relation to descriptive groups showing the life history of typical members of the series illustrated in the flat exhibits. The general design of this case somewhat resembles the entomological cases of the American Museum of Natural History known as the "A" and table cases combined, but with the added feature of a middle upright section in the shape of a rectangular exhibition space for the display of the life history groups.

The exhibition space is divided into three sections in which each of the two end sections consists of two shallow flat elements on either side of the longitudinal axis opening by hinged lids and surmounted by narrow vertical elements with slightly inclined sides, one of which is removable for the insertion of a double diaphragm



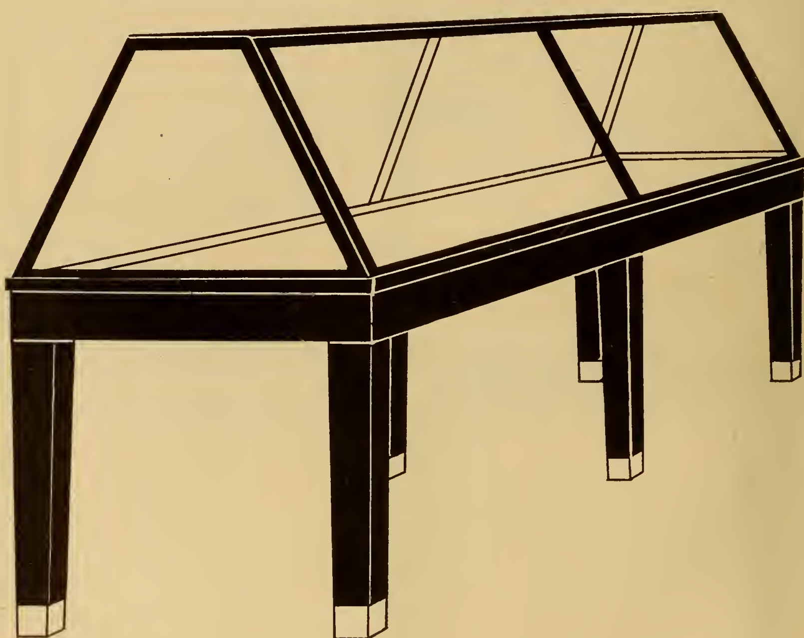
Type I

to hold the specimens which are consequently visible from both sides of the case. In the middle section, the vertical element is rectangular and is not provided with a diaphragm. The horizontal elements are 4 feet long by 1 foot 10 inches wide by 6 inches deep, the decks and lids are parallel and slightly inclined from the horizontal, the former being 2 feet 2 inches at the outside and 2 feet 6 inches at the inside line.

The upright end element is 4 feet long, 1 foot 3 inches wide at the bottom and 2 feet high. The same dimensions hold for the middle element except that this latter is 2 feet 3 inches high. The deck for all the upright elements is 3 feet 2 inches from the floor level. The case is supported on legs and covers a floor space of 12 feet by 5 feet.

FREE STANDING TYPES FOR LARGE SPECIMENS

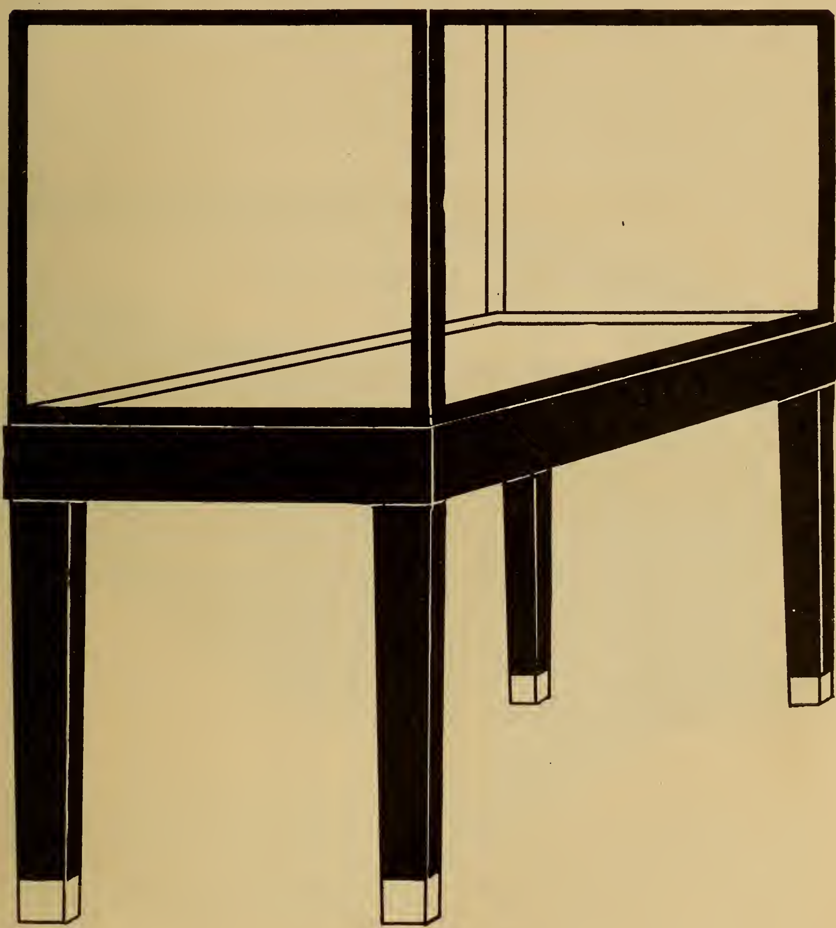
In the free standing types of cases are represented the extremes of simplicity in case design, in that they involve primarily a deck



TYPE J

or exhibition floor supported on legs and inclosed in glass to a height which gives sufficient head room for the required exhibit.

Type I. Type I represents a "general utility" case for the display of large objects such as mineral or geological specimens, series of specimens in industrial geology and paleontology. This type can also be used to advantage for the display of models of mine workings, industrial plants, etc. The exhibition space is rectangular and measures 6 feet long by 3 feet wide by 3 feet high and is mounted on legs to raise the deck 2 feet 6 inches from the floor level. Access is obtained by removing one of the long sides by means of removable screws which work in brass sockets. In practice, the interior may be furnished with block-steps or diaphragms depending on the nature of the material to be exhibited,

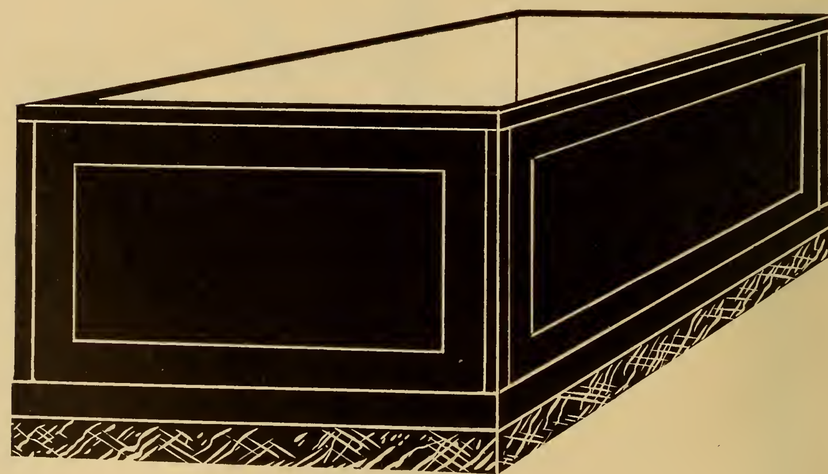


Type K

the proportions of the exhibition space yielding much latitude of treatment in this respect.

Type J. Cases of type J are also designed for the display of definite specimens, that is, large minerals of a special occurrence. They are intended to be used without diaphragms or step-blocks and to be installed in a group of which the single type L case forms a center. The exhibition space is in the form of a truncated wedge of which the base is 8 feet long by 3 feet wide and is raised 3 feet above the floor level.

Type K. Type K cases differ from type I only in size and proportions. They are intended for the display of the larger slabs of fossil remains which, on account of their development of fine detail, need to be closer to the eye of the observer than would be possible in a deck as close to the floor level as that of type I. The rectangular exhibition space which measures 4 feet long by 2 feet 6 inches wide by 2 feet 6 inches high, is consequently raised to a level of 3 feet from the floor level. For the interior furnishing of these cases narrow, high diaphragms or step-blocks are best adapted



Type M M

both from the point of view of the proportion of the material to be exhibited and from that of the proportions of the exhibition space.

Type L. Unlike the preceding types, this case design, of which only one was installed, was made to accommodate one particular specimen, a large crystal of calcite installed in the Mineralogy Hall. The exhibition space is rectangular, measures 4 feet 6 inches square by 2 feet high, and is raised 2 feet 6 inches above the floor level.

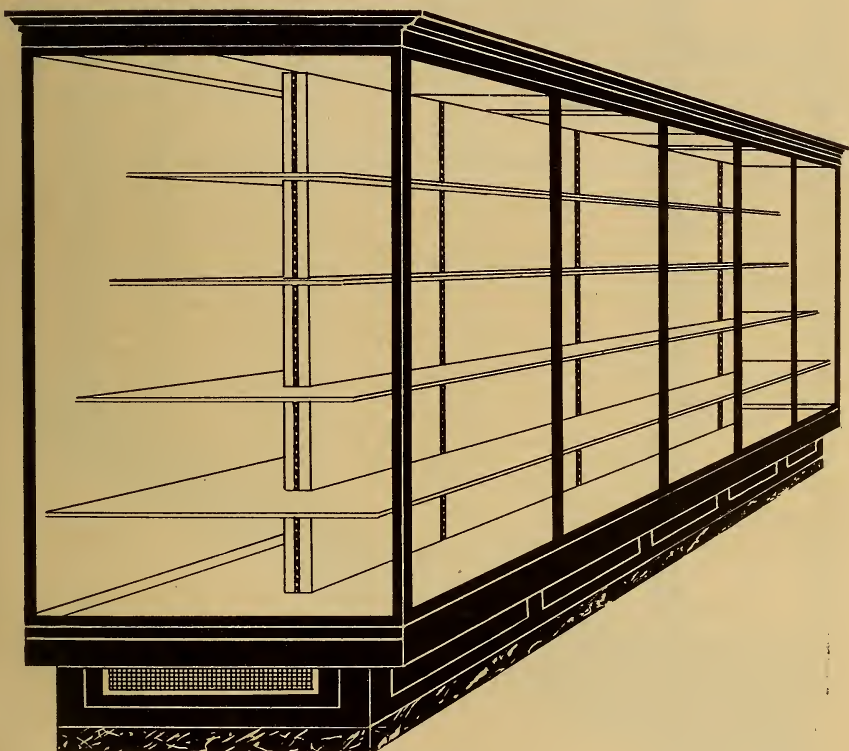
ARCHEOLOGY EXCAVATION TYPES

The archeology excavation types of cases consist essentially of rectangular boxes 3 feet in height, setting directly on the floor.

They are designed for the exhibit of reproductions of Indian grave excavations to be viewed through the glass lid which may be removed to gain access to the case. The two types, M and MM, differ only in one dimension, being 5 feet (6 feet for MM) long by 4 feet wide by 3 feet high. They are designed to be free standing, but may be installed with one side against the wall.

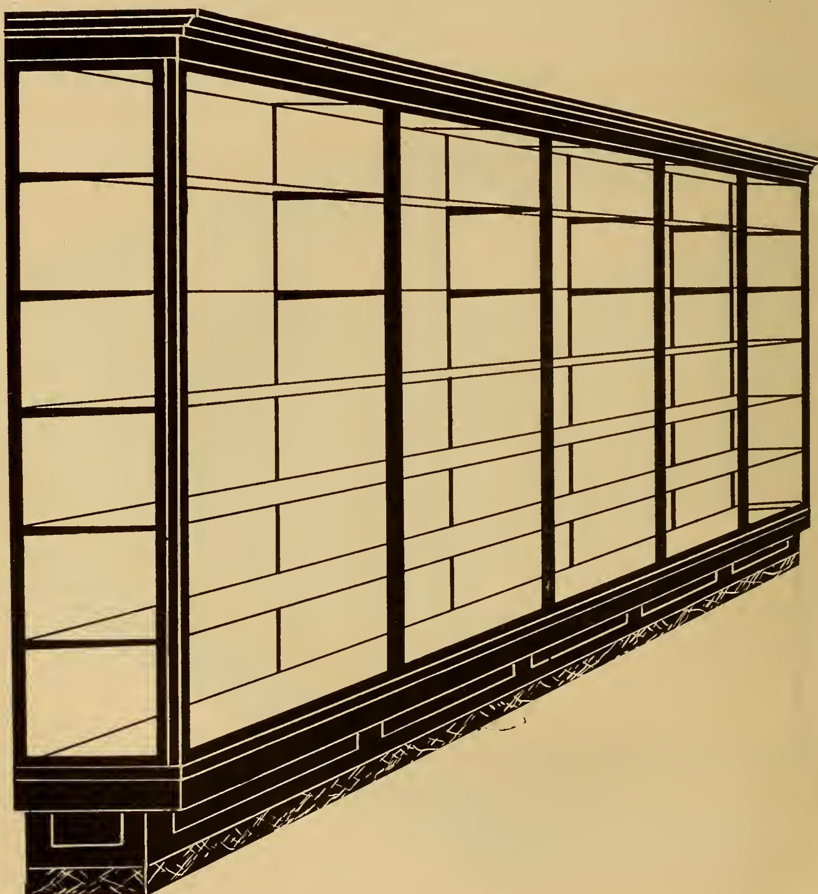
TYPES WITH ADJUSTABLE SHELVES AND WALL-CASE TYPES

Under the group of types with adjustable shelves and wall-case types are included the various forms of wall cases and the detached



Type N

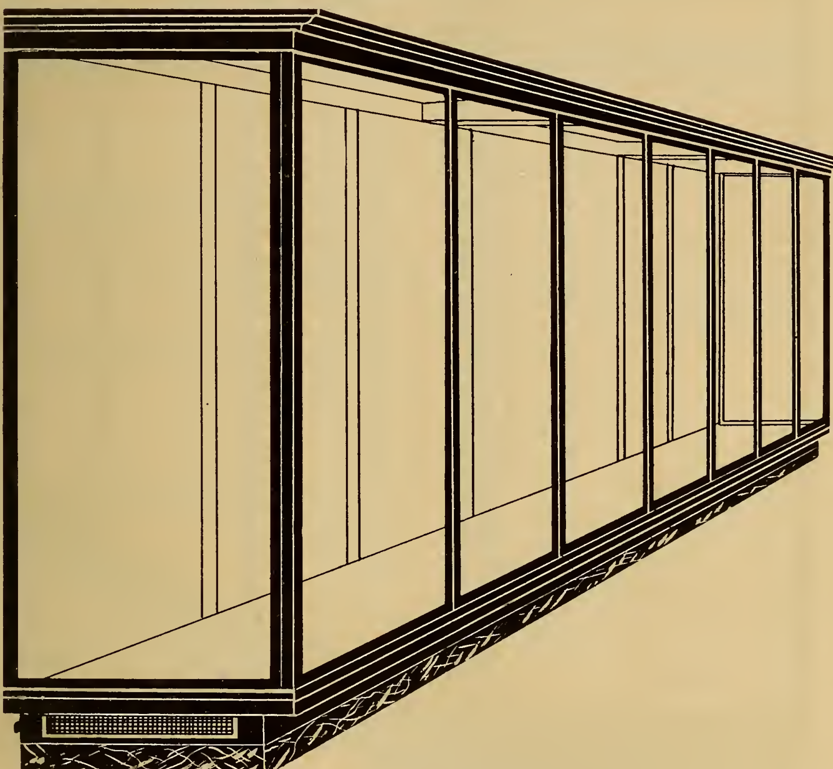
type with shelves which may for purposes of classification be considered a detached pier wall case. The group of types is characterized by a low deck and a uniform height of about 8 feet, the limit between which zoological and archeological specimens may be seen to advantage, the exception to the 8 foot height in cases of this group being type Q, which was designed for a children's exhibit in archeology. The longitudinal dimension in wall type cases is, of course, limited by the length of wall space to be filled and the lateral dimension by the character of the material to be exhibited; for instance, for large mammals or Indian canoes, a fairly wide wall case is required, while for Indian garments, ceremonial masks



Type O

or rows of bottled alcoholic specimens of invertebrates, a comparatively narrow wall case is best adapted. In the large zoology types of this group two features appear for the first time in this description: (1) The base is recessed in order to permit the observer to stand close to the glass. By this means an economy of aisle room is effected. (2) A ventilating device is introduced in the base by means of which the air passing into the case when pressure is equalized, after a sudden change of temperature, is filtered free of dust through a series of sheets of cotton.

Type N. Cases of type N were designed for the display of the general collection of New York small mammals, birds, fishes etc. The exhibition space is 16 feet long by 4 feet wide and 6 feet

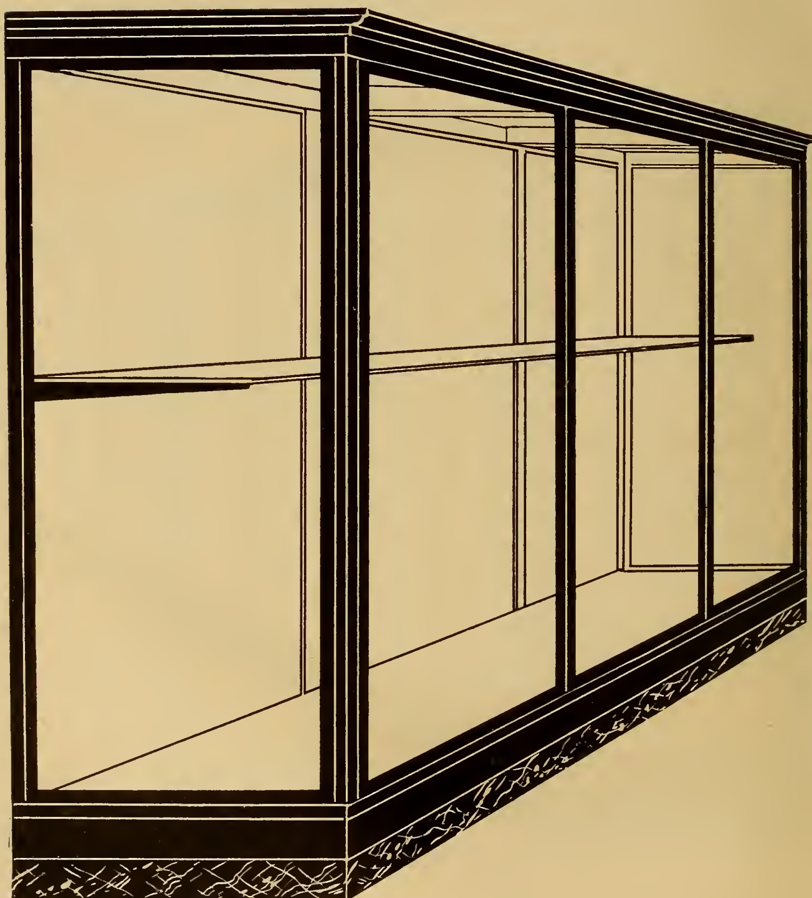


Type P

6 inches high, raised on the recessed base 1 foot 6 inches from the floor level. The case is divided longitudinally by a substantial diaphragm furnished with slotted strips upon which adjustable brackets are fastened which in turn support the wooden shelves. Access is gained through the second and fourth panels on both sides and the two end panels which are hinged doors. The top panels are glazed. The cases as at present installed are free standing arranged

with an aisle of about 10 feet between cases and an aisle of about 4 feet between the ends of the cases and the wall, giving an alcove effect in arrangement.

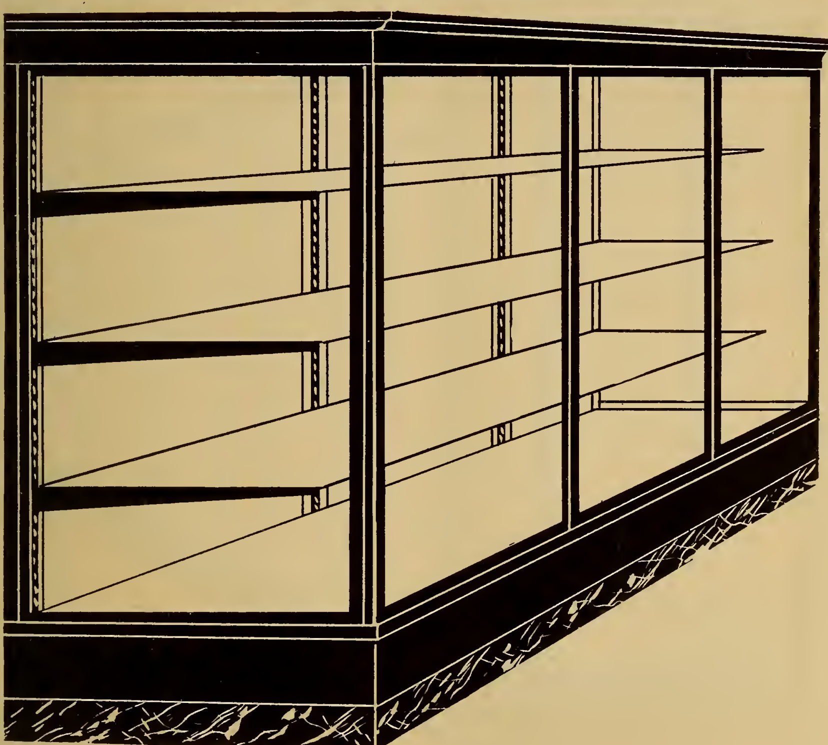
Type O. The two cases of type O are distinctly wall cases. They were designed for the display of small zoological specimens,



Type PP

models and preparations to illustrate the invertebrate fauna of New York. The type is consequently narrow compared with its length and has its glass shelves spaced closer together than those of type N. The exhibition space is 14 feet long by 1 foot 6 inches wide by 6 feet 6 inches high and is raised on a recessed base 1 foot 6 inches from the floor level. Access is gained through the second and fourth panels which are swinging doors. The glass shelves are adjustable on bronze brackets supported from the back on slotted strips. The top panels are glazed.

Type P. Type P is a single wall case occupying the space between the entrances of the Zoology Hall. It is designed for the display of groups of the larger birds, such as eagles and hawks.

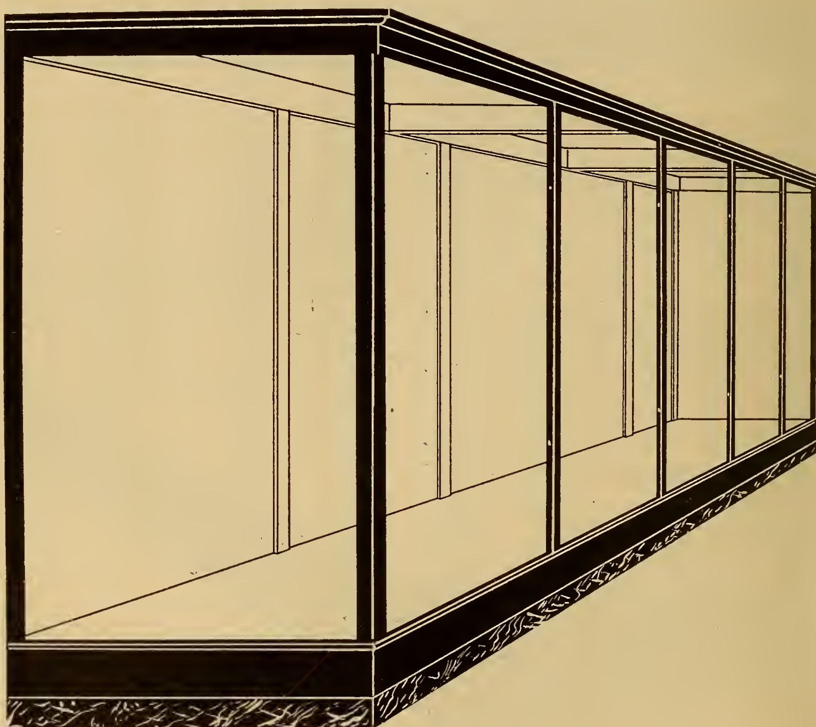


Type Q

The exhibition space is consequently unbroken by shelves, is 19 feet long by 3 feet wide by 7 feet high and is raised 1 foot above the floor level on a recessed base. On account of the size of the exhibition space the case is ventilated with the dust-filtering device. The first, third, fifth and seventh panels are hinged, giving access to the case. The top panels are glazed.

Type PP. The wall cases of type PP are planned for the display of the larger archeological specimens such as baskets, canoe paddles, pestles and mortars for pulverizing maize, etc. The exhibition space measures 10 feet long by 3 feet wide by 7 feet high and is raised 1 foot above the floor level. The glass shelves are supported on adjustable bronze brackets. The top panels are glazed. Access is gained through the first and third panels which are hinged on the end side.

Type Q. The two wall cases of type Q are intended for a children's exhibit of objects relating to Indian life and customs. The



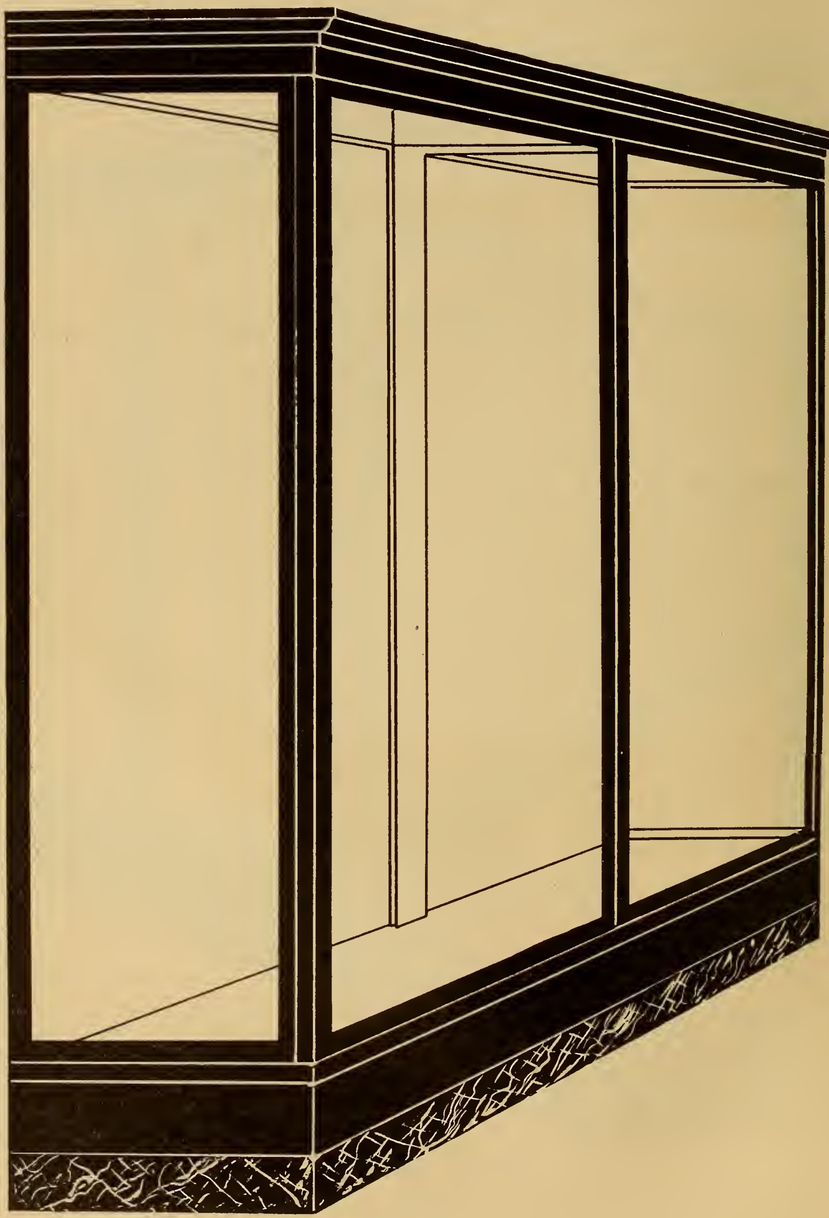
Type R

cases are consequently two feet lower than the customary height for wall cases. The exhibition space is 8 feet long by 3 feet wide by 5 feet high and is raised 1 foot above the floor level. The first and third front panels are hinged on the end sides giving access to the case. The top panels are glazed. The glass shelves are supported on adjustable bronze brackets and are divided between brackets into three units for each level so that a panel of shelving or any level of a panel can be eliminated to give head room for larger specimens.

Type R. The single case of type R was designed for the display of Indian canoes in the Archeology Hall. The case is con-

TYPE S

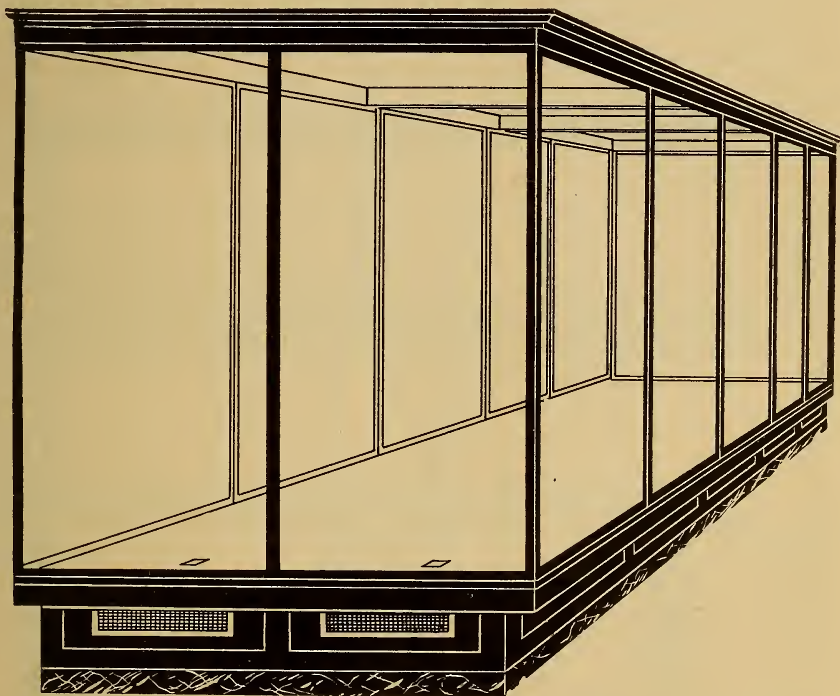
sequently longer and wider than is usual with wall cases and is not provided with shelves, the canoes being hung from the top of the case or supported on brackets from the back. The exhibition



Type T

space is 20 feet long by 4 feet wide by 7 feet high and is raised 1 foot above the floor level. The case is accessible through the first, third and fifth front panels which are hinged. The top panels are glazed.

Type S. Wall cases of type S were designed for the display of skulls in the collection of New York anthropology. The exhibition space is 8 feet long by 1 foot 6 inches wide by 7 feet high and is raised 1 foot above the floor level. Access is gained through



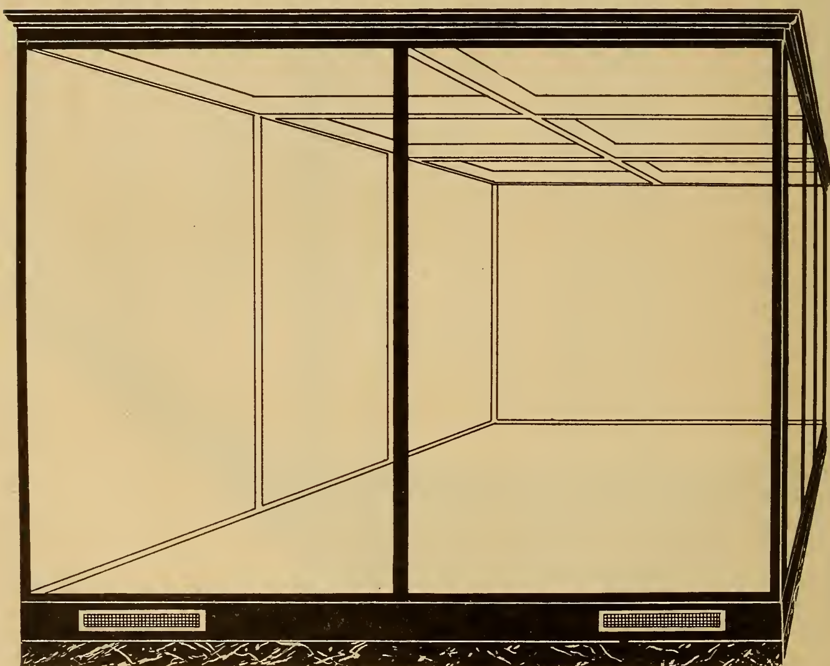
Type NN

the first and third front panels which are hinged on the end sides. The top panels are glazed. The glass shelves are supported by adjustable bronze brackets.

Type T. Wall cases of type T were designed to display such specimens in the ethnology and anthropology collections as complete Indian skeletons, clothing and miscellaneous ethnology objects. The exhibition space is 6 feet long by 2 feet wide by 7 feet high and is raised 1 foot above the floor level. The top panels are glazed. Access is gained through double doors in front.

LARGE FREE STANDING CASES FOR MAMMALS AND MAMMAL GROUPS

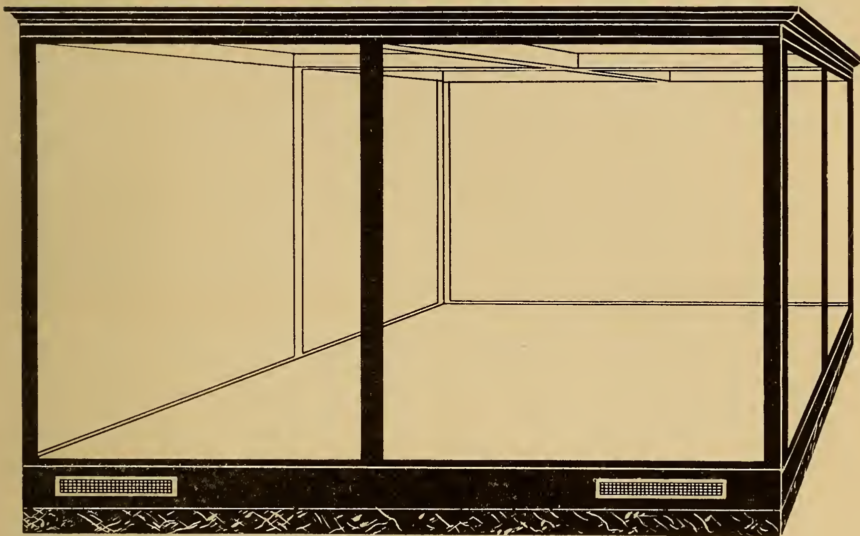
With the exception of type NN, the large cases for mammals are each designed to contain a certain definite group, as the moose group or the puma group, mounted to show the natural surroundings and habits of the animals. Type NN cases are here included because their museum function connects them more closely with the large mammal cases, but structurally they belong with the type N cases to which they conform in general design and with which they form a continuous series running around three sides of the Hall of Zoology. The ventilating dust-filter device is used on all cases of this group of types.



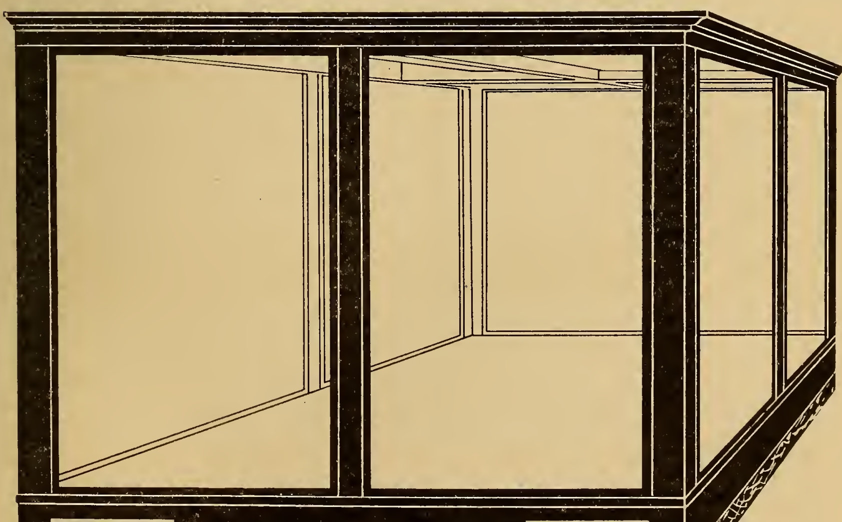
Type U

Type NN. The two cases of type NN were designed for the display of large mammals and groups of the smaller mammals in the collection of New York fauna. In design they are very closely related to type N cases, differing from the latter only in width. The exhibition space is 16 feet long by 6 feet wide by 6 feet 6 inches high and is raised 1 foot 6 inches from the floor level on a recessed base.

Types U, V, W, X and Y. Case types U, V, W, X and Y were designed to contain the large mammal groups of New York fauna. They differ from one another only in the dimensions of the exhi-



TYPE X



TYPE Y

bition space which is governed by the proportions of the group. They are all mounted on a straight (nonrecessed) base which is 1 foot high in the larger types U, V and W and 1 foot 3 inches high in types X and Y. Access to cases of these types is gained through one of the glazed top panels which is removable. Ground glass, instead of plain plate glass, is used for the top panels in order to cut off the view of the ceiling of the hall and thus render the group more detached. The sizes of the exhibition spaces are:

	Long	Wide	High
Type U	16 feet	12 feet	8 feet
V	14 "	12 "	9 "
W	10 "	10 "	7 "
X	10 "	8 "	5 " 9 inches
Y	8 "	$5\frac{1}{2}$ "	5 " 9 "

Number and distribution of types of museum cases
(Initial equipment)

Type	Archeology Hall	Entomology Hall	Geology Hall	Mineralogy Hall	Paleontology Hall	Zoology Hall	Total
A	....	....	....	....	20	....	20
B	30	....	75	48	33	24	210
C	12	....	....	....	....	....	12
D	6	....	....	....	....	....	6
E	12	....	....	....	....	....	12
F	6	....	....	....	....	....	6
G	11	....	....	....	....	....	11
H	....	12	....	....	....	....	12
I	....	....	19	15	....	....	34
J	....	....	....	4	....	....	4
K	....	....	....	....	11	....	11
L	....	....	....	1	....	....	1
M	3	....	....	....	....	....	3
MM	1	....	....	....	....	....	1
N	....	....	....	....	....	14	14
NN	....	....	....	....	....	2	2
O	....	....	....	....	....	2	2
P	....	....	....	....	....	1	1
PP	6	....	....	....	....	....	6
Q	2	....	....	....	....	....	2
R	1	....	....	....	....	....	1
S	3	....	....	....	....	....	3
T	2	....	....	....	....	....	2
U	....	....	....	....	....	1	1
V	....	....	....	....	....	1	1
W	....	....	....	....	....	2	2
X	....	....	....	....	....	2	2
Y	....	....	....	....	....	2	2
Total	95	12	94	68	64	51	384

PROGRESS OF INSTALLATION

As already intimated, the equipment of the collections has been in a measure restrained by the progressive completion of the cases. Those finished first were filled first; those which have just been completed are still vacant. The progress of this work has also depended in some measure on the condition of the collections. Some which had been on exhibition years before had been packed away in an orderly manner and judiciously selected. Others had to be taken over just as they had lain in storage for many years. The sum of the material assembled in all departments of work was very large; taken as a whole and, as was necessary, all at once, it was well-nigh overwhelming. Preliminary to any attempt at installation was the necessity of assorting these materials according to kind and quality and the selection of representative series of the best from the great preponderance of the second best. Confronted by these conditions the work of installation has proceeded well.

Mineralogy. The collections in mineralogy were removed from Geological Hall many years ago and put in storage. In dismantling the old collections everything was packed in carefully arranged consecutive order, so that on reopening these collections were in approximate readiness for installation. Having an advantage in this foresight, as well as in the fact that the mineral cases were the first to be completed, the curator, Mr Whitlock, has brought an effective installation nearly to completion. The general mineral collections and the collection of New York State minerals now occupy 78 cases at the west end of the long south hall, and it is quite probable that this section of the Museum may be opened to the public within a reasonably short time.

Geology. In illustrations of economic and structural geology the collections have proved quite deficient and every earnest effort has been made to acquire such and replenish the losses to the Museum arising from too lavish gifts to other institutions of displays made by the State Museum at various world fairs.

These efforts are bringing together the necessary materials for instructive exhibits, relating in large measure to the most active lines of mineral production in the State, but many serious problems in this section are still unsolved, and in some respects the case room is inadequate, the general treatment of Geology Hall is still ineffective and somber and much remains to be accomplished before the room can be exposed to the public. The work, in charge of Mr

Newland and Mr Jones, will eventually be brought to a successful conclusion.

Paleontology. The collections in the paleontology section which are very large, came to the new quarters in unavoidable disorder, due to the fact that the best part of them had been twice moved since the dismantling of the exhibit in Geological Hall, and the rest had in large measure been packed in boxes from five to thirty years and during this time shifted from pillar to post — from Professor Hall's laboratory to the State Hall and Geological Hall, from there to the McCredie malthouse, to the Taylor brewery — at length to this building where, for the first time since their collection, all were assembled in one place with the purpose of selection for one permanent exhibit. The boxes and crates and drawers containing this material were more than a thousand and the first and immediate problem here was to ascertain the nature and quality of their contents.

The progress made in this work is satisfactory, in view of the small number of men on the staff available for such service. The paleontology cases, 66 in number and consisting at present of four different types of construction, were made finally available in August and, except for a few of the smaller ones intended for special exhibits, all have been filled with a temporary arrangement of materials, and a final and permanent display has been worked out for certain groups of fossils: the Trilobites, Eurypterida, Crustacea and Cephalopods. This work has been carried out by Doctor Ruedemann, Mr Hartnagel and Mr Wardell.

In addition to this, much has been accomplished in the preparation of large exhibits of invertebrate fossils mounted on uncovered pedestals. Of these are a unique slab of Devonic starfish 4 feet 9 inches by 4 feet 9 inches, from Saugerties, N. Y., collected and mounted by Mr Wardell; a very striking display of cephalopods from the Agoniatite limestone, collected by Mr Hartnagel, developed by Mr Norton and mounted by Mr Wardell; a great slab of Devonic sponges from the Jenks quarry at Bath, N. Y., collected by the late C. Van Deloo, developed by Mr Norton and mounted by N. T. Clarke. Some very effective natural size reproductions of the Eurypterida, *Pterygotus, Eusarcus, Stylonurus,* have been made, framed and set up in the hall. These have been modeled by Mr Marchand and colored by Mr Barkentin. A series of natural size and enlarged relief designs to show the structure of the fossil cephalopods have been modeled by Doctor Ruedemann, cast by Mr Clarke and effectively colored by Mr Barkentin.

The fossil plants from the New York rocks will be assembled in the hall at the elevator landing. As a central piece for the room will be a restoration in life proportions of the unique Devonic tree, *Archaeosigillaria*, the largest and most complete of the terrestrial lycopod plants known from these rocks. The original of the restoration, taken from the Portage rocks at Naples and constituting a flattened trunk 11 feet long, has been remounted and cased, as has also the giant sea-weed *Nematophytum* from the Devonic rocks of Monroe, N. Y.

For the very extensive series of invertebrate fossils sufficient case room is not yet available and the necessary money has been provided for the construction of 37 additional cases which are designed to go entirely about the walls of the Paleontology Hall.

Attention has also been given to the vertebrate fossils. The Cohoes mastodon, a very celebrated skeleton and among the most complete known of the animal, has been set up by Mr Mirguet and in a manner much more effective than its original mounting. The Irish elk and the Asiatic elephant have also been remounted, the skull and tusk of the Ellenville mastodon set together and encased, the Harriman tusks and Monroe tusks put together. What is believed to be a fairly successful attempt to restore in natural proportions the extinct giant beaver of this State, Castoroides ohioensis, has been carried out and the model set up. It was modeled from measurements taken from the skull found at Clyde, N. Y., aided by more complete remains in the museum of Earlham College, Indiana. The workmanship is by Mr Marchand.

Restorations of the ancient Devonic fishes have been assembled in one case, recolored and effectively mounted.

A word should be said here in regard to the difficulty of preparing these exhibits in paleontology. The rocks of New York produce fossils which are almost exclusively of the invertebrate type and as a consequence the specimens are naturally small and rather inconspicuous except for certain noteworthy exceptions. The problem here is to present the small organisms to the public eye with the same effectiveness as if they were vertebrate objects of notable dimensions. It is needless to state that as natural objects each one is as momentous in its character and in the chain of life as though it attained the dimensions of the mammoth or the mastodon. Still, in the display of these small objects, all of a high degree of scientific interest, great thought and extreme care are necessary to make the presentation of them perfectly effective.

The remarks thus far made have especial reference only to the large south hall of the Museum. The efforts that have thus far been made herein toward installation have been supplemented by the accumulation and setting of the geological relief maps of which the Museum has now a considerable number and which it is hoped to supplement. The final determination of the arrangement of these relief maps has not yet been reached, but the walls of the halls afford reasonably favorable exposure for them and for such photographic illumination and similar decorative effect as may seem suitable.

Zoology. The cases for the Zoology Hall were not completed until the very end of the fiscal year, and as a consequence but little work has been possible in the matter of installing the extensive zoological collections. These cases number in all 43 and are divided into two series, one for the exhibition in zoology proper and the other for the exhibition in entomology, the two series of cases being of quite distinct types. In large measure the cases for the Zoology Hall are of conspicuous size and the installation in them of such groups as the large mammals will require much labor, artistic rendering and corresponding expense. From the old Museum was brought a limited number of small mounted groups, many of which have had to be repaired on account of the jolting received in moving. Among these also was one large group which has been entirely reset, and these few constitute all the mounted groups now in Zoology Hall. There remains, therefore, a very large amount of work to be done here, and if it is to be effectively done, it must be by the hands of expert workmen, who have not only ideas of scientific accuracy, but artistic conception and manual skill. Such men are not easy to find but the effort is being made to acquire the services of the highest grade in order that there may be no sacrifice of effectiveness in this hall. Meanwhile the installation of individual specimens of the higher mammalian and avian fauna has gone forward and at this time the case room available seems to be adequate for the immediate purposes of this division. It is, however, perfectly evident that this hall is now so full of cases that additions will be difficult and, if necessary, can not fail to close up the narrow aisles and aggravate the present obviously crowded condition. The members of the staff charged with this work are few in number and it will probably be necessary for a long time to come to go outside and employ the requisite expert assistants in ordering the zoological groups.

Archeology. The archeology section is to occupy the two mezzanine floors. Originally it was planned to restrict the archeological exhibit to the large mezzanine at the west of the building and to reserve the smaller mezzanine for the botanical collections. It seems, however, impracticable now to put together an effective exhibit in botany sufficient to fill the smaller mezzanine. The demands of the growing section of archeology for more room are imperious and the present plan contemplates assigning both mezzanines to this section and restricting botany, for the time being, to the space available in the separate compartment on the mezzanine floor at the east end of the building. The cases for the archeology section were released by the contractor only near the close of the fiscal year and these included only such as were embraced within the contract of George W. Cobb, jr. No provision had been made in that contract for the construction of the large group cases which are to contain the series of ethnological displays of the Six Nations. Since then plans have been undertaken which will lead to the construction of these cases to receive the groups for which the cost was contributed by the generosity of Mrs F. F. Thompson, and while these plans are now progressing, it will obviously be some time before these great cases are constructed and the exhibits completed.

Additional cases will be required, and reasonable provision has been made therefor, in order to put the smaller mezzanine in proper equipment for the reception of the archeological collections. In view of the uncertainty which prevailed as to the proper adaptation of the lesser mezzanine, the Cobb contract did not call for a sufficient number of cases to equip it suitably, and it is now hoped that the provision which has been made by the Board for additional cases may be adequate to put this room into proper order.

As a necessary consequence of these conditions the installation of the archeological collections, so far as it has gone (and some of the cases have been filled) is only temporary, for the construction of the new cases will require the removal and replacing of some cases already installed. Mention might properly be made, however, of certain work which has been done in the construction of the Indian graves in the cases prepared for them, the work on these having been effectively rendered and completed. This work has been carried out under the direction of Mr Parker by his assistants, Mr Clarke and Mr Lansing.

General. The Museum is still imperfectly equipped in office facilities and more especially in regard to suitable drawers for the keeping of the excess and duplicate storage collections of its material. We brought over from Geological Hall and State Hall many thousands of wooden drawers with their standards, for the purpose of affording necessary, even though dangerous, storage, and these are now standing in the corridors. In the basement of the building the machinery plant has been installed and the balance of the room there appropriated for the work of the Museum is given over to the storage of the large amount of material which it has been as yet impossible to open.

There have been some notable accessions to the collections purchased during the past year. These have been principally in the division of archeology which was the most severely injured by the Capitol fire. Of these recent additions those of leading importance are the collections of Indian materials brought together by R. D. Loveland, Watertown; Charles P. Oatman, Liverpool; Raymond C. Dann, Fairport; Alva S. Reed, Livonia; Frederick H. Crofoot, Sonyea; D. F. Thompson, Troy, and Otis M. Bigelow, Baldwinsville. This series of collections of Indian cultural relics constitutes the best of the Iroquois and pre-Iroquois materials now available in the State, and although further additions are always desirable, it is quite likely that they must be of very much less size and significance. To this list should be added the extensive collection of such materials made by Mr D. D. Luther, a member of the staff, from the Indian village in the town of Naples.

The Museum has also acquired by purchase the William D. Gebhard collection of fossils from the classical region of the Schoharie valley. This is the last of the great collections of fossils brought together by the Gebhards, through three generations, and the State Museum is fortunate in getting possession of it. An extensive collection of minerals from Orange county, made by the late Silas A. Young of Edenville, has also come into the possession of the Museum and makes an essential addition to the representation of New York minerals.

Full inventory of these collections will be given in the accession lists and made a part of this report, together with memoranda regarding smaller collections of various kinds and varying interest.

Orders have been given for the construction of a large relief map of the Finger Lakes region on the topographic scale of one mile to one inch. This is constructed for the purpose of showing the detailed stratigraphy of that region as it has been worked out by the members of the Geological Survey. The map will cover the quadrangles of Canandaigua, Naples, Bath, Phelps, Penn Yan and Hammondsport. There is also under construction a model of Mormon hill, near Palmyra, celebrated for its historical associations as the place where the alleged " gold plates " of the Mormon bible were dug up and quite as interesting geologically as an illustration of a glacial drumlin, a topographic form which occurs abundantly in the region of the Lake Ontario plain.

II

REPORT OF THE GEOLOGICAL SURVEY

CIVIC GEOLOGY

The mineral springs and the fault at Saratoga. On a later page reference will be made to the completion of the areal survey of the Saratoga quadrangle which covers the Mineral Springs basin. In the very successful operations made at Saratoga by the State Reservation Commission toward the rejuvenation of the exhausted springs, this office has taken a keen interest and has exercised such cooperation as has been in its control. In the execution of this work the commission has been successful to an unexpected degree in restoring the springs to their original virility, and in connection with the elaborate experimentation thereupon opportunity has been found to clear away the accumulations of rubbish and the tumble-down buildings which have long covered most of the escarpment of the celebrated *Saratoga fault.* The Saratoga fault has achieved a distinction which is perhaps quite out of proportion to its importance, and yet this fracture is a controlling influence upon the relief of the mineral water storage. The fault scarp stands as a rock cliff running through the village from the High Rock spring southward, gradually becoming a less conspicuous feature in the topography until it disappears in the vicinity of Congress Park or the United States hotel. The Saratoga fault has its heaviest throw far to the north of the village and in its course southward its escarpment lowers on its way through the length of the village until it is lost. It was formerly supposed that there was a direct continuation of this fault southward to Ballston where it influenced the Ballston mineral waters as it does those at Saratoga. The soil mantle covers all this area so deeply as to make it difficult to substantiate such an assumption. It has become clear, however, that the surface evidence of displacement terminates near Congress Park. In recent excavations made by the commission in preparation of the Spencer Trask memorial, to occupy this park, an opportunity was afforded of uncovering the rock surface at the south end of the fault where the displacement line is known to make a sharp turn to the west. The commission has, with fine appreciation of the geological interest attaching to this phenomenon, given instructions to have the probable course of the fault from this point uncovered where it crosses the street in the direction of the Ainsworth spring — the only water-bearing hole which has been put down west of the fault line.

Saratoga Fault
As exposed near the High Rock spring

Saratoga Fault
The escarpment at the High Rock spring

Saratoga Fault
The northern limb which has been cleared and parked

Saratoga Fault
The fault face, used as a dump for rubbish — a condition that will not long be tolerated

Of the several explanations offered for the existence of the heavily carbonated waters of Saratoga, one has assumed that it is along the fissure of the fault that the carbon dioxid has found its way from great depths within the crust of the earth.

Our present understanding of the geological origin of the mineral springs waters, briefly stated, is this: The region eastward of the fault is covered by a thick layer of impervious shale, which is very much broken up in the vicinity of the Hudson river. Where these shales are most disturbed and broken, the percolating meteoric waters have penetrated and have traveled along the dip of the underlying rock through the limestone beneath where as a result of secondary changes there taking place in the limestone, they have acquired carbon dioxid and when saturated with this gas have gained an increased solvent power which has enabled them to take up various soluble salts from the rocks through which they have passed. Traveling easterly they reach the fault fissure which they have been unable to traverse, and thus it happens that the springs derived through natural crevices or artificial holes in this basin, all lie on the east side of the fault line.[1] Whatever the future of the Saratoga mineral springs may be, and with the present and coming development of the science of hydrotherapy the outlook is most brilliant, Saratoga will always remain a place of high geological interest from the very fact of the relations of these waters to the rocks and to the fault line. It is therefore a matter of considerable public interest that the State commission should have brought out to its full effectiveness this fault cliff, even though the displacement is of a lesser order of magnitude. To increase public appreciation it might be well worth while to attach to the accessible face of the cliff, some placard or tablet which would explain the cause of the fissure and its influence upon the mineral waters. An eminent student of earthquake movements has suggested that it would be well worth while to attach a tablet not only to the face of the cliff but to the ground surface of the fault as well and have a precise leveling between fixed points on these two tablets so that it might be possible to determine any movement of the cliff up or down, that is to say, any reappearance of seismic or earthquake movements along this ancient line of weakness.

Stark's knob, Saratoga county. Stark's knob is a knoll of volcanic rock near the village of Schuylerville which, as its name

[1] The Ainsworth spring lying on the west of the fault, traversed it and derived its water from the east side.

indicates, has a definite historic association. It is the place where Captain John Stark established a little redoubt and effectually obstructed the movements of General Burgoyne during the battle of Saratoga. Its scientific interest, however, is quite as great, perhaps greater, than its historic. It has been described at length in the reports of the Geological Survey as a volcano or volcanic plug and as such is the only geological phenomenon of this kind known to occur in the State of New York. The question as to the origin of this plug, the stage at which the lavas penetrated the rock and the relation of the mass to all the surrounding geological terrane, has been much investigated and much discussed. There appears now to be very excellent reason, quite acceptable to those who have studied the phenomenon most closely, for assuming that this volcanic plug is not autochthonic, that is to say, is not now in the place where it originally appeared, but that in the great earth movements occurring in eastern New York during the time of the Taconic revolution, this volcanic mass was carried over on the crest of an earth wave from its original situs, possibly as far to the east as from the Connecticut valley in Vermont. This fact is not at the present time fully demonstrable but, as intimated, it seems a reasonable explanation to those who have studied the occurrence most closely. There are thus two elements of interest in this small and somewhat obscure topographic feature, of interest so extraordinary and unusual as to demand that some degree of public consideration be given to the preservation of this spot. Unfortunately some years ago the volcanic rock, which is a diabase, was thought to be available for highway construction, and the knoll or knob was leased for the purposes of producing road metal. The rock has decomposed so badly, however, that it has never well served any such purpose.

The writer has made an earnest effort to bring this spot under protection and control and there is a hope, perhaps not too remote, that the place may eventually become the property of the State under the custodianship of the State Museum. If this can be effected it will be a partial realization of a general public appeal made some years ago by the Director of the Museum for the preservation of objects of unique or noteworthy natural interest. This appeal met with many warm responses, but could be supported only by the activities of local societies or interested individuals, as no State money was available.

H. P. Cushing, photo

"Stark's Redoubt" as it appeared in 1910; from the southeast. Removal of rock has chiefly been from the south end; on the north it has been stripped though but little has been removed. The arrow points toward the slickensided surfaces

H. P. Cushing, photo, 1910

Glaciated surface of the "Cryptozoon Ledge" in the town of Greenfield, Saratoga county

H. P. Cushing, photo, 1910

Another view of the "Cryptozoon Ledge"

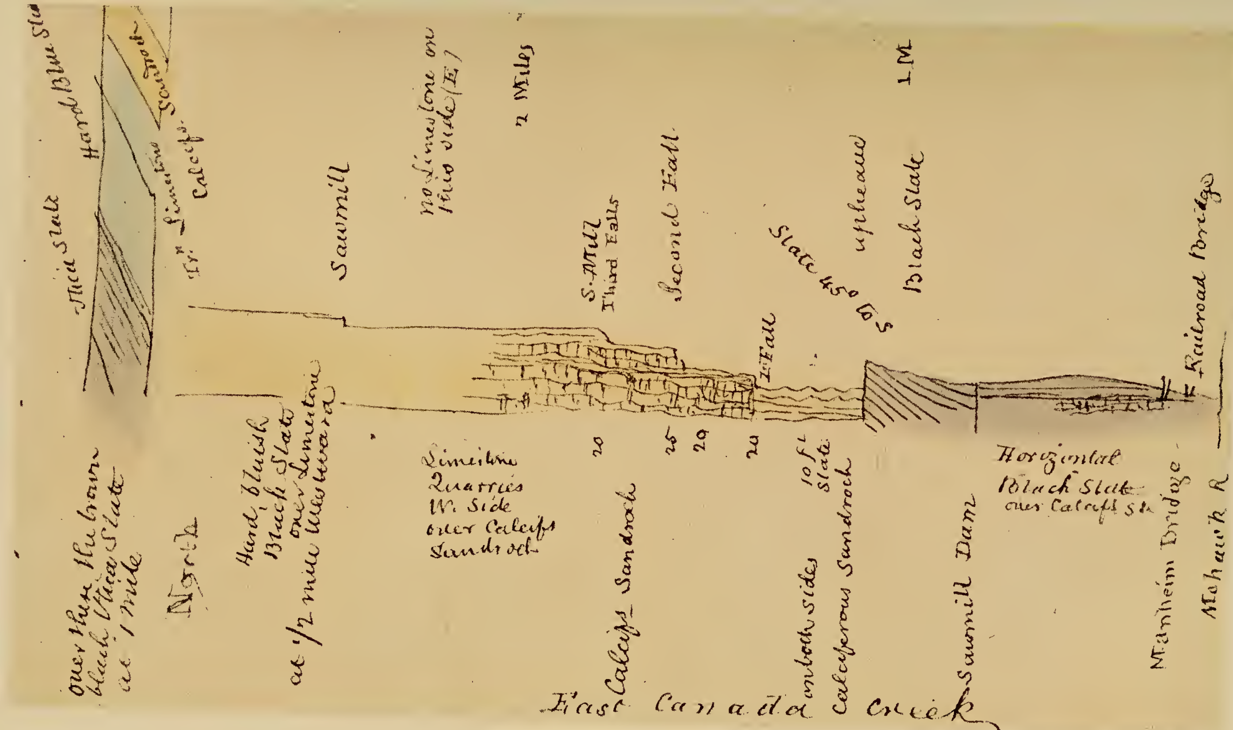
The "Cryptozoon ledge" in the town of Greenfield, Saratoga county. The geologists of the Survey have long been aware of the occurrence on the property now owned by Mrs Mabel A. Wesley, but generally known as the "Hoyt quarry," of a remarkable ledge of Cambric rocks exposing in most extraordinary fashion a reef of the fossil known as *Cryptozoon,* which is believed to be an algoid plant secreting a calcareous skeleton. This exposure is to be seen along the roadside from Saratoga Springs to Greenfield and the fact that the ledge has been smoothed down by glacial action renders it all the more conspicuous and interesting. These great circular Cryptozoon masses are often many feet in circumference, made up of concentric layers of algoid growths, and it is quite probable (indeed, it is so stated freely by geologists who have studied these ancient organisms in various parts of the world) that this exhibit is altogether unique. Especial interest attaches to these organisms from the fact that it is now thought that such reefs of algae or water plants, either marine or of fresh water, were present in the rocks of the Precambric and were among the first of known forms of life. This peculiar ledge of Cryptozoon is so out of the ordinary, so impressive to the student and even to the casual visitor, that an effort is now being made to bring it also under the control of the State as a public reservation. This is fully justified by the fact that the ledge is extraordinary, unique and teaches an interesting lesson which could well be explicated on the spot in case it can thus be brought under the control of the State Museum.

Mormon hill. Reference has been made to the production of a relief map of Mormon hill, in Wayne county near the village of Palmyra. This glacial drumlin or melon-shaped hill deposited by the melting ice sheet on its retreat to the north, is the spot where Joseph Smith, on a dark night in 1827, is alleged to have dug up the golden plates of the Book of Mormon. It is thus the Mecca of the Mormons and is visited by their distinguished members with frequency. In the history, therefore, of this State, it stands as a monument to a religious and civic enterprise which has now taken on an influential form, both of quality and circumstance; and it is well, therefore, that the place should be preserved. Doubtless the time will come when the disciples of this growing religious cult will themselves desire to possess and to protect the place; and should this ever happen, it is still to be remembered that its preeminent place as a factor in the history of the State is as one of the series of great glacial drumlins from a region in western New York where they are better developed than probably in any other part of the world.

Indian Ladder Park. Geologists in many parts of the world will be interested in the announcement recently made of the gift to the State of New York as a public park of the "Indian Ladder" and its adjoining portions of the Helderberg mountains escarpment in Albany county, New York. Next, perhaps, to the Schoharie valley, the Helderbergs and the Indian Ladder have the most intimate and ancient association with the history of geology in this State and are really a classic ground in American geological science. Interesting not alone for its geology, as the original section of the "Helderberg formation" and its various subdivisions, with their profusion of organic remains, the Indian Ladder is equally commanding as a scenic feature. There is perhaps nothing just like it in origin and effectiveness. From the summit of the long sheer limestone cliff the eye commands the panorama of the conjoined Hudson and Mohawk valleys picturesquely spread out over a vast area bounded at the north by the foothills of the Adirondacks and at the northeast by the Taconic mountains and the Berkshires. And over this splendid picture generations of geologists have gazed, for the Helderbergs have been the Mecca of geologists for well-nigh a century.

The generous gift to the people of New York State comes from Mrs Emma Treadwell Thacher, widow of the late Hon. John Boyd Thacher, a distinguished statesman, historian and litterateur. Its more than 350 acres extends along the escarpment so far as to include all its most striking portions and the new reservation is essentially a geologic and scenic park.

Geological sketches from an old notebook. During the past year the Director received from Thomas T. Wierman, Esq., of Harrisburg, Pa., an old field notebook of the New York State Geological Survey, dated 1841. The book bears no evidence on its face of original ownership, but inquiry from Mr Wierman brought out the fact that the book had originally belonged to Richard C. Taylor, an English geologist of that period, whose notes and papers became the property of Captain John McCandles of Philadelphia and were later passed on to Mr John Fulton, a mining engineer, with whom Mr Wierman was employed in Bedford county, Pennsylvania, back in the '70s of the last century. Mr Wierman further states that Mr Fulton became a resident of Johnstown, Pa., a village which was wiped out by the great floods of 1889



Section on East Canada creek
Sketch from the notebook of R. C. Taylor, 1841

and that all the Taylor books and papers were lost with the exception of this, which finally came into his possession.

The book is a noteworthy record. Mr Taylor was an accomplished geologist and a fine field observer, as well as a sketch artist of no mean ability. The pages of the book are filled with carefully detailed geological sketches in water color, many of them of outcrops and of localities in this State which are no longer accessible. Mr Taylor had come to New York evidently for the purpose of putting himself in touch with the recently acquired results by the New York State geologists, and seems to have been particularly intimate with Mr Vanuxem, of the Third District. Evidently he was received with courtesy by his colleagues here and given this notebook, which bears the official stamp of the organization; but his field trips were made independently of the official geologists themselves and he traversed the State from the southwest corner to its eastern boundary and beyond. Some of Mr Taylor's sketches are of so great interest as to be worth bringing back to the public eye and to the public record of the New York Geological Survey, into which they have entered only in one or two instances; for it is to be noticed that Mr Vanuxem made references to Mr Taylor's Pennsylvania work in his annual report for 1837 and used several of his drawings in the Final Report on the Third District, of which may be mentioned the sketches of the cliffs on Cayuga lake and of the inclined strata in Howland's quarry near Union Springs. But Mr. Taylor's connection with the organization has never before been a matter of record and it may be well to give here the following brief sketch of his career.

He was born in England in 1789 and came to America in 1831. In his own country he had been a mining engineer and practical geologist, a member of the Geological Society of London and other learned institutions of Great Britain. His practice of geology was entirely economic, and in the development of the coal and iron industry, particularly of Wales, he gained for himself noteworthy distinction.

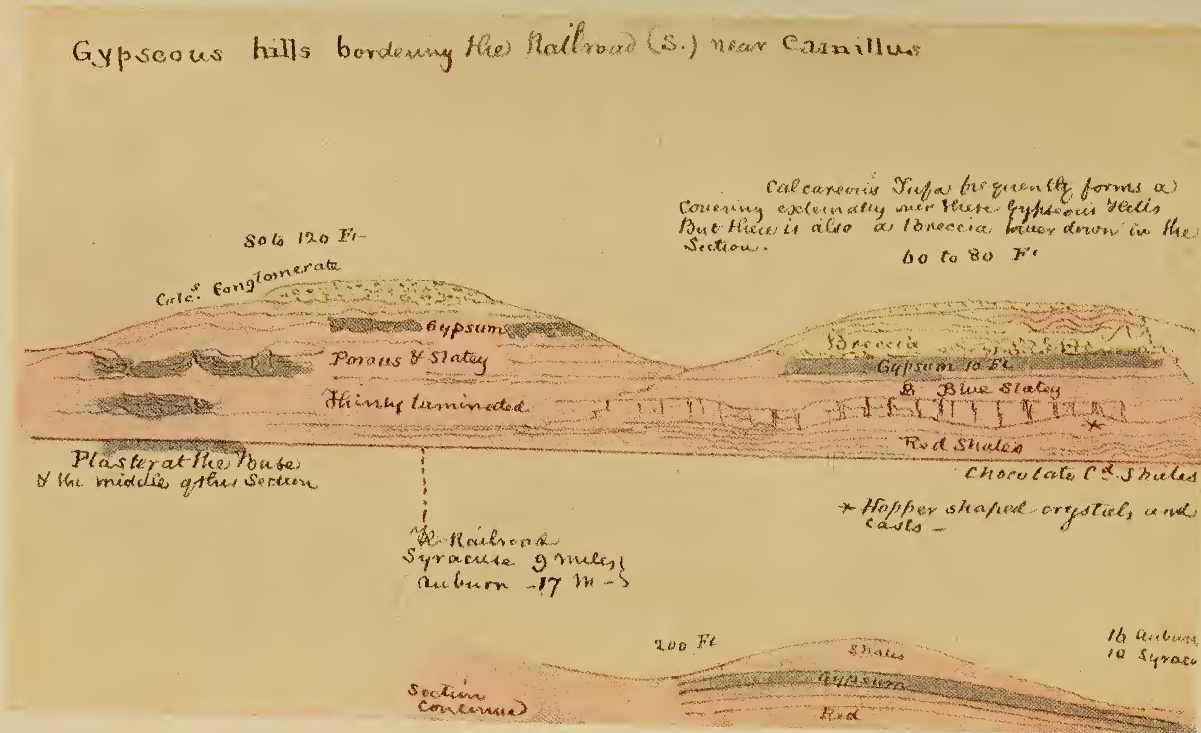
Upon his arrival in America he took up his residence in Philadelphia and shortly after was engaged in a survey of the coal fields of Tioga county, Pennsylvania, and subsequently in the southern coal fields in Dauphin county. Of so high order were these undertakings that he was frequently under professional engagement in other mineral districts of the United States. His great work, however, and that upon which his repute as a geologist rests, is probably his well-known book "Statistics of Coal," published in Philadelphia in 1848. The book contained summaries of labors of a long life in connection with coal formation and coal production, and it was received both in England and here with the highest approval and with unstinted commendation.

It was not exclusively to economic geology, however, that he devoted his interests, for his geological contributions show the versatility of his observations. He writes on the fossil marine plants of Mifflin county, on the existence of an ancient lake in Mifflin county, on the copper region of Cuba, on fossil plants in Dauphin county, on Indian mounds and earthworks, etc., etc.

Mr Taylor was a member of the American Philosophical Society and it is from the obituary notice of him read by Isaac Lea that the above memorandum has been largely taken. No mention, however, is made in any of the notices of his life that the writer has found, of his association with the New York State geologists or of his experience in the field of New York geology. As Mr Taylor was 52 years old when he came into the New York field, he was older than any of the four geologists engaged upon the survey and unquestionably had an experience in the field, especially, at least, in the field of economic geology, to which none of them could lay claim. Yet in spite of this fact, there is nothing in this notebook to indicate that his mind was especially fixed or his eye particularly keen to such development in New York. He seemed to be looking only for a knowledge of geological structure, to test the conclusions of the four geologists for his own personal and professional information and, so far as the writer is aware, he never expressed any public opinion or published any reference to his experiences and observations in the New York field.

Mr Taylor died in Philadelphia in 1851.

The time may come when it will seem well to reproduce, for the purpose of perfecting the record of the history of this survey, more of these sketches than are here given; but to indicate their character, their worth and their exactitude, the following pages carry a few of these, given, so far as seems practicable, in their original tints and with the original memoranda attached thereto.



Gypseous hills near Camillus
Sketch from the notebook of R. C. Taylor, 1841

BOARD OF GEOGRAPHIC NAMES

The Legislature of 1913 provided for the institution of a State Board of Geographic Names, in the following law, which is chapter 187:

Section 1 Article 10 of chapter 23 of the Laws of 1909, entitled "An act in relation to executive officers, constituting chapter 18 of the Consolidated Laws," is hereby amended by adding, at the end thereof, a new section, to be known as section 110, and to read as follows:

§ 110 **Board of geographic names; powers and duties.** A State Board of Geographic Names is hereby created, to consist of five members, of which the Commissioner of Education and the State Geologist shall be ex officio members, and three of whom shall be appointed by the Governor to hold for terms of two, four and six years, to be designated by him when the appointments are made. Their successors shall be appointed by the Governor for terms of six years. Vacancies shall be filled by the Governor for the unexpired terms of the offices vacated. The State Geologist shall be the secretary and executive officer of such board. All of such members shall serve without compensation. The said board shall have power, and it shall be its duty:

1 To determine and establish the correct historical and etymological form of the place names in this State and to recommend the adoption of such correct forms for public use.

2 To determine the form and propriety of new place names proposed for general use, and no corporation, individual or community shall introduce such new place names without the consent and approval of this board.

3 To cooperate with the United States Board of Geographic Names and with the United States post office department in establishing a proper, correct and historically accurate form for all place names proposed as designations of new post offices.

§ 2 This act shall take effect immediately.

Acting under the authority given him by this law, Governor Sulzer appointed as members for the terms of two, four and six years, Arnold J. F. van Laer, Albany, Hugh P. Baker, Syracuse, Herman Leroy Fairchild, Rochester. This law carried no appropriation for the execution of its provisions, for clerical help or even for stationery; but as the work of the board has an obviously University function, it has seemed entirely proper, for the present, to carry on this work in connection with the other activities of this Department, awaiting the day when the Board of Geographic Names shall very properly become an organic part of the University.

There have been many and very excellent reasons for the creation of such a board and these were fully appreciated, both by the late Commissioner of Education and the committees of the Legislature before whom the proposition was brought, and expressed in the enactment. Local place names in the State have often gone astray from their original significance; very frequently names which have no propriety within the State of New York have been, of late years, added to its already somewhat incongruous assemblage; meaningless names, names which are combinations of euphonious, perhaps, but jejune syllables have been imposed upon the State, often at the instigation or by the connivance of public service corporations. New York has had its own troubles in its place names and there probably is not another equal area in America which is so bespangled with classical names without the remotest relationship to this country, as the Old Military Tract of central New York.

This board has been called upon to exercise its functions on several occasions in regard to the institution of new or proposed names, and this has been without solicitation or warning on its own part. It seems, however, quite likely that in the further rearrangement of place names in the State, it may be part of the duty of the board to direct attention to the existence of the law and to invite conformity therewith.

As a present evidence of the activity of the board and its purpose to do something more than pass upon applications made to it from whatever quarter, there is submitted herewith a glossary of the place names of three of the counties of the State, Albany, Schenectady and Rensselaer. The prosecution of such work as this, if carried out thoroughly, would form a useful series of documents bearing upon the historic development of settlements in the State and such work should be pursued even more completely than is here indicated. It will be understood that the present brief definition of the place names herewith attached is only a suggestion or a hint of the appropriate direction which some of the labors of the board may take.

THE PLACE NAMES OF ALBANY COUNTY

Adams Station. Hamlet. Named for Nathaniel Adams, early settler. Also known as Adamsville. (Now *Delmar,* absurd misappropriation of well-known town name on border of Delaware and Maryland.)

Albany. County and city. Named in honor of James, Duke of York and Albany (1664), afterwards James II.

ALCOVE. Hamlet. Formerly Stephensville.

ALTAMONT. Hamlet (formerly Knowersville). Fancy name of no historical significance. *High mountain;* lies at base of Helderbergs.

AQUEDUCT. Hamlet. The Erie canal here crosses the Mohawk river.

AQUETUCK. Hamlet. *Ach-que-tuck,* Iroquois. Ach-que-tuck or Aquetuck was an early name for Coeymans Hollow. It is usually applied to the flats there but appears to be the *Hagguato* of the map of the New Hampshire Grants and the stream mentioned by Schoolcraft as *Hakitak,* below Coeymans. It may be derived from Ahque, *he leaves off,* and tuk, *a river;* i. e., *a river at a boundary* (Beauchamp).

AURANIA or URANIA. An early alternative name of Fort Orange.

BABCOCK CORNERS. Cognominal. Now Bethlehem Center.

BASIC creek. Thought to be Mahican; "may be a corruption of quassik, *a stone*" (Beauchamp).

BEACON island. Descriptive.

BEAR island. Descriptive.

BECKERS CORNERS. Hamlet. The Becker family were early settlers.

BEEREN island. The island of bears (Dutch). The Mahican name has a similar meaning (Beauchamp).

BERNE; BERNEVILLE; SOUTH BERNE. From Berne, Switzerland, native place of Jacob Weidman, one of the early settlers.

BETHLEHEM; BETHLEHEM CENTER. Suggesting the religious proclivities of the settlers.

BEVERWYCK. Original Dutch name of Albany.

BLACK creek. Flows over exposures of black shale.

BLOCKHOUSE creek. Early settlers built a blockhouse here.

BOGHT. Hamlet. Dutch = bend of the Mohawk river.

CABBAGE island. Descriptive.

CALLANAN CORNERS. Named for Henry Callanan, an early settler.

CASTLE island. Same as Van Rensselaer island. Fort Nassau was built on this island.

CEDAR HILL. Hamlet. Red cedar formerly covered the hills.

CHESTERVILLE. Hamlet. Named for Rev. John Chester of Albany. Now known as Westerlo.

CLARKSVILLE. Village. Named for Adam A. Clark, 1822.

COEYMANS. Town, village. Named for Barent Pieterse Coeymans, patentee.

COEYMANS HOLLOW. Hamlet on Hannacrois creek.

COHOES. Town, city. Mohawk = Ga-ha-oos, *canoe shooting over the falls.* "Cah-hoos or Ca-hoos, *a canoe falling,* as explained by the late Indian sachem, Brant." (Spafford)

COLONIE. Town. The Colony (Rensselaerwyck).

CONNERSVILLE. Cognominal.

COOKSBURG. Hamlet. Thomas B. Cook of Catskill, 1840, leading man in the Catskill and Canajoharie Railroad enterprise.

CRESCENT STATION. Hamlet. In the great bend of the Mohawk.

DELMAR. See ADAMS STATION.

DISBROWS. Hamlet in town of Westerlo. Name no longer in use.

DORMANSVILLE. Hamlet. Named for Daniel Dorman, first postmaster, 1832.

DUNNSVILLE. Hamlet. Named for Christopher Dunn, original owner.

DUNSBACK FERRY. Hamlet. Dunsback, early settler. Ferry over Mohawk.

EAST TOWNSHIP. Hamlet.

EIGHT-MILE creek. Descriptive.

ELDER creek. Descriptive.

ELSMERE. Modern name without appropriateness.

FECHTBERG. Hill in town of Berne. The name is said to have come from a dispute as to leadership among settlers, 1750.

FEURABUSH. Hamlet. Dutch: *vurenbosch* (pronounced *vüreboscch*), fir-bush, or woods. (A. J. F. van Laer) Now known as Jerusalem, the name Feurabush being attached to the railroad station.

FLY creek. Dutch: *Vlaie,* meaning *a meadow.* Same as *Vly.*

"This word *vly,* in the records also written *vley* and *vleye,* is a puzzling word in the Dutch language. It is obsolete at present and its real meaning is unknown to me. The word seems to apply in nearly all cases to low, marshy land, or to salt meadows, and I suspect that it is nothing but a contraction of *valey,* valley, or low land. At all events I should say that the meaning was low land, rather than meadow. *Vlaie,* is probably a later corruption, which, as far as I remember, does not occur in the Dutch records." (A. J. F. van Laer)

FONT GROVE. Modern name.

FOXENKILL = Foxes stream.

FRENCH'S MILLS. Hamlet. Named for Abel French, miller.

FULLER. Hamlet. Named for Major John Fuller.

GIBBONSVILLE. Old village incorporated into West Troy, 1836. Now a part of Watervliet.

GLENMONT. Hamlet. Fancy name.

GREEN ISLAND. Village. Descriptive.

GROESBECK. Formerly a suburb of Albany, in the town of Bethlehem. Named for the Groesbeck family. Now obsolete and included in the southern part of the city.

GUILDERLAND. Township and village. Named from Gelderland, in the Netherlands.

GUILDERLAND CENTER and GUILDERLAND STATION.

HAMILTON or HAMILTONVILLE. "A town or settlement lately laid out in Albany county, New York, in the extensive township of Water Vliet, formerly called the *Glass Factory;* and has its present name in honor of that great patron of American manufactures, the late secretary of the Treasury of the United States of America. It lies 10 miles west of Albany, 2 miles from the Schenectady road; and is one of the most decisive efforts of private enterprise in the manufacturing line, as yet exhibited in the United States. The glass manufactory is now so well established and so happily situated for the supply of the northern and western people of the State of New York as well as Vermont and Canada, that it is to be expected that the proprietors will be amply rewarded for their great and expensive exertions. The glass is in good reputation. Here are two glass houses and various other buildings, curious hydraulic works to save manual labor by the help of machinery. A copious stream runs through the heart of the settlement which lies high; and being surrounded by pine plains, the air is highly salubrious. The great Schoharie road traverses the settlement. A spacious schoolhouse and a church of octagon form are soon to be erected."

"The enterprising proprietors of the *Glass* and other works in this thriving settlement, were incorporated by the Legislature of New York in the spring of 1797; by the name of 'The Hamilton Manufacturing Society,' which act has given spring to the works here; and authorizes a hope that American manufactures may not only subserve the interests of our county but that also of the proprietors." (Jedediah Morse's *Gazetteer,* 1798).

The settlement and enterprise became effaced by 1840 and the only local trace of it now remaining is to be found in the name "Hamilton Church" in Guilderland township.

HANNACROIS creek. Supposed to be from Dutch signifying a crowing cock. It is said that during a freshet a barn was carried down stream and perched upon an open door stood a cock crowing.

HAVERS island. In the Mohawk. From the Dutch: *haver,* oats. Same as VanSchaick's island.

HELDERBERG mountains. Variant derivations have been suggested for this Dutch word; *helder* = bright, *bergen,* mountains. *Helder,* a fort in Holland.

HILLHOUSE island. Cognominal.

HUNGER KILL. The local story says that wagon trains from Albany to Buffalo stopped here for refreshment.

HURSTVILLE. Hamlet. Named for William Hurst, 1861.

INDIAN FIELDS. Hamlet. Indians had planted fields and orchards.

IRELAND CORNERS. Hamlet. Named for Elias H. Ireland, 1832.

IRISH HILL (Berne). The first settlers were Scotch-Irish.

JANES CORNERS. Same as SOUTH BETHLEHEM. Elisha Janes kept tavern here.

JERUSALEM. Formerly Feurabush. This later application of an old name which has appeared only on recent maps is objectionable, in view of the well-established application of the word to a township in Yates county and to a village in Queens county.

KAIKOUT kill. Stream. Dutch: *kijkuit = look-out.* See Kykout (Rensselaer co.)

KARNER. Hamlet. Cognominal.

KEEFER CORNERS. Hamlet. Named for Balthus Keefer, 1791.

KENWOOD. Suburb of Albany. Named by Mayor Jared Rathbone, Albany, after a Scotch place of his acquaintance.

KIMMEY'S CORNERS. Cognominal.

KNOWERSVILLE. Now ALTAMONT.

KNOX. Township and village. Named for John Knox by the Scotch settlers.

KRUM kill. Stream. Would seem to be from the Dutch *krom* or *kromme,* crooked.

LAMBS CORNERS. Hamlet. Named for Jehial Lamb, early settler.

LISHA KILL. Hamlet and stream. Name of Indian buried here.

LOUDONVILLE. Hamlet; on Loudon road, 3 miles from Albany. Named in memory of Lord Loudon, general of the English forces in barracks at Albany, 1756.

McKOWNSVILLE. Hamlet. Named for the McKown family, early settlers.

MARSH island. Descriptive.

MEADOWDALE. Hamlet. Fancy name, modern.

MEDUSA. Hamlet. Modern intrusion. Originally Hall's Mills, named for Uriah Hall, 1783.

MENANDS (properly MENAND). Hamlet. Named for Louis Menand, a Frenchman and first settler.

MORE'S CORNERS.

NEW SALEM. Hamlet. Named in 1830. An expression of the piety of the early settlers.

NEW SCOTLAND. Township, village. There were many Scotch families among the early settlers.

NEWTONVILLE. Hamlet. Named for John M. Newton.

NORMANS kill. Stream. A Hollander, Albert Andriessen Bradt, from Frederikstad, Norway, surnamed the Norman, settled at mouth of creek about 1630.

NORMANSVILLE. See NORMANS KILL. Early name UPPER HOLLOW.

ONISKETHAU. Hamlet. See ONISKETHAU creek.

ONISKETHAU creek. The old Indian name of the region *O-nits-quat-haa,* deeded in 1685 to Teunis Slingerland and Johannes Appel. "It is said to have been an early name for Coeymans, meaning *cornfields.*" (Beauchamp)

PATROON creek. Named after the Patroon of Rensselaerswyck.

PATROON island. The same.

PEORIA. Hamlet. Borrowed name.

PORT SCHUYLER. Old hamlet incorporated into West Troy 1836. Now part of the city of Watervliet.

POTTER HOLLOW. Hamlet. The Potter family were early settlers.

PRESTON HOLLOW. Named for Dr Samuel Preston, 1798.

RAVENA. Modern name. It has no local significance.

REIDVILLE. Village. Named for George Reid, Scotch immigrant.

RENSSELAERVILLE. Township, village. Named for General Stephen Van Rensselaer, patroon of Rensselaerswyck.

RENSSELAER lake. The same.

SELKIRK. Hamlet. The first settlers were the Selkirk families of Scotch descent.

SHAKERS. Hamlet. The Shakers settled here in 1776.

SLINGERLANDS. Village. Named for descendants of John A. Slingerland.

SOUTH BETHLEHEM. See BETHLEHEM and JANES CORNERS.

SPENCERVILLE. Cognominal. Same as West Albany.

STEPHENSVILLE. Hamlet. Named for Archibald Stephens, miller.

STONY HILL. Hamlet. Descriptive.

SWITZKILL. Stream. There were many Swiss settlers in the town of Berne.

TEN-MILE creek. Descriptive.

THOMPSON lake. Named for John and William Thompson.

TIVOLI HOLLOW. Early hamlet now included in the northern part of the city of Albany.

TOWNHOUSE CORNERS. Hamlet. Descriptive.

UNIONVILLE. Hamlet. A "Union" church is located here. Originally UNION CHURCH.

UPPER HOLLOW. Early name for Normansville.

VAN LEUVEN'S CORNERS. Hamlet. Named for Isaac Van Leuven, early settler.

VAN SCHAICKS island. In the Mohawk. Cognominal.

VAN WIE'S POINT. On Hudson river. Named for Jan Van Wie.

VLAUMANS kill. Stream. Cognominal.

VOORHEESVILLE. Hamlet. Named for Alonzo B. Voorhees, 1862.

WARNER lake. Named for Johannes and Christopher Warner.

WATERVLIET. City. Dutch; *water*=water, *vliet,* stream, course. Former name West Troy, which, in 1836, was incorporated of the villages or hamlets of Gibbonsville, Watervliet and Port Schuyler.

WEMPLE. Hamlet. From a pioneer family.

WESTERLO. Township and village. Named for Rev. Eilardus Westerlo, a Dutch clergyman in Albany, 1760. Formerly known as Chesterville.

WESTERLO island.

WEST TOWNSHIP. Hamlet.

WEST TROY. Now a part of Watervliet.

WILLEMSTADT. The name given to Albany in 1673 in honor of Willem (William) III, of Orange, later king of England.

WILLIAMSBURGH. Hamlet. Now Connersville.

WOLF creek. Descriptive.

WOLF HILL. Hamlet.

THE PLACE NAMES OF RENSSELAER COUNTY

ALBIA. Suburb of Troy.

ALPS. Hamlet. In the hilly eastern part of the county.

AVERILL PARK. Hamlet. Named from old and prominent family in the town of Sand Lake.

BABCOCK pond. Named for John Babcock.

BALD mountain. Descriptive.

BARBERVILLE. Hamlet. Cognominal.

BATH. Named from supposed medicinal qualities of a spring near it. Now included in city of Rensselaer and name abandoned.

BERLIN. Township, hamlet.

BERLIN CENTER. See BERLIN.

BLACK brook. Takes its name from the black shales over which it flows.

BLACK river. Same as above.

BOYNTONVILLE. Village. Cognominal.

BRAINARD STATION. Hamlet. Named for David Brainard, missionary to the Indians here.

BROOKVIEW. Hamlet. Modern name; formerly Schodack Center.

BRUNSWICK. Township; hamlet. Said to have been settled by a colony of Germans. Among early settlers was a family by the name of Braunschweiger.

BURDEN lake. Cognominal.

BUSKIRK'S BRIDGE. Village, on Hoosick river. Named for Van Buskirk family, early settlers.

CAMPBELL island. Cognominal.

CASTLETON. Village. Named from Castle hill on which stood an Indian fortification.

CENTER BRUNSWICK. See BRUNSWICK.

CHURCH HOLLOW. Named from the Church family, early settlers.

CLUM'S CORNERS. Hamlet. Named for O. Clum, blacksmith.

COW island.

COOPER pond. Cognominal.

CRANBERRY pond. Descriptive.

CROPSEYVILLE. Hamlet. Named for Valentine Cropsey, early settler.

DEEP kill. Descriptive.

DEFREESTVILLE. Hamlet. Named for the early settlers DeForeest; also spelled DeForest, DeFreest and DeFriest.

DUNHAM HOLLOW. Named for Isaac Dunham, settler, 1800.

DILL creek. This may have been a family name, or perhaps derived from the presence of dill along its banks.

DWAAS kill. Stream connecting the Hoosick and Hudson rivers, its current varying with freshet. "This is probably a corruption of *Dwars kill,* or cross creek, a stream connecting two others, just as a *dwars straat* means a cross street. *Dwaas=foolish;* hence, I suppose, the attempt to explain the name as "of two minds," a stream "flowing both ways." (A. J. F. van Laer)

EAGLE BRIDGE. Village at the bridge over Hoosick river. Patriotic.

EAGLE MILLS (MILLVILLE). Village. Valuable water power on Poestenkill.

EAST GRAFTON. See Grafton.

EAST POESTENKILL. Hamlet. See POESTENKILL.

FONDA hill. Named for John Fonda, 1750.

FOX HOLLOW. Name may be derived from Levit Fox, early settler, or may be descriptive.

GARFIELD. Hamlet. Modern and patriotic; originally South Stephentown.

GLASSHOUSE. Extensive glass works.

GLASS lake.

GRAFTON. Township and hamlet. Named from Grafton, Vt.

GRANT HOLLOW. Hamlet. Grant-Ferris Co. operated an agricultural implements factory here.

GRAVEL pond. Descriptive.

GREENBUSH. Township and village. *Greene bosch,* from the pine woods adjoining. Now part of the city of Rensselaer.

HANFORD pond. Cognominal.

HAYNERVILLE. Hamlet. Named for the Hayner families, early settlers.

HAYNERS pond. Cognominal.

HICKS pond. Given as *Hacks pond* on old map.

HILLS HOLLOW.

HOAG CORNERS. Named for W. B. Hoag, early settler.

HOAG'S pond. Named for Jonathan Hoag who constructed dam and formed pond.

HOOSICK. Township, village, river. Mohawk, *stony place* (Ruttenber). Algonquin, *along the kettle* (Beauchamp).

HOOSICK FALLS, HOOSICK JUNCTION, WEST HOOSICK and NORTH HOOSICK, all take name from the river.

IVES CORNERS. Hamlet. Named for Ives family, early settlers.

JOHNSONVILLE. Hamlet. Named for William Johnson, early proprietor, 1800.

KENDALL pond. Named for David Kendall, early settler.

KINDERHOOK creek. A Dutch name signifying " Children's Point." Name belongs properly to Columbia county.

KYKOUT hill. From Dutch *Kykuyt* or *Kijkuit* (modern spelling) = *lookout.*

LANSINGBURGH. Town, village (part of Troy). Named for and laid out in 1771 by Abraham Jacob Lansingh as the City of

Lansinghburgh. In its early history commonly known as New City in contrast to Albany, the " Old City."

LITTLE SCHODACK island. See SCHODACK.

LONG pond. Descriptive.

LOWER SCHODACK island. See SCHODACK.

LYONS pond. Cognominal.

MASTENS CORNERS. Hamlet. Named for the Masten family, storekeepers.

MELROSE. Hamlet. Probably Scotch.

MESHODAC PEAK. Indian = *mishadchu, great mountain* (Beauchamp).

MILLER CORNERS. Hamlet. Named for George Miller, storekeeper, 1840.

MILLVILLE. Alternative name for Eagle Mills.

MOLLS island. Named for the Molls family.

MOLLS PLAAT. Named for the Molls family.

MOON hill. Named for the family of J. S. Moon.

MOORDENER kill. Stream. Refers to an early battle on its banks between settlers and robbers. " Moordener is a corruption of Moordenaer or Moordenaar = murderer." (A. J. F. van Laer)

MUITZES kill. Stream. The story is that a Dutch female with high hat lost it in the stream and cried out, " Di muitz is in de Kil." " *Muitzes* may be a corruption of *Mutzen* (pl. of *Muts* = woman's lace cap or man's woolen or fur cap), but the story sounds foolish. More likely, *Muitzes* is a corruption of *Muizen* –mice." (A. J. F. van Laer)

NASSAU. Township, village. Named from old Nassau; originally Philipstown.

NORTH NASSAU, EAST NASSAU, NASSAU pond.

NEPIMORE creek.

NEWCOMB POND. Named for Daniel Newcomb, 1790.

NORTH GREENBUSH. See GREENBUSH.

ODELL hill. Named for Simeon Odell, 1790.

PAPSCANIE island. Abbreviated from the name of the original owner, Papsickenekas or Paep-Sikenekomtas.

PATTERSONS CORNERS. Hamlet. Named from early settlers.

PECKHAM pond. Named for early pioneer who lived near it.

PETERSBURG. Township, village. Named for Peter Simmons, 1791.

NORTH PETERSBURG.

PETERSBURG JUNCTION.

PIKE hill. A companion name to Pike pond.

PIKE pond. Descriptive.

PITTSTOWN. Township, hamlet.

PIXTAWAY island.

PLATTSTOWN. Hamlet. Originally Platstown from Peter Plate, innkeeper. Better known as *Tamarac*.

POESTENKILL. Township and hamlet. Named for Jan Barentsen Wemp, nicknamed Poest. "*Poest* means a cowherd." (A. J. F. van Laer)

POPLAR hill and POPLAR island.

POTTER hill. Hamlet. A man named Potter was killed here by accident.

PROSSER HOLLOW. Stream. Named for Ichabod Prosser, early settler.

QUACKEN kill. "Probably from Quack, or Kwak (pl. Quacken, Kwakken), a heron (Ardea nycticorax). Kwakken also means 'to croak,' but if the kill was full of frogs, it would more likely be called Kikoorschen kill than Quacken kill." (A. J. F. van Laer)

RAYMERTOWN. Hamlet. Named for Raymer family, early settlers.

RED pond. Descriptive; colored by soil.

REICHARD pond. From Reichard family, early settlers.

RENSSELAER. City, county. Taken from Albany county in 1791 and named for the Patroon of Rensselaerswyck.

REYNOLDS. Hamlet. Cognominal.

ROCK HOLLOW. Hamlet. One of the gorges of Quacken kill.

ROUND pond. Descriptive.

SAND LAKE. Township, hamlet, lake. Descriptive.

SCHAGHTICOKE. Township, village. Named for the Schaghticoke or Skaachkook tribe of Indians.

SCHAGHTICOKE hill.

SCHAGHTICOKE JUNCTION.

SCHERMERHORN island. Named for Cornelius Schermerhorn.

SCHODACK. Township. Indian *Skootag,* fire, *ack,* place; "fireplace of the nation." Council seat of the Mahicans in this town.

SCHODACK CENTER. Hamlet = BROOKVIEW; SCHODACK LANDING; SOUTH SCHODACK; Hamlets.

EAST SCHODACK. Hamlet.

SHAD island. Descriptive.

SHAVER pond.

SHINGLE HOLLOW. Stream. Recalls a shingle mill.

SLITERS. Village. Named for Calvin Sliter.

SNAKE hill. Descriptive.

SOUTH BERLIN. Hamlet. See BERLIN.

SPEIGLETOWN. Hamlet. Named for the Vanderspeigle families, early settlers. " Vanderspeigle is probably a corruption of the well-known Dutch family name of van de Spiegel. Cf. Lawrens Pieter van de Spiegel, a famous Dutch statesman, about the time of the French revolution, for whom a street in Amsterdam is named." (A. J. F. van Laer)

STAATS island. Named for Barent Staats.

STEPHENTOWN. Township, hamlet. Named for Stephen Van Rensselaer, Patroon, 1784.

STEPHENTOWN CENTER. Hamlet (formerly Mechanicsville).

WEST STEPHENTOWN, SOUTH STEPHENTOWN and NORTH STEPHENTOWN. Hamlets.

STILLMAN VILLAGE. Hamlet. Cognominal.

SUNKAUISSIA creek. Sank-an-is-sick, a branch of the Tomhannock. Root may be sonkin, *to grow up like a plant.* (Beauchamp).

SWEET MILK creek.

TACONIC mountains. Indian name. Beauchamp gives Tagh-ka-nick, *water enough.* Zeisberger has Tach-an-ni-ke, *full of timber.*

TACKAWASICK pond and creek. (=Tsat-sa-was-sa and Sas-sa-was-sa).

The name may refer to a stone mortar (Beauchamp).

TIASHOKE. Hamlet. (Ty-o-shoke). Iroquois, " meeting of waters " (Beauchamp).

TIERKEN kill. Dutch=noisy creek. " The derivation from the verb *tieren,* to make a noise, does not account for the *k* and seems impossible, as *tieren* is used only in connection with people. A more likely derivation is from Tierk, or Tjerk, the Frisian form for Dirck, the given name of some early settler." (A. J. F. van Laer)

TOMHANNOCK. Hamlet and creek. Mohawk=a flooded river (Beauchamp).

TROY. City. Originally Van Der Leyden and Van Der Leyden's Ferry. " Changed in 1789 into the more classic name of Troy." It contains two hills, Mt Olympus and Mt Ida.

UPPER SCHODACK island. See SCHODACK.

VALLEY FALLS. Village, on Hoosick river.

VOSBURGH pond. Cognominal.

WALLOOMSAC. River and hamlet. Variously written, of Indian derivation.

West Sand Lake. See Sand Lake.

White Lily pond. Descriptive.

White Rock mountain.

Wynantskill. Village and stream. Named for Wynant Gerritse Vanderpoel, 1674.

THE PLACE NAMES OF SCHENECTADY COUNTY

Aalplaats. Village and stream. Dutch, *a place for eels.* Now corrupted to Alplaus. "Given as Aelplaats in Burr's atlas of 1829, Aelplatts and Alplatts on map of 1856. Though *plaats,* in Holland, by the illiterate, is often pronounced *plaus,* it would seem as if Alplaus might be a corruption of *Aalplas* = eel pond." (A. J. F. van Laer)

Adams Killetye. Stream. From Adam Mull, taken prisoner by the Indians when drinking from it. "*Killetye,* corruption of *Killetje* = little kill (old spelling *Killetie,* though doubtless pronounced Killetje and not Kille*tee*)." (A. J. F. van Laer)

Alplaus. Modern corruption of Aalplaats.

Aqueduct. Hamlet. Canal crosses Mohawk.

Binne kill. Stream. "Inner river." A short diverted part of the Mohawk south of Van Slyck island.

Bonny Brook. Named by the Scotch settlers.

Bramans Corners. Hamlet. Named for Dr Joseph Braman, 1840.

Chuctenunda. Stream. Chaugh-ta-noon-da = *stony houses* or *stony places.*

Cooksborough. Hamlet. Named for the Vandercook (Van der Koek?) families.

Crabbe kill. Stream. Cognominal.

Delanson. Village. Present name of Quaker Street. Combination of "Delaware and Hudson."

Duanesburg. Town, village. Named for James Duane who settled here in 1765.

East Glenville. Hamlet. See Glenville.

Eaton Corners. Hamlet.

Featherstonhaugh lake. Named for the Featherstonhaugh family. Now improperly written Featherstone lake.

Giffords. Hamlet. Named for J. Gifford, hotel keeper.

Glenville. Township and village. Named for Sanders Leendertse Glen, patentee, 1820.

Greens Corners. Hamlet. Named for the early settlers.

HIGH MILLS. Hamlet. Old milling settlement deriving its name from falls in the Alplaus known as High falls.

HOFFMAN'S FERRY. Named for John Hoffman, 1835. Now HOFFMAN. Originally VEDDER'S FERRY, from Harmanus Vedder, 1790.

JAN WEMPS creek. Jan Barentsen Wemp was the ancestor of the Wemp family. Name appears on some maps as Van Wemps creek.

KELLEY'S STATION. Hamlet. Named for Andrew Kelley.

MARIAVILLE. Hamlet. Named for a daughter of James Duane.

MOHAWKVILLE. Hamlet.

NISKAYUNA. Township, village. Con-nes-ti-gu-ne or Nis-ti-goo-ne, *cornflats*.

NISKAYUNA pool. Name recently introduced, with approval of Board of Geographic Names, for a body of water impounded by barge canal construction. Replaces "Peck Lake," not approved.

PATTERSONVILLE. Village. Named for W. H. Patterson, hotel keeper.

PLOTTER kill. Stream. "Plotter kill is probably a corruption of Platte kill, which occurs also in Ulster county. Platte kill = *flat creek*, seems a strange name. *Het platte land* is the term applied in Holland to the country districts, in contradistinction to the cities, and in a country which is mostly flat, is self-explanatory. But why a kill should be called *plat* I do not know." (A. J. F. van Laer)

POENTICS kill. Stream. "This may be a corruption of Poenties kill. Poentie (or Poentje) was the nickname given to both Teunis Cornelissen Van Vechten and Teunis Dircksen Van Vechten (see Van Rensselaer Bowier MSS, p. 815, 819). The meaning of the word *poentje* is unknown to me. *Poent* is Middle Dutch spelling for modern *punt* = point. *Poentje* is the diminutive form. There is also a word *poenter* = assessor, so that poentje may be either a nickname for a person with a pointed face, nose or chin, or else be the real surname of the Van Vechtens, derived from some ancestor who held the office of assessor." (A. J. F. van Laer)

PRINCETOWN. Named for John Prince of Schenectady, member of Assembly.

QUAKER STREET. Village. Quakers settled here in 1790 and made purchases of land. Now Delanson.

REESEVILLE. Named for an early settler. Now a part of Scotia.

ROTTERDAM. Township and village. Named from Rotterdam, Holland, on account of lowlands.

RYNEX CORNERS. Hamlet. Several members of Rynex family settled in this vicinity.

SANDERS lake. Named for Sanders family.

SANDSEA kill (formerly, ZANTZEE kill). Stream. "*Zantsee* (better *Zandzee*, or else *Santsee*) is a familiar Dutch expression for *sand desert.*" (A. J. F. van Laer)

SCHENECTADY. County and city. Schagh-nac-taa-dagh, *beyond the pine plains.*

SCOTIA. Village. The ancient name of Scotland. The patentee, Sanders Leendertse Glen, was a Scotchman.

TOWN HOUSE CORNERS. Hamlet. The town's business was transacted here.

VAN SLYCKS island. Named for Jacques Van Slyck, 1662.

VERF kill. Stream. Dutch = *paint creek.* "Given in Burr's atlas of 1829 as Vert kill. This, however, has no significance as most of the Dutch names in that atlas are misspelled." (A. J. F. van Laer)

WEST GLENVILLE. See GLENVILLE.

AREAL GEOLOGY

In previous annual reports statements have been regularly given in regard to the progress made in the completion of the great geologic map of the State on the topographic base, scale of one mile to one inch. It may be broadly stated that the quadrangles which have been surveyed and fully reported upon, or upon which work is under way, now number approximately 40, although this is but a small percentage of the total number of quadrangles of the State already surveyed by the United States Geological Survey, in cooperation with the State Engineer and Surveyor. The execution of the geological work is of a kind which must of necessity progress very slowly and with every possible attention to detail. The progress of the work, however, has at no time been interrupted and at the time of writing this report there are now in press final reports on the following areas, accompanied by detailed geologic maps on the topographic base:

The Attica and Depew quadrangles

Published together as a single map with descriptive text, by Mr Luther.

The Saratoga and Schuylerville quadrangles

Also published together in one report with full descriptive details and discussion of the various important interests pertaining to the Saratoga Mineral Springs basin, by Professor Cushing and Doctor Ruedemann.

The North Creek quadrangle

Lying in the eastern Adirondack region, the report and map of which have been prepared by Professor Miller.

The Syracuse quadrangle

and its accompanying text, by Professor Hopkins.

In addition to these reports, there is also a bulletin on the Geological History of New York by Professor Miller, which relates especially to the physical development of this State. All these publications will presently be ready for distribution.

Central and western New York. In this region Mr Luther has continued the long series of field surveys upon which he has been engaged for nearly twenty years, and during the season of 1913 covered the quadrangles of Olcott and Lockport and that part of the Tonawanda-Wilson quadrangles which lies east of the east line of the map prepared and published some years ago in connection with Professor Grabau's bulletin on the Geology of Niagara Falls. Mr Luther's reports on the quadrangles mentioned are now essentially prepared and will soon be ready for publication.

Northern New York. Professor Miller began the survey of the *Blue Mountain* quadrangle during the summer of 1913. Most of the time was spent in making a detailed study of approximately one-third of the area in the vicinity of Long Lake and Blue Mountain Lake villages. As most of the quadrangle has not been examined and no laboratory work on the rocks yet been undertaken, only certain more evident results of the field work so far executed can be here presented.

Grenville series. The Grenville rocks are but slightly represented. Their only important development, where free from closely involved igneous rocks, is in Blue Mountain lake and immediate vicinity. With slight exceptions, all the islands of the lake consist of Grenville limestone and hornblende-garnet gneiss together with smaller amounts of quartzite and various well-banded gneisses. Outcrops are usually large and excellent. Similar outcrops occur on the lake shores except on the north, and no doubt the bottom of the lake consists almost wholly of such Grenville strata.

Syenite-granite gneiss series. Rocks of the syenite-granite gneiss series constitute most of the area studied. No very basic phases of the syenite were noted, the usual rock being the greenish grey, quartzose variety so well known throughout the Adirondacks. There are many fine exposures as, for example, on Blue mountain, Owl's Head mountain and in the vicinity of Long Lake village, particularly in the large stone quarry alongside the road 1½ miles southwest of the village. With increasing quartz content this rock passes into a granitic syenite which frequently shows a pinkish color. The granitic syenite in turn grades into true granite gneisses which are nearly always pink or red. Many small and large Grenville gneiss bands or inclusions occur parallel to the foliation in all facies of the syenite-granite series. Frequently these rocks show rather rapid changes in color and composition parallel to the foliation, though not the slightest evidence that one of these rock types cuts another has yet been found. Rather there is much evidence to show that the different facies really grade into each other and are only variations of the same intrusive body. Though at times the porphyritic texture is somewhat developed, no mappable areas of granite or syenite porphyry were found.

Mixed gneiss series. There are two considerable areas of syenite-granite and Grenville mixed gneisses. One of these occupies several square miles just south of Blue Mountain and Eagle lakes and the other some 8 or 10 square miles along the northern border of the quadrangle. As usual, in areas previously reported by the writer, these rocks consist of Grenville strata shot through by and closely involved with syenite or granite. Often wide bands of Grenville are plainly visible while more rarely the Grenville has been more or less assimilated by the intruding magma.

Gabbro. Several gabbro stocks or dikes of the usual sort with associated amphibolite have been found. The largest, occupying three-fourths of a square mile, is crossed by the main road 4 miles east of Long Lake village.

Diabase. Two fine diabase dikes occur on the eastern shore of Long lake, respectively one-half mile and 1 mile north of Long Lake village. One dike has a width of 40 feet and both show sharp contacts and clear-cut branches from the main masses. They strike north 30° east.

Faults. It is quite evident that the western portion of the Blue Mountain quadrangle lies west of the region of extreme faulting in the Adirondacks. Good evidence for but one fault was found and this line of fracture has determined the Raquette river channel across the corner of the quadrangle. Thus the remarkably straight northeast-southwest strike of this channel is accounted for. Nothing very positive can be said regarding the amount of displacement and date of this fracture but its presence is demonstrated by fine crushed and broken rock zones at Buttermilk falls and several places in the ledges along the shores of the lake.

Glaciation. A number of good glacial striae were observed especially near Long Lake village and toward the western base of Blue mountain. These bear from south 30° to 50° west, thus harmonizing with other observations in the interior Adirondack region. Much glacial drift has been deposited, particularly over the lowlands, but there is no good evidence for ice erosion other than the removal of superficial loose or decomposed materials.

Brier Hill and Ogdensburg quadrangles. Professor Cushing was engaged for part of the summer of 1913 in the Brier Hill and Ogdensburg quadrangles and reports that, so far as his observations have extended, the Precambric rocks are of considerable interest. There are long, narrow tongues of porphyritic syenite cutting the Grenville rocks and in parallelism with their structure. It is suggested that they are of the nature of huge dikes, but if this is the case the parent body of syenite from which they sprung nowhere appears and must lie to the south on the Gouverneur sheet. There is much amphibolite and interbedded Grenville sediments cut by the porphyritic syenite. Part of this amphibolite, however, into which the porphyritic syenite appears to grade, is evidently igneous, yet so far it has proved impossible to distinguish certainly the two in the field.

The Paleozoic section is well shown on these two quadrangles and is of much interest. The Potsdam sandstone is thin and of unequal thickness owing to the irregularity of the surface on which it was deposited. It is quite like the Potsdam of the Alexandria Bay and Theresa region described in Museum Bulletin 145. The overlying Theresa formation has greatly thickened and in its upper portion carries a massive 20 foot sandstone which is prominent all across this district and, according to Professor Chadwick, is continuous into the Canton quadrangle. The horizon is fossiliferous but until a definite examination of the fossils has been made it is not practicable to say whether this sandstone and the overlying beds are positively of Theresa or whether they may be of the age of the Tribes Hill formation. The overlying Beekmantown formation has a thickness of about 100 feet, with no summit shown. It is highly fossiliferous and these fossils indicate that the base of the formation here is comparable with the middle of subdivision D of the Champlain section, that is, that division D and C of that section and the lower part of D, are lacking here and that Beekmantown deposition at the west of the Adirondacks began correspondingly later than in the Champlain valley.

Canton quadrangle. Mr Martin, who has been occupied with the Precambric rocks of this quadrangle, reports as follows:

The *Grenville formations* and the later intrusives are about equally abundant in the area examined. Nothing older than Grenville was discovered, for these rocks everywhere rest upon later igneous masses. Their total thickness is not demonstrably greater than 2 miles. Of the Grenville sediments, the limestones, in varying degrees of purity, are perhaps the most abundant; sometimes they are made up of pure carbonate of lime, but as a rule there is a prominent admixture of silicates, actinolite, coccolite, phlogopite and other minerals. Transitions through quartz-mesh varieties to thin-bedded quartz-schists are often observed.

Garnet-gneiss, with garnet-free varieties, is strongly developed in the southeastern part of the quadrangle, but elsewhere it occurs only in thin layers. These rocks are associated with limestones and rusty gneisses, and the total thickness is not far from 3500 feet. The series has been injected by later intrusives of both gabbroic or gabbro-dioritic and granitic composition, and the whole doubly folded back upon itself into an immense isoclinal sigmoid, now beveled by the surface of erosion.

Silicious gneisses, occurring chiefly in the western part of the sheet, comprise garnetiferous biotite schists, quartz-feldspar-biotite paragneisses, thin quartzites and other transitional sedimentary varieties. With these are sometimes associated thin laminae and layers of calcareous quartzite, and some limestone strata, only the largest of which are mapped separately. Minor types, such as quartzite, quartz-mesh limestone, quartz schist and pyritous gneiss, are of restricted development, and of these the latter has the more general distribution. Certain amphibolites, in the lack of precise indications as to their origin, are questionably included in this series.

The amphibolites of the Pierrepont region, on the other hand, are believed to be, and those of the Little River-Pyrites belt are known to be, derived from an early gabbro intrusion, and the two masses are probably, though not certainly, continuous. South of Pierrepont Center the basic intrusive has formed an injection zone with the garnet-gneiss as country rock; in the case of the Pyrites mass, numerous xenoliths of Grenville limestone and gneisses have been included, among them the narrow belt of pyritous gneiss at Pyrites which is the ore-bearing stratum.

The pink granite-gneiss occupies broad belts and smaller isolated subcircular areas; while generally foliated, it is rarely massive and saccharoidal. Pegmatite dikes of simple mineralogical composition are abundantly developed in the western area where they cut through Grenville silicious gneisses. Some of these penetrate the amphibolitic border of the gabbro formation, and the granite is believed therefore, though other evidence is lacking, to be younger than the latter. The granite contains abundant amphibolitic inclusions; in the absence of satisfactory data as to the derivation of these by the metamorphism of limestone, which nowhere shows contact alteration as distinct from regional, the xenoliths are viewed as inclusions of the earlier basic rocks caught up during the intrusion of the granite. Inclusions other than amphibolite are absent, and because of the apparent impotence of the granite to produce contact alteration, it is believed that widespread assimilation has not taken place in those portions of the magma now accessible to observation.

The schistosity has a general northeast-southwest strike and a northwest dip of 20 to 40 degrees; it ordinarily follows the banding or strike of the formations, but in numerous instances the latter intersects it at an angle as high as 90 degrees. Pitch, as applied to the directrices of folds of all sizes and to the elongation of mineral groups and individuals, is usually parallel to the direction of average dip, but may depart from it as much as 15 or 20 degrees. In the more western gneisses, on the contrary, it is almost parallel to the strike. On the whole, the axes of folds in the limestone, garnet, gneiss and other formations, as well as the elongation of xenoliths in granite, conform with remarkable constancy to this northwest pitch.

An important structure is the tilted sigmoidal isocline south and west of Pierrepont, which involves the broad belt of garnet-gneiss already referred to, and its peripheral amphibolitic and granitic injection zone. Its axes correspond to the regional pitch, its axial planes to the regional foliation and its limbs are parallel to the regional trend of the formations. Its greatest measured dimension is over 6 miles in an east-northeast direction; from top to bottom it measures 3½ miles, and it is perhaps the largest Precambric structure of its type known. The wide departure of its axes from the formation trend is believed to point to at least two periods of orographic disturbance in this vicinity.

Igneous rocks are ordinarily in the form of sills. In the case of the gabbro these may represent stocks or bosses rolled out by dynamic readjustments, but many of the smaller masses were undoubtedly intruded as thin sheets to form an injection zone, such as that south of Pierrepont. In the case of the granite, the habit is much the same; but the sills are of huge dimensions and together with the smaller bosses probably represent the irregular surface of a regional bathylith.

In view of the limited area covered by the field work for this report, perhaps too much reliance should not be placed upon the broad generalizations here offered. Nevertheless they represent, in the writer's opinion, the weight of evidence for this quadrangle; but they are recognized as being subject to modification when viewed in the light of future more extended researches.

Professor Chadwick, who has been engaged with the Paleozoic rocks of this quadrangle, reports as follows:

The Paleozoic formations occupy the northern third of the quadrangle and occur also as several small outliers through the southern half. The northern outcrops are in general quite limited in number and in area, since the region is under a heavy cover of drumlin drift; they are confined chiefly to the beds of the Grasse river, Trout and Stony brooks, and the Raquette. While all the layers decline, broadly speaking, to the northward, following the present slope of the subsurface of Precambric crystallines, they present many minor undulations of gentle dip, crisscrossing like the waves of a choppy sea.

Along the contact of the main mass with the crystalline rocks that lie to the south, there exists a blank zone exceeding 1½ miles in breadth, in which bedrock is wholly concealed. The first outcrops seen on the north of this zone are small, often easily overlooked, exposures of the *Theresa beds* — upper semicalcareous Cambric strata. These are followed, usually immediately, by extensive ledges of a white vitreous "quartzite," 20 feet or more in thickness, containing numerous "Scolithus" and having much the appearance of the "white Potsdam" sandstone, with which it has evidently been confused in earlier explorations. Fine exposures of this are seen at Morley and northeastward to the Trout brook, thence southeastward along Stony brook to Sissonville on the

Raquette river. The discovery of large flat-coiled gastropods up to $3\frac{1}{2}$ inches in diameter in this sandstone early threw doubt upon its supposed Potsdam age and led to the study of the better sections on the neighboring Ogdensburg and Brier Hill quadrangles. At Heuvelton, on the Oswegatchie, the field relations of the much more conspicuous ledges there widely exposed indicated a position above the Theresa division, which formation shows well in the falls below the dam; and this was confirmed by the succession of these strata in the nearly continuous section exposed along the St Lawrence river between Morristown and Ogdensburg. The heavy "twenty-foot" sandstone, carrying the large gastropods and "Scolithus," was found to lie far up in the "transition" series of mixed calcareous and arenaceous beds and to belong apparently in the base of the Canadian group (Ordovicic), corresponding to a part of what have been termed the "Tribes Hill" beds farther west and south.

The overlying, alternating sandy and dolomitic beds of the Tribes Hill formation are best displayed at Buck's bridge on the Grasse river and there carry well-preserved Pleurotomaria hunterensis[1] in the sandy layers; though farther west, as at Theresa and Heuvelton, these occur in the calcareous parts only. In passing eastward this formation has become far more arenaceous than in Jefferson county, so much so that it too has been included with the "Potsdam" in the earlier mapping. Its lithic characters are here much more like those of the (restricted) Theresa beds than is the case in the Theresa region, where the Tribes Hill outcrops at once suggest the higher marine Beekmantown.

What appear to be the top beds of this division are overlaid conformerly opposite the lower mills at Hewittville on the Raquette[2] by 10 or 11 feet of more calcareous strata of different aspect. These consist of drab calcilutytes, weathering light buff or greenish yellow, more or less shot with irregular, brown-weathering streaks of sand. In the Morristown-Ogdensburg section, 4 or 5 feet of similar beds are seen at the summit of the Tribes Hill; but at an intervening exposure on Trout brook they seem to be lacking though present again in a railway cut a few rods to the west. The appearance of an unconformity with the overlying purer dolomites of the Beekmantown at each of these three lo-

[1] Identified by Doctor Ruedemann.

[2] This locality is just over the line on the Potsdam quadrangle.

calities is thus emphasized by this discontinuity of the subformation. It is expected that these beds will be found to thicken eastwardly and to take on a more open-water character, whereas here they have many marks of a shoreward, shoal-water deposit. A small Maclurea-like gastropod is the only fossil observed in them.

The beds that succeed, apparently unconformably, are of normal "upper Beekmantown" character, mostly drab or gray dolomites, sometimes with a pinkish cast, though there are one or more sharply defined beds of white sandstone of "Potsdam" type in the series, and a limited amount of sand in scattered worn grains is likely to be found at any level, but its presence is not conspicuous. The rock generally has a velvety surface on fresh fracture. These beds are well seen along the Rutland Railroad at the Madrid-Potsdam turnpike crossing and near Norwood, and constitute the highest layers exposed on the Canton quadrangle.

Paleozoic outliers. Returning to the southern boundary, it is observed that the rock sequence above discussed lacks a base, and that no exposures of its lowest beds, where the substantial Potsdam sandstone is to be expected, are known on this quadrangle, and only the topmost part of the succeeding Theresa formation. A glance at the State geologic map will show that the Precambric crystalline rocks protrude far to the north on the meridian of Canton. A reasonable assumption, to which the field evidence offers no dissent, is that the Potsdam sandstone is entirely, or nearly, cut out across this quadrangle by an elevated area or monadnock in the Precambric erosion surface ("sub-Potsdam peneplain") north of Canton. There is abundant evidence about Canton of the ruggedness of this sub-Potsdam surface, and this would be merely repeating over a larger district what happens in a smaller way here and there about Theresa and on Wellesley island.[1] What comes the nearest to being an outcrop of the main body of white sandstone below the Theresa is an extensive exposure of cross-bedded saccharoidal sandstone with occasional large white quartz cobbles, in the bed of the Grasse river just above the county house. This small area is nearly surrounded by the crystallines, the actual contacts covered, however, and thus must fit a deep embayment in these, if it is not actually an isolated outlier. No great thickness is visible, though the ledges form two separate series of rapids.

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[1] N. Y. State Mus. Bul. 145, p. 60.

Similar white saccharoidal sandstone, usually but little disturbed and with dips no greater than have been seen over the northern belts, occurs as outliers in separate localities along the east side of the Grasse river 2 and 3 miles respectively south of Canton. At the nearer of these the actual contact with the adjacent Grenville quartzite is excellently revealed, the latter beds standing vertically. Not far away are exposures of a more indurated and disturbed red or reddish sandstone of typical Potsdam character and revealing extensive brecciation and microfaulting. Often this rock is virtually a quartzite, though quite distinct in character from the thoroughly metamorphic Grenville. Small thrusts and monoclines are common. Some of the rock is highly autoclastic. These two types of rocks, with their color contrast even more pronounced perhaps, occur in very close proximity at the more southerly locality, where the *red* one is seen (as at several other points) in an equally unconformable but strikingly different type of contact with the Grenville quartzite and marble. The relations here are such that pertinence of the white and the red sandstones to the same formation seems open to question, though positive evidence of difference of age is not yet discovered. And these doubts intrude themselves at all the other localities examined, including the exposures north and south of Potsdam village. A distinction between these beds has been suggested by Cushing [1] for the Theresa quadrangle, with an erosion interval postulated on the basis of red pebbles incorporated in the white beds. It appears to us that no considerable age difference is indicated by the accumulating data and that Winchell's suggestion [2] of lower or middle Cambric age for the true red *Potsdam sandstone* of the Hannawa quarries (type locality) is hardly acceptable, though still possible.

SURFICIAL GEOLOGY

During the year past Professor Fairchild has continued his observations upon the changes in the postglacial waters. In the summer of 1913 his work was partly in the Champlain valley and partly, for purposes of comparison, in the valley of the Connecticut river. The manuscript copy of the forthcoming Churubusco or Ellenburg quadrangle sheet gave opportunity for determination of altitudes in the area near the Canadian boundary east and southeast of Covey hill. With the help of this map, it was found that the series

[1] N. Y. State Mus. Bul. 145, p. 62.

[2] *Vide* N. Y. State Mus. Bul. 95, p. 360.

of heavy cobble beaches at and north of Cannon Corners reached 735 feet in altitude, which is very near to the figure 750 feet which has been used for the theoretic height at the north line of the State. It seemed apparent that the up and down movement of the Hudson-Champlain valley must have involved the adjacent Connecticut valley, and therefore an exploration was made of the latter from Long Island sound to Wells River. This invasion of New England is also necessary for the study of the pleistocene of Long Island, since in position and in glacial history the latter area is a part of the former.

It was found that the phenomena of submergence in sea-level waters, so obtrusive in the Hudson-Champlain valley, were clear and abundant in the Connecticut valley. The high-level "terraces" and sand plains, of which much has been written, attributing them to deposits of the glacially-flooded river, are really delta deposits made in standing waters at sea level. The plains and terraces are partly contributed, as in the Hudson valley, by glacial outwash and partly by land drainage, and later somewhat distributed and shaped by river work at lower levels.

The origin of the plains in Massachusetts as static water deposits were recognized by Professor Emerson, and so described in his United States Geological Survey publications, Monograph XXIX, and Holyoke folio, no. 50. His water plane was taken as a datum plane, and it was found practically to mark the upper limit of the standing water from Middletown north to the mouth of Passumpsic river, about 280 miles. Northward from this point the valley was above the sea level.

In the Connecticut valley the uplifted marine plane has a northward rise of 2.30 feet a mile, nearly identical with the gradient in the Hudson valley which is 2.23 feet. But for equal latitudes the Connecticut plane lies about 50 feet higher than the Hudson plane, which makes the isobases or lines of equal uplift lie about 20 degrees north of west by 20 degrees south of east.

Following are some of the altitudes in the Connecticut valley: Riverhead, L. I., 120 feet; New Haven, Conn., 180; Middletown, 220; Hartford, 280; Springfield, Mass., 300; Brattleboro, Vt., 420; Hanover, N. H., 565; Wells River, Vt., 620. These are theoretic altitudes of the datum plane, but are very close to the actual levels of the summit terraces.

It appears that the west end of Long Island was mostly above this sea while the east end was mostly submerged. The heavy moraines stood above the sea. The broad sand plains, so characteristic of broad areas of Long Island, are attributed to the submergence in the ocean as the ice sheet melted.

The Winooski valley in Vermont, opening at Burlington and heading east of Montpelier, is a replica of the Connecticut valley. It was deeply flooded by the Champlain sea-level water and exhibits well-formed high deltas. The history of its terraces is the same as for the Connecticut.

It is planned to publish as a bulletin of the State Museum the proofs of the marine submergence of the Hudson-Champlain valley and description of the phenomena. In this connection it will be necessary to make comparison with the corresponding features in New England.

The study of the surficial geology of the Saratoga quadrangle was completed by Professor Stoller and the final report, with map, submitted. Beginning was also made by him in the study of the glacial geology of the Cohoes quadrangle.

INDUSTRIAL GEOLOGY

The collections relating to the economic mineral materials of the State have been so largely augmented during the past season as to constitute practically an entirely new addition to the Museum. The materials have been assembled by solicitation among the representative industries and in part by personal canvass in the field. Although fairly complete exhibits of the kind have been prepared at different times by the Museum for the expositions at Chicago, St Louis, Portland and Buffalo, there has never been any attempt hitherto to incorporate a series of the products of our mineral industry as a permanent feature of the Museum itself. As a consequence, the collections previously made were largely scattered after they had served their purpose of temporary display, and much of the remnant returned to Albany has suffered damage from repeated removals from one storage place to another. A list of the new collections is included with the Museum accessions for the year.

It is proper to state that the plan of assembling such an exhibit has met with hearty cooperation on the part of the mining and quarry enterprises concerned, and that many have gone to considerable inconvenience and expense in preparing the necessary materials. Acknowledgment may be made in this place for the general support that has thus been received, without which the labor would have been greatly increased and the results no doubt much diminished in value.

Mining and quarry review. The usual statistical canvass of the mineral industries was carried out, as a basis for the publication of a summary of the year's activities. The total production returned by the industries for 1912 had a value of $36,552,789. This indicated a period of general business expansion, since it was larger by nearly 17 per cent than the amount reported for the preceding year. In fact, the value of the output failed by only a small amount of reaching a new record, although the market conditions were by no means so favorable as they had been in some of the previous years.

In some branches of the mineral industry, New York State occupies a very prominent place and it participates in a large number of others which altogether contribute very considerably to the aggregate. There were thirty-five materials listed in the general table of products. The clay-making and quarry industries accounted for the largest items, the former with a total of $11,947,497 and the latter with an aggregate value of $5,718,984. These branches show great stability, but no marked tendency toward expansion from year to year. On the other hand, the cement industry, which in a sense competed with both the stone and clay-working industries, has made rapid strides of late years, after a period of vicissitude that nearly exterminated the once prosperous natural cement business of the State. With the decline of the latter, the portland cement branch was built up and has more than counterbalanced the loss of the former, with a gain in output over last year of nearly one-third. Similarly, the gypsum industry within a short time has developed from small proportions to a very important business that appears capable of further growth. The local mines supply a large share of the gypsum required by the Pennsylvania and New York portland cement plants which insure a steady market for the surplus rock. Most of the output, however, is used by the producers themselves for the manufacture of wall plasters and stucco. Another industry in which local enterprise is prominently concerned is the production of salt, both by underground mining and by evaporation of brines pumped from wells. Two of the largest salt mines in the country are located in Genesee county and there are more than twenty-five evaporating works distributed among six counties. The annual output is now above 10,000,000 barrels and is gaining steadily. The iron deposits of the State have attracted much attention recently and there is prospect of a material enlargement of the productive industry which has long been an important one. Recently the resources of the Highlands region have shown the greatest interest perhaps, although developments have continued in the Adirondacks where the principal mines are now situated. Additional details in regard to the economic situation of the mineral resources will be found in the report already mentioned.

Report on quarry materials. Owing to the press of other work, it has not been possible to extend the investigation of the quarry materials beyond the crystalline rocks, and consequently the preparation of a comprehensive report on the subject which was mentioned last year as in progress has had to be postponed for the present. The matter already in hand has been made ready for publication and will be submitted for that purpose unless the field work can be resumed during the coming season. The part completed covers the crystalline silicate rocks and the marbles, the materials that have received the least attention in previous work in the field.

Molding sand. Some of the molding sand localities in the vicinity of Albany were visited last summer for the purpose of procuring samples for the Museum collections, and the opportunity was used to study the features surrounding the occurrence of this material. The origin of the sands and of their peculiar qualities which give them industrial value have received little attention hitherto beyond brief statements included in some of the areal reports on the Hudson river region and one or two other publications.

Stoller in his report on the "Glacial Geology of the Schenectady Quadrangle" remarks that the deposits in that vicinity do not occur at any definite level, but rise and fall with the surface contours, a feature which is true for the sands throughout the region. Although they are restricted to the flat-terraced area of sands, gravels and clays accumulated in the glacial Lake Albany, there is a variation of 200 feet in the elevations at which they are found in the section around Albany and Schenectady. Moreover, the sand in any particular locality follows the minor surface irregularities with a variation sometimes of as much as 20 feet between the high and low places. Any sudden and pronounced change in the topography, however, such as caused by a stream cutting into the terrace, marks the disappearance of the valuable sand. The thickness of the sand ranges from a mere film to several feet. Eight or 9 feet was stated by the gatherers as the maximum known to have been excavated in the vicinity, but the average is probably not over 30 inches.

The molding sand occurs directly under the soil and is succeeded by a layer of loose or "open" sand of variable thickness. The latter is usually of coarser nature and does not pack like the molding sand. It has a grayish color from admixture of shale with the quartz grains. Below this layer is found the Hudson river clay, yellow on top, changing to blue in depth.

The features surrounding the field occurrence of the sand appear to be exceptional for a simple water-laid deposit like the sand, gravels and clays that underlie it. It is not a definite bed or layer interstratified with the others and exposed at certain horizons, nor does it appear to have any counterpart in the series. It contrasts with the underlying sands in its fine, even grain, in its evidences of a weathered condition and in the fact that except for the intermixed clayey material is a very fine quartz sand. In its distribution it has the character of a surficial mantle that varies in thickness rather rapidly and also changes in vertical altitude more than would be expected from an undisturbed water-laid stratum.

The characteristic fine-grained sands which form the principal material shipped to foundries are made up of angular to subrounded quartz grains. Under the microscope the individual grains are frequently observed to possess sharply concave sides which are natural fracture surfaces of the quartz, developed no doubt by granulation under pressure. This points to a glacial source which, of course, is generally accepted as the origin for the whole series of detrital deposits, but there appears to be some indication of additional abrasion by other agencies. The angles are more or less rounded and the grains may show frosted or pitted surfaces, features suggestive of wind action subsequent to that of the ice.

Sufficient details of the field occurrence of the sand have not been assembled as yet to justify any conclusions as to the process by which the sand has attained its present distribution and attitude toward the other deposits. In some places, however, there is strong resemblance to eolian deposits, with modifications arising from their fixation by plant growth and subsequent weathering. Live sand dunes exist in the vicinity of the molding sands. Their materials are similar to the latter with the difference that they are not so well sorted and lack the weathered appearance which is always found in the true molding sands. It seems quite probable that the finer particles of these shifting sands are being sorted out by the winds and distributed over the surrounding area and may thus contribute some share to the upbuilding of the molding sand layer. There is little question that weathering influences by the breaking down of the shale particles and the hydration and oxidation of their constituents, specially the iron compounds, exercise a beneficial change upon the material. The subject needs further study, however, in order to ascertain the specific effects wrought by the different agencies.

Miscellaneous. Field investigations other than those incident to brief trips for collecting purposes have been suspended during the year.

The office work has involved the usual extensive correspondence, of which a large part is concerned with the statistical canvass of the mineral industries. There has been a very active interest shown in the various undeveloped resources of the State, and numerous inquiries were received for advice as to possible locations for enterprise. These have related to almost all departments, but there seems to be particular interest at present in natural gas, iron ores, and high-grade limestones. It is aimed to give all possible assistance to legitimate requests of this character. The office has also been frequently called upon to identify and value samples of minerals, a function that is well within its province so long as there is not involved any elaborate chemical analysis or assay, in which case commercial laboratories must be consulted.

MINERALOGY

The time of the mineralogist has been given exclusively to the arrangement of the mineralogical collections, which is now well advanced. Reference has already been made to the acquisition of the Silas A. Young collection of minerals of Orange county which has been incorporated in the general arrangement. The mineral collections as now displayed constitute a double series, one being the general collection which has been made as complete as circumstances permit, and the other a series of New York State minerals which is undoubtedly the best of its kind.

PALEONTOLOGY

The attention of the paleontological staff has also been almost exclusively given to the arrangement of the paleontological collections. This work has been carried well forward, but the preliminary arrangement must of necessity be succeeded by a more permanent and carefully selected one. Into this collection of materials from the old Museum has had to be incorporated a large amount of material obtained by the purchase of the Gebhard collection. In addition to this work of arrangement of fossils, much has been done toward the effective restoration of fossils, and to these reference has been made. A series of life-size restorations of the Eurypterida of the genera Pterygotus, Eurypterus, Eusarcus and Stylonurus, have been prepared, effectively colored, framed and set up in the Museum. The reproduction of Pterygotus, a New York species, is upwards of 9 feet in length, a statement which may convey some conception of the enormous size attained by these great arthropods of the shallow waters of the Silurian sea. Doctor Ruedemann has also very successfully rendered a series of reconstructions of the cephalopods, showing the interior structure as well as the complete form of the exterior. This series includes the genera Manticoceras, Gyroceras, Endoceras, Orthoceras, Piloceras, Trochoceras and Gonioceras, all on sufficiently large scale to bring out the structural details, which are not always clearly preserved in the fossils themselves.

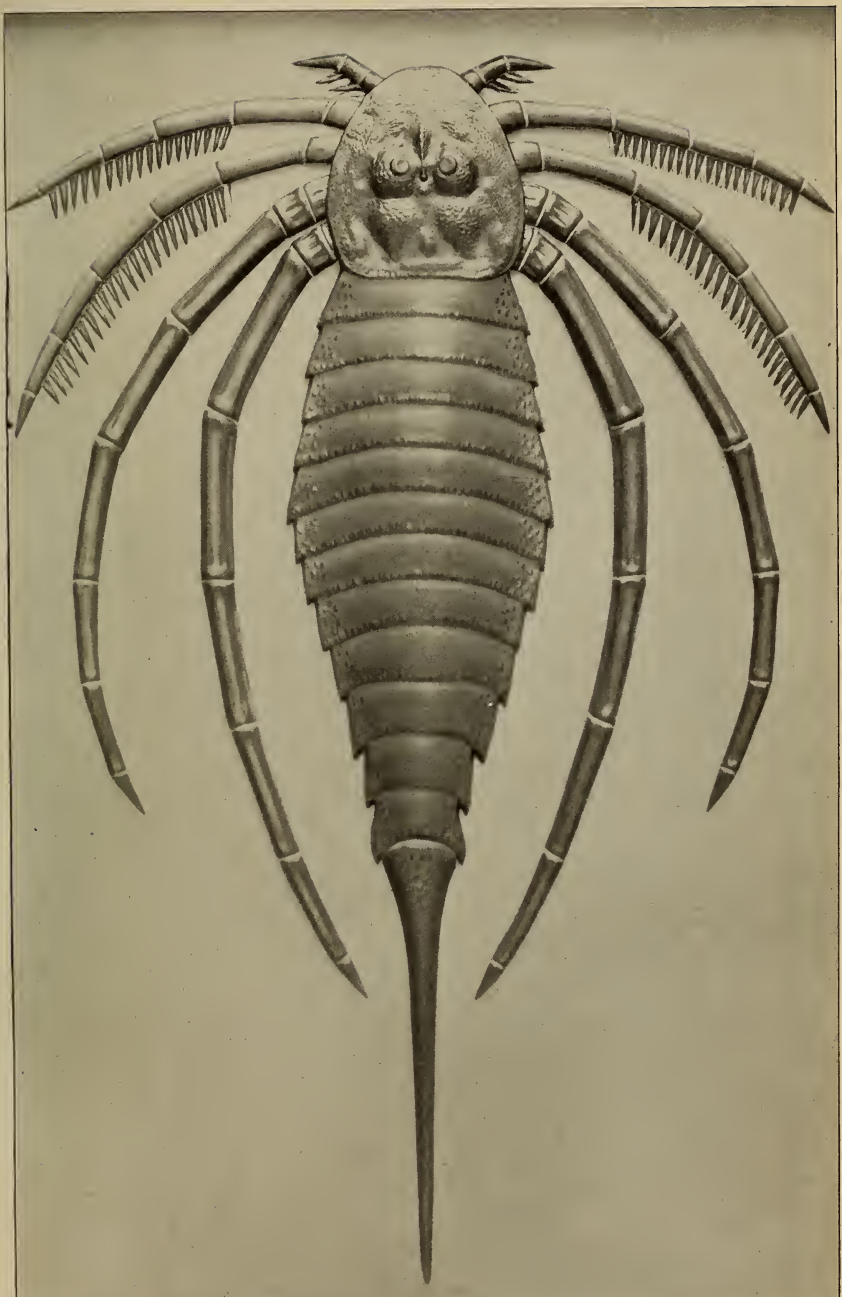
In the face of the pressure of Museum work it has not been possible during the past year to accomplish any field work in paleontology or to carry forward in the office any extensive researches in this subject.

For a number of years past the paleontologist has made reference in these reports to the development of the New York fossil faunas and their containing formations in lower Canada, specially in the region of the Gaspé peninsula. During the summer of 1913 the twelfth meeting of the International Geological Congress convened in Toronto, and among the geological excursions that were prepared in connection with that meeting was one into the Maritime Provinces including the Gaspé peninsula. At the request of the Canadian authorities, the paleontologist prepared a guide for the part of this excursion embracing the Gaspé peninsula and a portion of northern New Brunswick, and was privileged to act as guide over part of the course. This inviting excursion was participated in by about seventy geologists from various parts of the world, among them being the directors of the Geological Surveys of Great Britain and of France, as well as distinguished workers in this field from all the countries of Europe, from Indo-China, China, Japan, South Africa and the isles of the sea. Inasmuch as this field has been so fully exploited in the reports of the New York Geological Survey, it seems altogether appropriate now to present here a summary opinion of its geology by the director of the Geological Survey of France, M. Pierre Termier, recently published in the Proceedings of the *Academie des Sciences*. For these very ex-

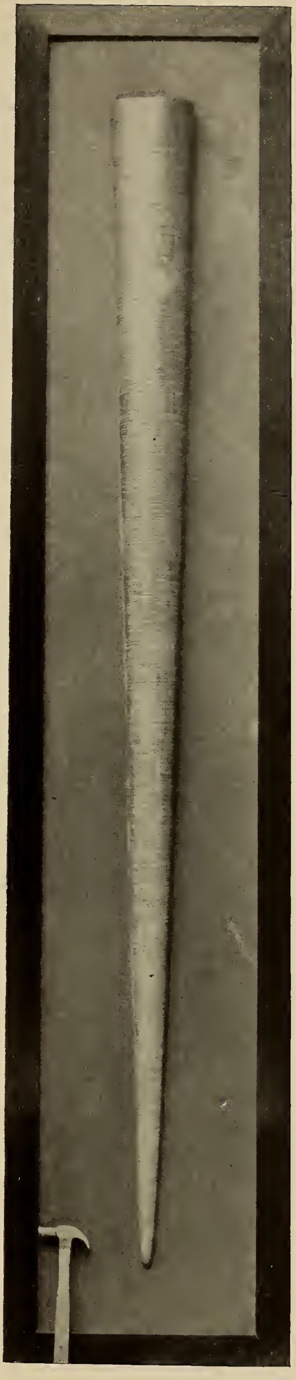
Panel restoration of the Siluric merostome Pterygotus buffaloensis. Actual length of animal, 9 feet

Life-size panel restoration of the Siluric merostome Eusarcus

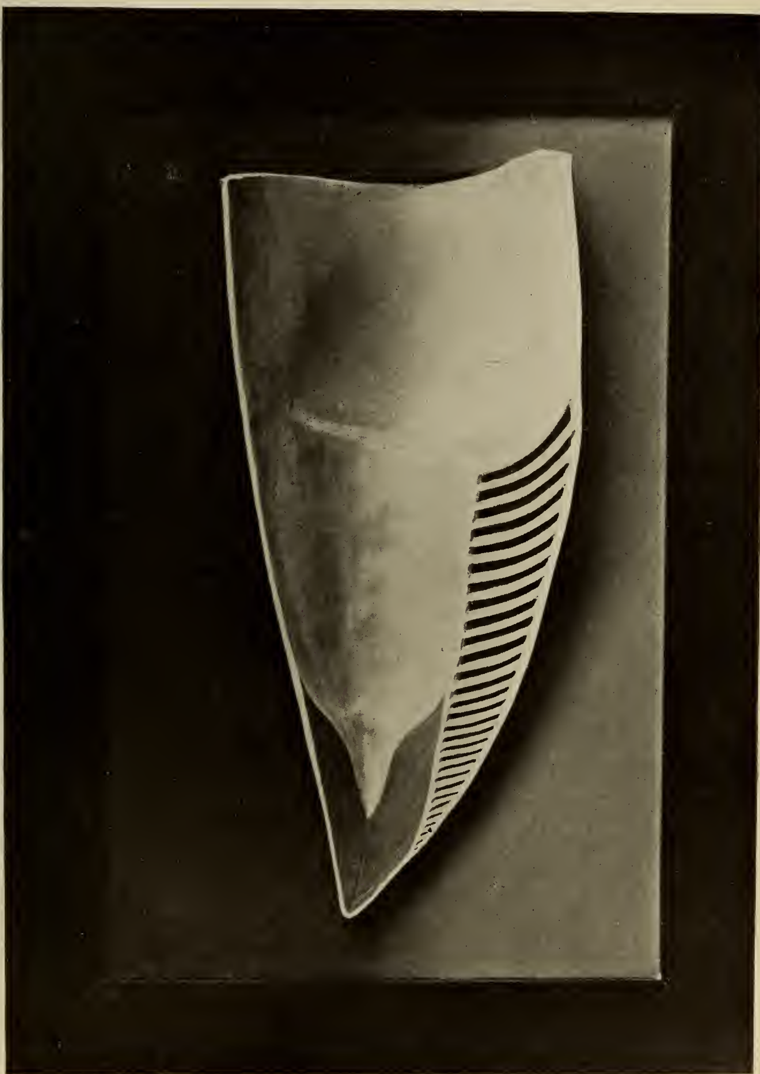
Life-size Eusarcus habitat group. Submarine view showing the ancient merostomes in their natural surroundings during the period of the Bertie waterlime (Siluric)



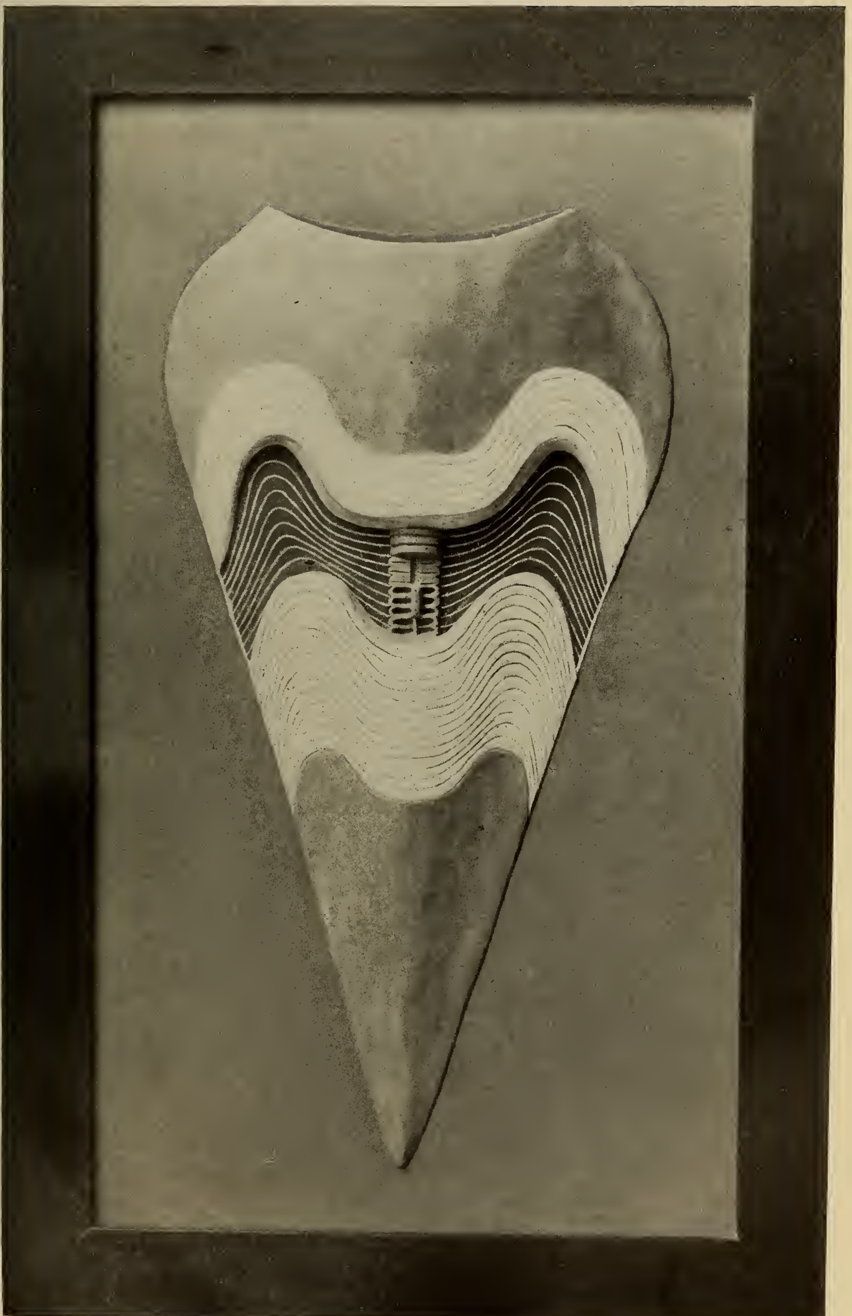
Life-size panel restoration of *Stylonurus excelsior* from the Catskill mountains



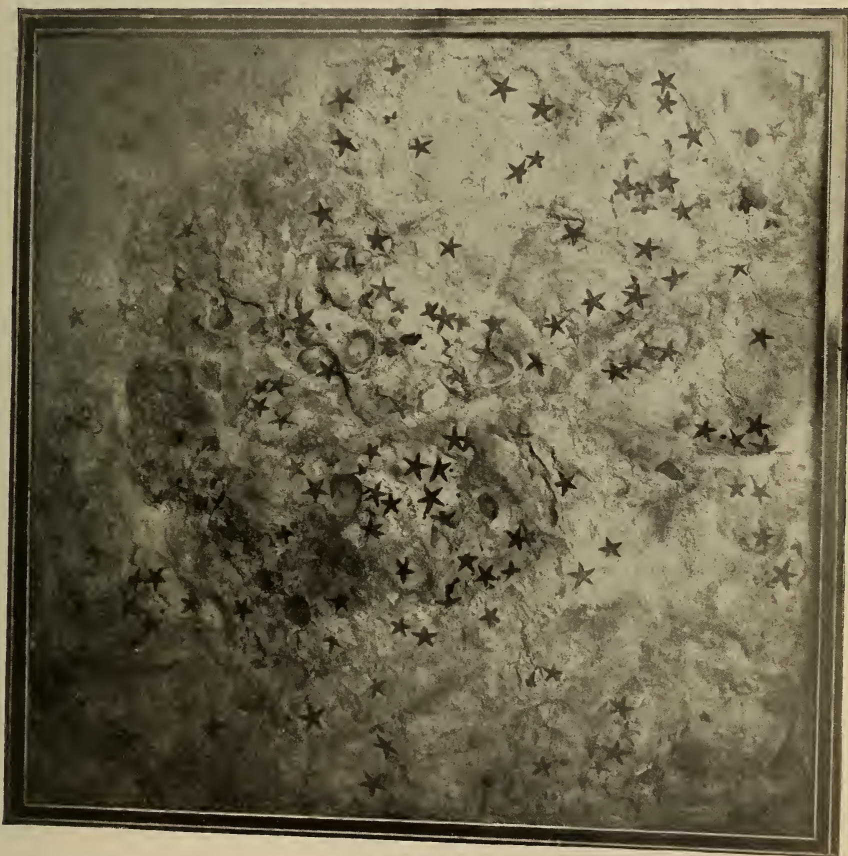
Model of a giant Endoceras from the Ordovicic rocks



Restoration of the internal structure of the cephalopod Piloceras



Restoration of the Ordovicic cephalopod, Gonioceras



Slab of Devonic starfish from Saugerties, N. Y., as mounted in the Museum. This slab measures 4 feet 9 inches x 4 feet 9 inches and carries 190 starfish. View taken from above

cellent reasons, a translation of M. Termier's summation of his observations in the field is herewith attached:

This excursion led us across the region of the primitive rocks, some of them much folded, some only undulated or even nearly horizontal, and which lie between the St Lawrence river and the Atlantic coast of Nova Scotia. I call this country the Appalachian region of Canada; for it is the prolongation, in Canadian territory, of the primary folded region known as the Appalachians which plays so important a rôle in the eastern United States. The same folded belt extends farther on to the north, to form Newfoundland; it then buries itself beneath the waters of the Atlantic, and Marcel Bertrand believed that he had seen it, in the ocean depths, joining the folded Armorican belt.

The interest of this excursion, to my mind, was twofold: stratigraphic and tectonic. Under guidance of the best authorities, the whole primary series, almost complete, and often rich in fossils, to discern the folds of this series; to follow them and fix their date, in a folded belt not less than 600 kilometers in width and the length of which we failed to cover in more than 500 kilometers; it is that which occupied and enamored us for eighteen days.

The Appalachian region of Canada parallels the southeastern border of Laurentia, pressing and molding itself against it. It is well known that Laurentia (of Edouard Suess), still called the Canadian Shield, is an immense domain of the earth's surface lying as though frozen down since Cambric times. All the beds belonging to it which are not earlier than the Cambric, are horizontal. They may be faulted and eroded; they are not rearranged nor folded. This anchored Laurentia comprises the greater part of Canada. At the south it reaches well into the United States; at the west to the Rocky mountains; on the northwest to the Mackenzie river; at the north as far as the mountains recently discovered in Ellesmere, Grinnell and Grant Lands; on the northeast it extends beneath the Atlantic, and the ancient north Atlantic continent, of which Greenland and Iceland are only the debris, seems to belong to it. Quebec is a point on the southeast margin of Laurentia. To the northeast of Quebec this margin coincides with the valley of the St Lawrence; it trends down-river toward the east, then toward the southeast along the coast of Gaspesia passing between this shore and the south coast of the island of Anticosti, and regaining its direction toward the northeast, passes along the Straits of Belle Isle, to lose itself at once in the Atlantic. To the southwest of Quebec the southeast border of Laurentia crosses the valley of the St Lawrence, then, little by little, taking a south-southeast direction and even an almost due south course, coincides with the long depression of Lake Champlain. Wherever it can be seen, the southeast border of Laurentia is a great fault. The two regions separated by the fault are in striking contrast: contrast in the aspect of the paleozoic lands, here perfectly horizontal, there folded, twisted, some times crushed; contrast in the relief of the ground, much more striking than in Laurentia which is a country overelevated and formed of hard rocks while the folded paleozoic country is a low land, profoundly worn, and with gentle curves.

There are few regions on the surface of the earth where the present geography is so intimately bound to a very ancient geography, where the present relief has so great an antiquity as in the Appalachian region of Canada. One may say that since the Cambric or at least since the lower Ordovicic, the St Lawrence has flowed as it does today from the place where Quebec now stands; sometimes in the condition of a marine channel, long and straight, turning to the south of Anticosti and passing through Belle Isle; sometimes as a vast fluvial valley collecting the waters of the immense American continent and carrying them to the sea by way of the Cabot strait, as it does today.

All about the Gulf of St Lawrence the plan of the coasts is an ancient plan, determined in its ground lines by phenomena earlier than the Carbonic. The peninsula of Nova Scotia, with its curious shape, is a Precarbonic link formerly connected with Newfoundland, partly covered by the whole of a transgressive series which has remained horizontal but manifests nevertheless the Precarbonic aspect in the alinement of its hillocks and its coasts, in the rias which characterizes the entire island of Cape Breton. The Bay of Fundy has not changed since Triassic times and in those times it resembled very much what it had been during the Carbonic. It requires but little imagination to see this country as it was in the different epochs of the Paleozoic, in the Gothlandic, in the Devonic, in the Westphalic, in the Permic. In very truth, if any member of the human family had lived in those times so prodigiously remote, for example at the end of the Devonic, if he had then traversed all this region already folded and prepared for the great Carbonic transgression, and if he could return today after millions of centuries of sleep and exile, to Gaspesia, New Brunswick or Nova Scotia, it would not seem at all a strange land to him.

The great orogenic movements in the Appalachian region of Canada are of Devonic age. As always, they had been slowly prepared by preliminary movements, and for a long time after them the ground continued to undulate. Preliminary movements and posthumous undulations have had, broadly speaking, the same direction as the principal folding. The most ancient preliminary movements date back to the Cambric. It is in the Cambric that history ceased to be the same for Laurentia and for the Appalachian region.

The age of the principal folding is perhaps not everywhere exactly the same. In Gaspesia and about the Bay Chaleur where there are two highly fossiliferous Devonic series, one lower Devonic, the other upper Devonic, and where the great discordance lies between the two, the principal plication is dated with reasonable precision — the middle Devonic. No part of it seems to have been delayed into the Dinantic.

The principal folding, of Devonic age, was extremely energetic. The folds are often greatly squeezed with a general tendency to leaning to overthrust toward the northwest. It is the push toward Laurentia, as intimated long ago. This may have resulted in the formation of veritable sheets which have gradually disappeared. We have seen one indisputable overthrust, that of the Ordovicic of Cap-des-Rosiers by the Lower Devonic of Cap-Bon-Ami and Grande Grève, at the extreme point of Gaspesia. The surface of displacement, unfortunately not very clear, dips here to the southeast at an angle of about 30°.

Very often the folds are straight and the beds vertical. Phenomena of crushing and foliation have not seemed to me very frequent or very intense. I have seen them, however, very beautifully developed in the Bathurst iron mine south of the Bay Chaleur — a foliated microgranite, having the aspect of gneiss and even the appearance of glazed slates, gray or clear green, in a band of folded Ordovicic. There are analogous compressions, and much more abundant, in the azoic rocks of Nova Scotia, granites and diabases on the east coast of the Bras d'Or, auriferous slates and granites in the region of Halifax; but these terranes are probably Precambric and their folding belongs to an epoch much more remote than the Appalachian folding.

The folds of Devonic age are, in a general sense, directed southwest-northeast. They are the ones which, as I have above said, determine the prolongation of Nova Scotia and the island of Cape Breton; likewise those which determine the rias of this island and those of Newfoundland. But the easternmost of these folds, those that are close against the margin of Laurentia, bend downward, beginning at St Anne-des-Monts, parallel to the coast of Gaspesia. At Gaspé and Percé, they are oriented toward the southeast. It is clear that this sinuosity is quite local and that the same folds, concealed today at the bottom of the Gulf of St Lawrence, regain soon between Anticosti and the Magdalen Islands, the northeast direction. The Carbonic mantle of New Brunswick conceals from view the same sinuous effects in the Devonic plications of this province. It seems as though we had an analogous sinuosity, but highly attenuated, on the east coast of the Bay of Fundy, on the long fjord (Minas bay) and in the country which extends from Truro to Arisaig. It will then be manifested by posthumous undulations much more than by the almost invisible Devonic folds. At any rate the sunken region of the ancient Devonic chain, which has become the Gulf of St Lawrence, corresponds to an energetic destruction of plication and it seems to me that under the waters of the gulf all the folds of Gaspesia are squeezed and crushed along the west coast of Newfoundland. This great Devonic chain, at least 600 kilometers across, where widest, and even 400 kilometers on the north of Newfoundland, doubtless continues well beyond that to the northeast. But does it go, as Marcel Bertrand thought, toward the south of England and toward Bretagne? I do not think so, now that I have seen it. The Devonic chain of Canada is an *arrested Caledonian* chain; I mean to say by that, a branch of the great chain of northern Scotland, of a little later date than the Scottish stock. It is with the Highlands of Scotland that the old Newfoundland mountains seem to me to be in agreement.

Here, as there, upon the partly leveled Caledonian folds extend, transgressive and rich in coarse conglomerate, the red sandstones. Those of Canada are a little more yellow than those of Scotland and their highest members are of Dinantic age. These red sandstones of Canada, dated, here and there, by fishes or by plants, are often nearly horizontal. The Bonaventure, the Scaumenac, the Horton Bluffs formations belong to them. The so-called Windsor beds (with brachiopod limestones and frequent gypsum masses) seem to me to be the upper element of this complex and incontestably Dinantic.

After the deposition of this mantle of red sandstones, and doubtless toward the close of the Dinantic, began a new movement, of slight intensity, gently displacing the coasts and producing here and there lacunes and discordances in sedimentation. For over a restricted area of the ancient chain, an area covering the northeast portion of New Brunswick, Prince Edward Island, Cape Breton and northwestern Nova Scotia, the Westphalic is deposited almost everywhere to an enormous thickness. The base of the Westphalic is often designated by the name Riversdale and Union formation and correlated in a broad way with the Millstone grit. It incloses many beds of red sandstones or schists, and numerous black schists with Leaia and Anthracomya. This group alone may have a thickness of 3000 meters. The upper part is a productive coal, very actively exploited at different points (Stellarton, Pictou, Sydney etc.) with a thickness of 600 meters at Sydney, more than 2000 meters at the Joggins. It may be that the most elevated of these coal beds are Stephanic. There was a new movement again, a new discordance or a new formation of conglomerates in the Stephanic epoch. The New Glasgow conglomerate is at the base of a very heavy series of coarse conglomerates, the upper part of which is Permic and which form today all of Prince Edward Island and almost the whole isthmus which attaches Nova Scotia to the mainland. The Trias of the Bay of Fundy which extends as far as Truro, corresponds to an analogous episode, but much later and affecting a region which the Permic transgression did not reach.

Trias and Permic have remained nearly horizontal. In the vast Carbonic mantle, the thickness of which will reach about 4000 meters, there are, generally speaking, only undulations, but accompanied by truncations through faulting. The coal of Sydney and Glace Bay disappears gently beneath the sea with a feeble dip and a perfect regularity and the workings are boldly going forward beneath the waters of the Atlantic. Nowhere have we seen the Carboniferous actually folded. It is, nevertheless, at certain points in southern New Brunswick and at Pictou, but such local folds are not intense, it seems, except in the early Carbonic.

The stratigraphic analogies between the Carbonic of the Maritime Provinces and that of England and the north of France are everywhere remarkable. They were pointed out long ago. But, tectonically speaking, there has been no direct connection between the Appalachians and the European coal chain. In Canada the Appalachian chain is a chain of Middle Devonic age, thus a Caledonian chain; and the movements which have affected it, at different times, in the Carbonic, the Permic, perhaps also at the end of the Trias, are very slight movements, which are entitled to be designated only as posthumous movements. Farther southwest, in the United States, these posthumous movements became gradually more intense and have built up a real chain, a true range of *American Altaids* in the exact prolongation of the *Canadian Caledonids*.

III

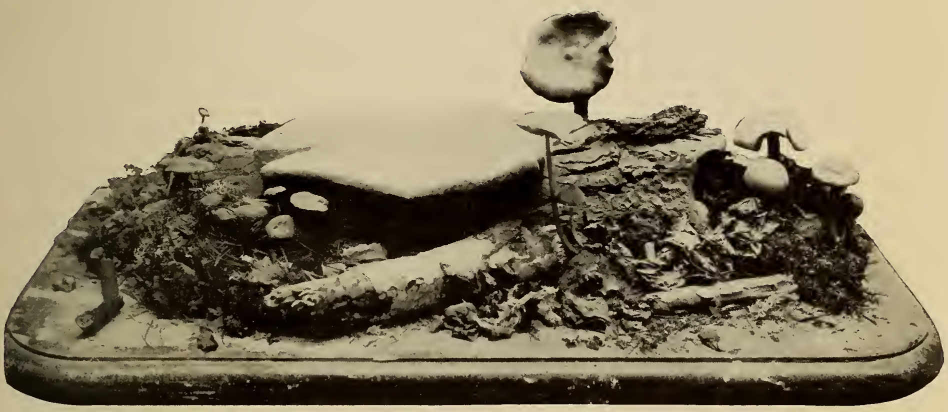
REPORT OF THE STATE BOTANIST

(During the past year the work of the office has practically passed into the hands of Dr H. D. House, assistant in botany, who took the place of S. H. Burnham, resigned, and who has prepared this report.)

Noteworthy contributions. Specimens of ten species of Crataegus have been added to the herbarium. These were collected by Dr J. V. Haberer, in central New York, and are the co-types of species described by Prof. C. S. Sargent in the report for 1912. Nearly all the 218 known species of Crataegus in this State are now represented by specimens in the herbarium. Doctor Haberer has also contributed four new species of Antennaria, to be described later by Dr E. L. Greene of Washington, D. C., a specialist upon that group. Doctor Haberer's set of plants also includes several other species either new to the State or new to central New York. Mr A. Olsson of Gloversville has collected and presented to the herbarium a large number of Fulton county plants containing several additions to the flora of the State and to Fulton county, the most interesting being a small orchid, Ophrys australis (Lindl.) House.

Dry weather damage to maples. About the middle of July several inquiries were received concerning damage to maple foliage. The first noticeable effect was a bronzing of the leaves, followed by the withering and death of the leaves when they turned brown but remained attached to the limbs, thus causing a very unsightly appearance. Most of the complaints apparently considered the damage due to either fungus or insect enemies of the tree. By the last of July the damage seems to have been generally noticed on shade and park maples throughout most of the State. A personal examination of some of the badly affected trees in towns of the central part of the State and about Albany resulted in an explanation of the damage.

July was ushered in by about ten days of unusually hot weather, following a considerable period of drought, with high temperatures prevailing on some days. While the week of July 6th was a little cooler, the drought continued, and in fact the precipitation for the entire summer was far below normal. On July 12th and 13th there occurred a strong hot and dry westerly and southwesterly wind, which continued with greater or less strength for several days.



A group of fungi cast in wax

The maple is well known as a very shallow rooted tree and the effect of the dry wind upon transpiration in the leaves is very marked in the case of any tree. It is apparent that the period of drought preceding the early part of July had reduced the available water of the soil to a minimum, so that the factors favoring transpiration (that is, dry, hot winds) which followed, greatly exceeded the power of the trees to absorb water from the soil which was actually deficient in moisture. Such a condition of affairs was particularly active in the case of maples along streets, highways, in parks or other situations where the soil was not protected by litter or undergrowth from drying out.

The leaves of the maple being unable to maintain the high rate of transpiration necessary under such conditions, were susceptible to the chemical activity of the sun's rays, causing the bronzing effect, a chemical change of the cell contents, somewhat analogous to what takes place normally in autumn when the leaves turn to shades of red or yellow. In many cases this state was followed by withering and death of the leaves, as sufficient moisture was not available to revive the leaves and to maintain their turgidity, which alone keeps them under ordinary conditions from collapsing.

That the dry weather and dry winds mentioned were responsible for the widespread damage seems probable also from the fact that the trees in situations of permanently damp soil, as in deep woodlands, suffered little or not at all; and of the trees affected, the greatest damage seems to have been on the side exposed most directly to the wind. Elms, having deeper-going roots, did not suffer so much as the maples, although considerable damage to their foliage was noticed in the case of some trees growing in dry soils. The leaves of the elm also possess a thicker epidermis and are better adapted by structure to withstand the factors like wind and heat which favor excessive transpiration and its subsequent damage.

The injury to maple and elm foliage thus noted is not likely to be permanent, nor is it likely that the trees thus affected will suffer from more than a slight setback. The damage consists chiefly in the unsightly appearance of the foliage. Local and even widespread occurrence of this sort of damage has frequently been reported in former years but not with such severity as during the past season.

A new fungus enemy of the maple. Several ornamental sugar maples at Glen Cove were observed by Mr F. E. Willets to be suffering from the attack of a fungus which caused the death of numerous twigs and branches, so that by August the trees were quite unsightly with the accumulation of dead twigs and brown leaves upon them. The fungus has been identified as Steganosporium piriforme (Hoff.) Cd., and it is said to have been destructive to maples in a town in southern Minnesota at one time. It seems, however, not to have been previously noted in New York State. It is not usually regarded as a serious enemy of the maple and its destructive work at Glen Cove may be due to a combination of circumstances, not the least of which was the weakened condition of the trees due to the excessive and prolonged drought.

Weather and fungi. Numerous observations in former years have led to the conclusion that unusually dry seasons were productive of but few forms of fleshy fungi, and Doctor Peck makes special comment upon the abundance and variety of fungi following a damp or rainy summer (Report for 1912, page 9). The season of 1913 seems to furnish abundant support to his conclusions for in most parts of the State few fleshy fungi developed during the summer season of 1913, although numerous common ones appeared late in the fall and a large crop of field mushrooms followed favorable late summer rains in most localities. Many correspondents have concurred in attributing the scarcity of fleshy species during the summer to the unusually dry weather.

Condition of the collections. The collections having been moved to the new Museum quarters early in the year, much time was necessarily occupied in properly arranging the herbarium and duplicate specimens in the new metal cases.

The collections of fungi made by the staff or received through contributions during the past year have been placed in cardboard boxes suitable for their reception and arranged in their proper places in the herbarium. The collections (345 in number) include 55 specimens of fungi and 290 specimens of ferns and flowering plants, collected in the counties of Albany, Madison, Rensselaer, Oneida, Onondaga, Schenectady and St Lawrence.

Specimens were contributed from the counties of Fulton, Herkimer, Monroe, Oneida, Onondaga, Queens, New York, Richmond, Washington and Wyoming.

Correspondents have contributed extralimital specimens collected in Alabama, Canada, California, Colorado, Connecticut, District of Columbia, Illinois, Maryland, Minnesota, New Hampshire, New Jersey, North Carolina, Oregon, Pennsylvania, Utah, Washington, Wisconsin, Wyoming, and Porto Rico and Germany.

The number of species of which specimens have been added to the herbarium from current collections and contributions is 128, of which 62 were not before represented in the State herbarium. Of these, 6 are considered new or hitherto undescribed species.

In addition, 2622 specimens have been placed in pasteboard boxes, labeled and properly incorporated into the herbarium from the stored material. The following synopsis shows the number of such specimens now added to the herbarium, but heretofore stored away in bundles and not easily accessible:

	NEW YORK	EXTRALIMITAL
Agaricaceae	1160	293
Polyporaceae	333	205
Boletaceae	260	140
Other families	118	113
Total	1871	751

The total number of specimens added to the herbarium, from all sources, is therefore 2740. This large addition is made possible by the enlarged space now available for the herbarium in its new quarters.

A list of the names of the added species (not including those added from the stored material) shows which species are new and which are not new to the herbarium.

The number of those who have contributed specimens of plants is 33. This list includes the names of those who sent specimens for identification only, if the specimens were of such character as to make them desirable additions to the herbarium.

The number of identifications made is 830; the number of those for whom they were made, 110.

IV

REPORT OF THE STATE ENTOMOLOGIST

The State Entomologist reports that two leaf feeders attracted general notice the past season, namely, the *apple tent caterpillar* and the allied *forest tent caterpillar.* The former, devouring the leaves of many orchard and wild cherry trees, was easily recognized by the large nests in the forks of the limbs. It was particularly injurious in the upper Hudson and Mohawk valleys. The latter pest, distinguished by the somewhat diamond-shaped, silvery white spots down the back, defoliated extensive areas of oaks on Long Island, attacked the sugar maples in the upper Hudson valley and stripped poplars in the Adirondacks. The probabilities of such injuries were foreseen last year and timely warnings issued. A number of rare or particularly interesting species have been observed during the year, and brief notes concerning a number of them are given in the Entomologist's report.

Petroleum compounds as insecticides. The serious condition of many sugar maples, following the application of miscible oils in 1911 and similar trouble in several apple orchards in 1912, was followed up the past season by studies of some cases and these, in connection with certain experiments, have resulted in confirming the Entomologist's opinion as to the cause of the trouble. This is a matter of much practical importance, since the injudicious use of these materials may jeopardize the existence of hundreds of valuable shade or fruit trees. The details of this work are given in the Entomologist's report.

Fruit tree pests. The studies and experiments of the last four years on the *codling moth* were continued. In midsummer some fruit growers became apprehensive of severe injury by larvae of the second brood. Examinations failed to disclose a substantial basis for such fears, and this opinion was confirmed in October by observations made in the orchards of Messrs W. H. Hart of Arlington and Edward Van Alstyne of Kinderhook. The owners sprayed under strictly commercial conditions and with no expectations that the trees would be subjected to a test later. There was a good crop and it was found that from 95 to 97 per cent of the entire yield were worm-free as a result of one timely spraying.

A small parasite has been exceedingly abundant and widely distributed in orchards infested by *San José scale,* and in not a few instances has been an important factor in reducing the numbers of the pest. Observations show that in most cases the trees in unsprayed orchards were seriously injured in earlier years and, as a rule, he believes that fruit growers must continue to rely upon applications of lime-sulphur washes for the control of this pernicious enemy.

Injuries by *red bugs*, two very similar species of which are known to occur in New York, were so abundant in one orchard near Poughkeepsie as to deform about one-third of a large crop of greenings. A brief account of this outbreak is given in the Entomologist's report.

The work of the *pear thrips*, one of the newer fruit pests, was studied in the vicinity of Athens, and a marked localization of injury observed as in earlier years. A detailed account of this insect has been given in the Entomologist's report for 1912.

The *pear psylla* is a pest of considerable importance, especially in the western part of the State, and occasionally very injurious in the Hudson valley. Incidentally the practical value of late spring applications of a lime-sulphur wash for the control of this insect was demonstrated in a badly infested orchard near Athens.

A new grape enemy which may become of considerable importance to growers in the Niagara section, in particular, has been discovered. It may be known as the *banded grape bug*. Its work is described and a discussion of its habits and the best methods of control are given in the Entomologist's report.

A number of other insect pests of fruits have been studied and records concerning them are given in a series of classified notes.

Gipsy moth. The small colony of the gipsy moth discovered last year appears to have been completely exterminated. This occurrence proves, in a concrete manner, the ever present possibility of the insect becoming established in New York territory, and amply justifies the maintenance of rigid precautions to prevent this. Evergreens and shrubbery grown in sections where gipsy moth is known to occur should be examined most carefully; especially is this true of the former. The presence of broken egg masses usually means the occurrence of living eggs in the packing material or about the roots of the plants in the same bale or box, and a due regard for the public welfare necessitates the destruction of the shipment or the part of the shipment exposed to infestation of this character.

Brown-tail moth. There is little to report concerning the brown-tail moth, though the danger of its establishing itself in the State has not decreased. It is only a question of time before this occurs. The winter nests are so characteristic that there should be little difficulty in recognizing the pest and at the outset preventing its becoming extremely abundant.

Grass and grain pests. The white grub outbreak of last year has largely abated, partly at least as a result of various natural causes. The studies of last year have been continued. The most interesting development was the discovery of many large, beneficial maggots, probably a species of Erax, which were abundant in fields badly infested by white grubs the preceding year, and at the time of observation last spring, nearly free from the pests.

A rare or usually overlooked corn pest, the *lined corn borer*, was destructive in Ulster county fields. A full discussion of this relatively new insect is given in the Entomologist's report.

The discovery of the *European wolf* or *grain moth* in a local seed warehouse adds another to the list of important grain insects. A careful study has been made of this insect and a detailed discussion appears elsewhere.

Shade tree insects. Observations show that the comparative immunity from severe injury by the *elm leaf beetle* the past season is probably due to the exceptionally cool weather in June, a time when the laying of eggs by this pest is at its height and the period when adverse climatic conditions might be expected to exert a maximum influence. There have been some cases of very severe injury locally here and there, due probably to a decreased vitality of the trees and a speedy destruction of the abnormally small leafage. It is undoubtedly true that the more thorough spraying by certain communities during the last few years has been most beneficial. The apparent check of the past season is presumably temporary and any extended reliance thereupon is considered inadvisable.

The *false maple scale* has been the cause of a number of complaints, though it has been distinctly less numerous than in recent years. It was extremely abundant during late summer in one locality at Mount Vernon.

The *tulip tree scale*, a pest occasionally numerous, was unusually injurious in the vicinity of New York City. Several natural enemies were noted preying upon this species.

Forest pests. Work has been continued upon the *hickory bark beetle*, and field observations by the Entomologist lead him to believe that the period of severe injury for the vicinity of New York City has largely passed. His investigations of previous years and the studies of this season indicate the practicability of protecting the more valued trees by applications made shortly after the beetles have entered the bark. The probable efficacy of this treatment by no means lessens the advisability of cutting and burning badly infested wood before the borers can mature and escape.

The extensive plantings of white pine in recent years have given the *white pine weevil* almost ideal opportunities for multiplication and, as a consequence, there have been numerous complaints regarding the work of this insect. The Entomologist, in cooperation with Mr Waldo C. Johnston of Cooperstown, conducted a practical test of the value of collecting the weevils by hand. It was found that four collections could be made for about $1.25 an acre where the trees were not more than 3 feet high and, as a result, no weevils were to be seen later. There are reasons for believing this to be a practical and possibly a profitable method of controlling the pest in such plantings. It is planned to continue the investigations of this important pest.

Original studies were also made of the *spotted hemlock borer,* an insect which destroyed several hundred valuable hemlocks in the New York Botanical Gardens, and one which has killed many trees in the Appalachian region. A detailed account of this borer is given in the Entomologist's report.

The *Rhododendron clearwing* and the *pitted Ambrosia beetle* were also studied. The first deforms and weakens the valuable Rhododendron, while the latter may destroy a considerable proportion of one or more beds of this shrub.

The work of the *two-lined chestnut borer,* a pernicious enemy of both chestnut and oak, was observed in several localities about New York City and appropriate recommendations made. A detailed account of this pest has been given in New York State Museum Memoir 8.

The Entomologist has taken advantage of the recent outbreak by *bark beetles,* to study the general conditions which may result in serious injury by these borers. A careful examination of weather records, especially those relating to precipitation, tends to support the belief that a series of annual droughts may so weaken the trees as to produce conditions very favorable for the multiplication of the borers. A discussion of the data is given in connection with an account of the hickory bark beetle.

Flies and mosquitos. The interest in the control of the *house fly* and the subjection of the *mosquito* has continued. Several warning notices were sent out early in the year and a brief folder on the house fly was prepared, the latter being widely circulated in early summer.

Gall midges. Studies of gall midges have been continued and a number of species and three new genera described. The practical character of this work is illustrated by the description of one midge which is considered a most important natural enemy in controlling the red spider on cotton, and a consultation has been held with Prof. Henry Tryon of the "Prickly Pear (Traveling) Commission" respecting the introduction of certain gall midges into Queensland, in the expectation that they might become important agents in practically freeing large areas from the introduced and obnoxious prickly pear. The Entomologist's report contains a detailed account of a *Cactus midge* which may prove of great value in Australia, though regarded as a pest under certain conditions in this country. The *rose midge,* an important enemy of the rose grower, has caused considerable apprehension in the vicinity of Rochester on account of its injuries to young plants.

Publications. A number of brief popular accounts regarding such common pests as the house fly, apple tent caterpillar and forest tent caterpillar have been widely circulated through the press. The most important publications, aside from the report of last year, are: The Gall Midge Fauna of Western North America; Studies in Itonididae; and several papers describing new species of gall midges.

Removal. The moving of the collections and their establishment in the new quarters in the Education Building involved a large amount of work, which necessarily restricted activities along other lines and must continue so to do until the insects are permanently rearranged. The removal was accomplished with practically no breakage or loss of either specimens or equipment and with comparatively little hindrance to the regular office routine.

Faunal studies. This phase of entomology has received some attention almost from the establishment of the office and has an important bearing upon practical work, since data of this character make possible the fixing of boundaries beyond which there is little probability of injurious species maintaining themselves in numbers. Earlier unpublished studies have resulted in fixing approximate boundaries for the various life zones in the State. It has been the policy for some years to collect in representative areas whenever opportunity offered and much valuable material has been secured in this manner. Collections in the Adirondacks, begun by the late Dr J. A. Lintner, have been continued. The past summer collections were made in several Adirondack localities and at Wells. These data are now being prepared for publication.

Collections. A special effort has been made the past season to secure specimens of the work and early stages of various injurious forms, since biological material is a most important component of economic collections and indispensable in elucidating the habits and life histories of the various species. The State collection now contains a large amount of such material, invaluable because of the associated data. Many miscroscopic preparations of smaller insects have been made and incorporated in the collections as in earlier years.

Much labor has been expended upon the rearrangement of the collections, an undertaking which has been hampered to some extent by insufficient case or tray room. This work, while time consuming and in a certain measure unproductive, is a necessary preliminary to effective studies in the future; otherwise more time would be lost in endeavoring to find misplaced specimens than would be required to put the collection in order in the first place.

Material provision for the care of the collections is essential. The pinned insects are in boxes or trays in wooden cases. There are not enough of the former to permit the specimens being properly arranged, and the latter should be replaced by steel cases and more provided to accommodate the additional boxes and trays required. The biological material is in an even less satisfactory state. It is in shallow, wooden trays and difficult of access because of the lack of space. There is need of a modern series of metallic trays for the accommodation of such specimens. Some equally satisfactory provision should be made for the large collection of microscopic slides, many of them containing types of species, and therefore impossible of duplication. The constantly increasing collection of photographic negatives requires a metallic filing case of approved design.

Nursery inspection. The nursery inspection work conducted by the State Department of Agriculture has resulted in the Entomologist being requested to make numerous identifications and also advise in regard to the policy which should be pursued by the State. Many of the specimens submitted for name were in poor condition, and as they may represent any stage in insect development and frequently originate in a foreign country, such determinations are laborious, time consuming and require for their successful prosecution a large collection and many entomological works, both domestic and foreign. The correct identification of such material is very important, since the disposal of large shipments of nursery stock depends in considerable measure upon the character of the infestation.

Miscellaneous. Cooperation with the Division of Visual Instruction has been continued and additions made to an excellent and somewhat extended series of photographs, mostly of injurious or common insects or their work.

V

ZOOLOGY

In spite of the temporary lack, or inaccessibility, of many things essential to the work of the zoology section, substantial progress has been made in restoring an orderly arrangement of the collections and in acquiring the equipment necessary for meeting the requirements of a zoology exhibit much larger and more varied than could be attempted in the former quarters. In the early part of the fiscal year, the removal of the collections and outfit of the zoology section was successfully accomplished. The time and labor previously devoted to packing and preparing the collections proved well spent; the packed material was all handled rapidly and easily and arrived in good condition. On account of the delay in delivering the zoology storage cases, boxes and wrappings have been obliged to do long service as storage. While by no means adapted for protection against insects, depredations from that source seem to have been effectually warded off by opening up the boxes and examining the specimens as soon as warm weather came on, and putting in each box a plentiful supply of naphthalene. No damage from insects has been found in the material thus far taken out.

The special groups of birds and animals having more or less elaborate accessories, such as prepared or artificial plants, celluloid or glass representing water, etc., presented great difficulties in moving on account of their bulk and liability to injury. They were carefully transported without packing, but not without considerable damage, due largely to the partial dismantling made necessary by the narrow and crooked stairway and lack of an elevator in Geological Hall.

The group of fresh-water fishes prepared by Mr Klein while taxidermist at this Museum was found most difficult to handle. The large sheet of celluloid representing the surface of the water cracked, causing considerable damage, apparently because of the sudden change in temperature due to moving it in cold weather, every care having been taken in handling it.

The large group of black bears acquired several years ago and temporarily set up at the State Normal College for lack of room in Geological Hall, was also moved to the Education Building, but on account of its large size, it had to be entirely dismantled and nearly all the accessories replaced. The moose group, which had been in storage since its delivery in Albany, was also moved but not set up, owing to the delay in delivering the cases.

To accomplish the difficult task of setting up and restoring these groups, the services of Mr B. M. Hartley, of New Haven, were obtained. During the four months he was at the Museum, the damaged and dismantled groups were put in shape again and two large nesting groups (goshawks and duck hawks) were prepared from material previously acquired from the collection of Mr S. H. Paine, of Silver Bay, and other smaller exhibits were finished. The skeleton of the finback whale was assembled and hung in the zoology hall by Mr C. E. Mirguet, of Washington, by whom the skeleton was originally mounted.

One of the important parts of the year's work was in adding to the equipment of the taxidermist's room so that the work of preparing the specimens and accessories for the bird and animal groups could be carried on. The water power air compressor used in Geological Hall proved a failure in the new quarters because of its worn-out condition and because of the lower water pressure in its new location, and has been replaced with a much more powerful portable electric compressor which will be available for a great variety of uses. Other needed additions to the taxidermist's outfit, notably a carpenter's work bench, a drill press and other tools, a galvanized iron box and cover for the relaxing chest and a wooden tank for preserving fluid were also made.

The collection of birds' eggs and nests has been sorted out, cataloged and so packed that the specimens suitable for exhibition will be easily accessible. The alcoholic material has been gone over and cared for, and made accessible for study and comparison. Though useful for such purposes, it is not for the most part of a character desirable for exhibition. It will be kept in storage cases in the zoologist's room, and specimens prepared in ways more attractive to the public will be used for exhibition.

Under the conditions that have prevailed, it has been impossible to devote much time and money to increasing the collections, but a number of important additions to the exhibition collections of mammals, birds, birds' nests and eggs and fishes have been received, notably a pair of pumas and a pair of fishers previously ordered from Ward's Natural Science Establishment and a number of native fishes obtained in the local markets and mounted by the museum taxidermist. The most valuable single specimen received is the skin of a large buffalo bull from the Blue Mountain Forest Preserve, presented by Mr Austin Corbin, which has been mounted at Ward's

Natural Science Establishment and will be used in a group with several other specimens already in our possession.

Birds of New York. The completed text of volume 2 of Birds of New York, the publication of which has been delayed on account of the illness of Professor Eaton, the author, was sent to press in the summer and it is expected will be ready for delivery by the first of May or June. This volume covers the land birds and, as the game and water birds were included in volume 1, the completion of the work in hand as volume 2 of Museum Memoir 12, will bring to an end the present representation of all species of birds occurring in the fauna of New York, including visitants and migrants, with a complete illustration in color of every species. Volume 1 was received with such general approbation and appreciation, it is believed that volume 2, which covers the birds coming under more general daily observation of the larger public, will meet even a greater need than its predecessor. Volume 2 carries, besides the descriptions and illustrative matter, a series of general chapters on the habits and general ecological relations of birds and the part they play in human society and culture. Occasion is taken at this time to make announcement of the fact that volume 1 was offered to the public at $3 a volume; volume 2, which is somewhat larger than volume 1, carrying more text matter and a greater number of color plates, will be sold at the same price to all who have received volume 1, but otherwise at $4.

Monograph of the New York mollusca. The work of preparing the monograph of the New York mollusca, which is in the charge of Dr H. A. Pilsbry of the Philadelphia Academy of Sciences, has gone forward and the author reports an increasing number of illustrations made, together with the preparation of considerable additional text matter. It is probable that the entire work will be brought to completion within the coming year.

Myriapods of New York. The late Frederick C. Paulmier, while zoologist of the Museum, prepared and annotated a checklist of the myriapods of New York, and this list was supplemented by notes and memoranda, together with an index of the genera, made by Professor George H. Chadwick while occupying the same position on the Museum staff. It has seemed well to bring this undertaking to completion and Dr Roy W. Miner of the American Museum of Natural History has very kindly consented to take over the manuscripts and memoranda with the purpose of putting them in final form as an illustrated compendium of these animals as they occur in the State.

Animal effigy pipes from the Dann Collection, Honeoye Falls. The two larger pipes at the top have brass or copper eyes

Types of pipes from the Dann Collection, Honeoye Falls

Clay vessels with ears from the Dann Collection, Honeoye Falls

VI

REPORT OF THE ARCHEOLOGIST

The fiscal year ending September 30, 1913 has been unusual in the history of the archeology section of the State Museum. During the year the general display cases for archeological and ethnological material have been installed, but the large group cases for the ethnological series of Iroquois culture phases have reached only the stage of plans. This circumstance prevents any definite attempt to fill the other cases, so soon to be moved, rearranged and covered during the building of the group cases. A temporary display of the ethnological material, however, demonstrated that the archeological and ethnological divisions will be cramped for exhibition room unless the greater portion of the eastern mezzanine hall is taken over for a hall of comparative and special area archeology. Plans have already been made to fill this hall with archeology cases.

From the Museum rehabilitation fund several important collections of archeological specimens have been acquired. This encouraging fact again makes the State Museum the repository of an extraordinary collection of cultural artifacts of the New York aborigines. Through careful purchases and wise selections of large collections from special localities, the archeological series will surpass the former exhibit destroyed in the Capitol fire. The more adequate means now at hand for exhibiting these specimens will make possible an exhibit of vast importance. Definite plans have already been drawn up in view of a scientific display of these artifacts.

It must be definitely understood that, in the vulgar sense, no relics or curios will be exhibited. The curious object devoid of adequate data will have no room in these cases, the plan being to show visually the arts, industries, crafts, ceremonies, means of livelihood and burial customs of the race or races, tribes and nations that preceded the white man in the occupation of this territory. The plan is to make an educational exhibit of culture history and culture development. The collections as exhibited must live, in the sense of being valuable modes of instruction in the prehistory of New York. All the various collections acquired have been thoughtfully studied with this object in mind. It is hoped this plan, when carried out, will establish the educational value of the archeological exhibits. We have the material, though it is highly desirable that it be constantly added to, for it is by no means as yet complete.

The special interest inherent in this collection is that we are able to link the aboriginal period through its gradual stages of transition to the Indians still living in the State today. Valuable collections like that acquired from Raymond C. Dann of Fairport show the Seneca culture at an interesting period of transition. The so-called " stone age " is linked with the " age of iron."

Collections purchased. During the year the Archeologist visited all the principal collectors who had indicated a willingness to sell their specimens to the State Museum. This examination has led to the acquisition of the following collections:

	Number of specimens
R. D. Loveland, Watertown	1965
Charles P. Oatman, Liverpool	775
Alva S. Reed, Livonia	646
Ward E. Bryan, Elmira	1092
R. E. Van Valkenburg, Mount Upton	331
C. A. Holmes, New Berlin	652
Raymond G. Dann, Fairport	1662
Frederick H. Crofoot, Sonyea	9647
Smaller collections	600
Total	17370

The localities represented are the territory adjacent to the eastern end of Lake Ontario, the upper waters of the Hudson, the Chenango valley, the southern end of Canandaigua lake, the valley of the Susquehanna near Elmira, the Genesee valley and the various sites in Ontario and Monroe counties. Other collections from important centers are under consideration. The material so acquired does not represent merely surface finds, for the Reed, Oatman, Loveland and Dann collections are largely the result of excavations.

To describe in detail the various collections acquired during the year would be a lengthy task and require much special study involving a considerable period of time.

For the purposes of a general report, the sketches of each collection as found below will be sufficiently descriptive.

The Raymond Dann collection results from excavations made on the John Dann farm three-fourths of a mile south of Honeoye Falls, Monroe county. The site lies along Totiacton creek and covers a large acreage, probably 30 or 40, with scattering evidences of occupation all about. Here, during the third quarter of the 17th century, was a large Seneca village and graveyard. Mr John Dann believes this site to be one of the several Totiacton villages. There is every evidence of a continued contact with Europeans and the artifacts of the so-called stone age mingle with those of European manufacture, such as brass, iron, lead, crockery, glass and bone.

Much of the material came from refuse pits and dumps, but by far the greater portion was taken from the numerous graves on the sloping hillside. The objects found by Mr Dann were carefully cataloged, giving thereby an added value. An interesting variety of pipes is contained in this collection. Of greater interest, however, is the fine collection of pottery vessels, some of which have unique features, for instance, handles or ears. Among the shell ornaments are many quarts of wampum beads, many effigies, disks, crescents and cylindrical and spheroidal beads. The bone implements include a fine series of combs having figures carved at the top, awls, effigy figures of the human form, cylindrical beads and tortoise carapaces. The stone implements include the usual array of flints, anvils, hammers and pitted stones.

The proof of European contact is found in the European wampum, glass beads, objects of brass (as kettles, chains etc.), iron knives, lead and pewter.

By this collection it is possible to illustrate the art of the Senecas in all the various substances in which they wrought and then to show side by side the objects brought by the traders to supplant the native artifacts. The goods of the white man were superior and were therefore eagerly sought. Native industries gradually decreased and they became dependent upon implements and utensils that they themselves did not and could not produce. A temporary arrangement of the Dann collection illustrates this, showing the decadence of native art and industry resulting from contact.

An earlier Seneca site is illustrated by the Alva Reed collection. This collection is the result of digging into the refuse pits and side hill dumps of an ancient Seneca stronghold near the town of Richmond Mills, Ontario county. The site is upon a high hill overlooking the Hemlock valley. The site itself is well protected by the high walls of a creek on one side, a long slope on the west side and a ravine to the south. There are indications of palisades that still further protected the place. No graves have been found on this site although on one of our surveys we found human remains near the surface in the stiff clay at the upper end of the " fort." Graves were later found across the ravine by Frederick Houghton, but no objects other than human bones were discovered in the graves.

Mr Reed, who made the collection through many years of digging at his leisure hours, has been careful to collect and catalog with method. He found no objects of European manufacture and no signs that the occupants of what he terms "the old fort" had ever seen the white man. The collection embraces good series of shell, bone, antler, stone and clay objects. It is especially rich in fine bone implements and early shell ornaments. The pottery unfortunately is mostly fragmentary. The special value of this collection lies in the fact that it may with reasonable certainty be called precolonial Senecan. It is therefore a good type-collection of this period and is valuable as a base for comparison.

A mixed collection from Livingston county is that made by Mr Fred H. Crofoot of Sonyea. It is the result of a surface examination of some forty sites up and down the Genesee valley from the Honeoye Junction to Mount Morris, and of all the tributaries within this region. Many stages of occupation are represented and occupations beginning with the Esquimaux-like through the early Algonkian, the mound culture, the later Algonkian, the early and later Iroquoian into the colonial period.

One of the thickly populated centers of the early Iroquoian peoples is the area bounded on the west by the east shore of Lake Ontario and on the north and northeast by the St Lawrence. This geographical area is embraced in the present county of Jefferson. Here have been a succession of occupations with the precolonial Iroquois leaving the greater portion of cultural artifacts. Several large collections have been made there, with those made by R. D. Loveland and Charles Oatman leading in objects of interest. Earlier small collections are those made by Dr R. W. Amidon, Doctor Getman and Captain Oldham. The Museum acquired these smaller collections between 1906 and 1909. This year the Museum has been enabled to obtain both the Loveland and Oatman collections. Each collection is rich in fine examples of clay pipes, more than 250 being embraced in both. Some have been carefully restored from the broken fragments, thus showing almost exactly the original forms. The range of ornamentation and relief decoration is wide and on the whole is consistently Iroquoian. No entire clay vessels were found in this locality, but the collections contain thousands of valuable fragments. Bone and antler objects are numerous and of good quality.

From the region drained by the Susquehanna and its tributaries we have acquired three small but not unimportant collections —

Antler combs and effigies from the Dann Collection, Honeoye Falls

Antler combs from the Dann Collection, Honeoye Falls

those of Ward E. Bryan of Elmira, R. E. Van Valkenburg of Mount Upton and C. A. Holmes of New Berlin. Here, as might be expected, are many evidences of Algonkian occupation. Some of the specimens appear to be early types as illustrated by the weathered argillete and limestone chipped implements.

Mr D. D. Luther during the year sent in 440 specimens from an early Algonkian site near Naples, Yates county. Although

Stone Face from Chemung County

many of the specimens are fragmentary, for purposes of comparison the collection is highly interesting. It was through Mr Luther that the Museum has acquired the fine objects from the site near Middlesex. These specimens are largely tablet gorgets, stone tubes, shell beads and a copper implement. The burials appear similar in type to a certain Ohio culture.

Ethnology. Two trips were made to the New York reservations and some valuable specimens of historic Iroquoian art obtained.

Among these specimens were ceremonial objects of the Eagle or Bird dance, dance rattles and paraphernalia, carved bowls, wood spoons and similar ornaments. Decorated clothing was obtained at Allegany and husk objects, notably moccasins, at Cattaraugus.

Year by year the native artifacts used by the Iroquois of New York and Ontario are diminishing in number and variety. Makeshifts are frequently employed, as for example, tin can rattles for horn rattles, fringed canvas masks for corn-husk masks and a tin dipper for the ceremonial ladle. Only a few old persons remain who remember the ancient arts of weaving and quill decoration. Thus the field is constantly growing more barren and it is only with great effort, combined with good fortune, that desirable objects of ethnological interest are obtained. Flying trips on the reservation are not satisfactory means of collecting. A residence of several months for the express purpose of collecting specimens will be found more conducive of results. Thus the short time actually devoted this year to collecting was remarkably productive.

As is customary, this year some effort was made to add to our store of folk tales, myths and texts, but little time could be given to this task. Some corrections to manuscripts already at hand were made. Our important manuscripts on Iroquois ethnology must receive early attention with the idea of a thorough revision and publication. Students of ethnology in general eagerly await the facts that we have to give. The amount of work ahead in this direction alone represents much activity and time for the future.

Public interest. It is gratifying to note the increasing value of this section of the Museum to the public. Although the accessions are not yet on exhibition, numerous students make personal visits and the specimens are made available for study. The specially valuable locality collections afford a unique means for comparison. Distribution of types and specimens may be studied here as in no other institution. The gradual realization of these facts is constantly bringing inquiries relative to the aboriginal occupation of the State.

Numerous letters are received requesting information on various subjects, such as the history of the New York Indians, myths, games, customs, rituals, religion, language, names, music, present condition, distribution etc. etc.

Many requests have come for accurate and appropriate Indian names. The intended use of these names has ranged from names for camp fire girls clubs, estates and boats, to names for lakes, hills, springs, and other geographical features. At the request of Hon.

George Foster Peabody, State Commissioner of Saratoga Springs, appropriate Indian names were selected for certain springs at Saratoga. These names are from the Algonkian or Iroquoian languages and may be verified as correct by any student of these tongues.

The publications relating to archeology and ethnology continue to be in demand. The public call has exhausted the supply of several of these bulletins.

The degree with which this section of the Museum may be useful as a source of information is shown by the very active interest taken by educators, historians, ethnologists, sociologists and writers of fiction, in the Iroquois confederacy. Scarcely any one of these refers to the colonial history of New York without weaving in the history of the Iroquois league and its unique influence. Our archeological and ethnological sections have thus become sources of information and as this fact becomes better known, are attracting increasing attention. The completion of the Museum exhibits will naturally stimulate this interest to the highest degree.

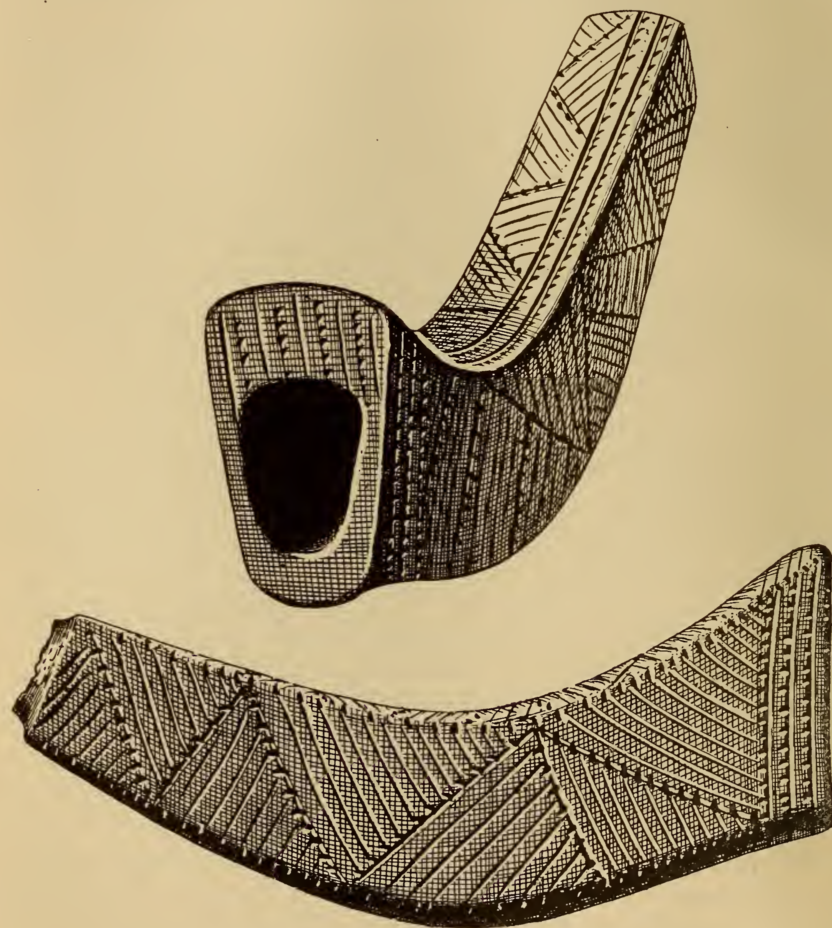
NOTES ON CERTAIN ACQUISITIONS

From Irondequoit creek has come a unique clay pipe. It was collected by Mr B. Benro and acquired through the courtesy of Frank H. Ward of Rochester. Mr Benro found it protruding in the bank of the creek about 3 feet below the surface. The form of the pipe as shown in the accompanying figure is like that of a flattened war club or stone axe handle. It is flattened on each side with a curved surface on the back side (away from the smoker). The material is a compact clay, well baked and tempered with sand containing mica. There is a fracture in the pipe just below the curve, and the nipple or mouthpiece has been broken off. The decoration is the familiar angular pattern made by filling the triangles with parallel lines, using one side of the triangle as the base parallel. Short lines more deeply incised, or long dots, are found at each end of these triangles and seem to represent the stitching of quills on birch bark. There is a stitched seam on the front (toward the smoker) of the pipe, near the left side. The back and left side of the pipe are more neatly decorated, as if done first. The top edge of the bowl is decorated on the back and two sides with three parallel lines at the edges of which are "long dots" or "stitch markings."

The bowl is about 2¾ inches deep and extends to the bend. The capacity of this bowl is greater than the usual Iroquois pipe.

The pipe is so balanced despite its bend that it will stand upon its bowl. In a collection of several hundred Iroquoian pipes in the State Museum, none approaches the Irondequoit pipe in form.

Some very fine specimens of pre-Iroquoian art have come to the Museum from the eastern shore of Canandaigua lake. The site



The Irondequoit Pipe

covers a small hillside and consists of an ancient burial plot, though the skeletons are not placed in any degree of regularity, as to location, nor are the graves numerous. The culture represented is similar to that of the mound-building Indians of New York and Ohio.

String of shell beads, elk teeth and shell disk from a site in Middlesex on Canandaigua lake

Articles from Middlesex site. Stone tubes, broken amulet, crude clay pipe, bar-amulet, stone tube

Articles from the Middlesex site. Bone pendant, antler awl, slate gorget, copper chisel and portion of ivory dagger blade

Artifacts from this culture are found in certain portions of New York State but usually associated with small mounds or stone graves. The State Museum has records of several such sites but unfortunately has never been able to excavate one. No trained observer has watched or recorded these accidental finds. It is to be hoped that in the future it may be possible to supplement the bare objects with their meager data of discovery, by excavating such sites under scientific oversight.

In one grave opened up in a gravel bank, near Middlesex, two entire stone tubes and one broken specimen were found. With these was a crude clay pipe with a short stem and small bowl, an awl lance head of antler, a bone pendant and a small copper chisel.

In another grave opened this year was a large black slate gorget of the two-hole type, a double-tailed "bird stone" and the middle portion of a dagger or blade made of mastodon tusk. No other specimen made of such material has been found in the State, as far as is known to the Museum. The gorget is one of the largest in our collections, measuring 6 inches in length, 4 inches in width at top and 3½ inches at the bottom. The sides are only slightly convex, but both top and bottom are arcs of circles. The central point of each arc is the perforation most distant from it. The center of each hole is equidistant from the edge immediately below it. The perforations are all so exactly placed on the gorget that each is the midway point in a line drawn perpendicularly.

The gorget seems to be divided in approximate fifths with each hole at a point from each end, about two-fifths of the length. The distance between the holes is $1\frac{5}{16}$ inches. These measurements are given only for the sake of description to show the exactness with which the specimen was made. The surface is covered with arborescent crystals of some carbonate, though originally there was a high polish.

The range of pipe forms and pottery as illustrated by the specimens from Jefferson county and contained in the Oatman and Loveland collections, presents a fairly good view of precolonial Iroquoian ceramic art. The pipes are of especial interest because they break away from purely utilitarian forms in outline and conventional decoration. The modeling on many represents human and animal forms, sometimes quite natural, and in other instances conventionalized.

The Iroquoian clay pot, judged by the specimens in these collections, is usually a fine piece of work, in the sense that the clay has been carefully prepared, tempered and modeled. Iroquois pottery in texture and durability is superior to Algonkian pottery. The body of the pot, in general, is that of a flattened globe with a constructed neck that flares into a wide collar, either round or, more generally, squared with upward projecting tips at each corner. This collar is generally decorated with triangular patterns made of parallel lines. Some of the older potsherds show cord or paddle markings all over the outer surface.

The parallel lines in triangular patterns seem to imitate porcupine quill decorations on birch bark and indeed the form of the pot seems to follow the stitching of a birch bark receptacle. The dots or indentations about the base of the neck indeed seem to point out the place where the upper portion of the bark collar was sewed to the lower portion. This idea was suggested in the early writings of Frank Cushing. As far as has been discovered, however, the New York Iroquois did not use birch bark receptacles. Theirs were of elm bark, a much rougher material but more durable. No circular or curved designs are found on Jefferson county Iroquois pottery, the only exception being round dots, punched on, singly or in angular patterns. Jefferson county Iroquois pipes of clay are superior to any found among contiguous stocks. They were molded with their stems and were not designed for long wooden stems. There are several types of pipes as may be seen on the accompanying plate. The simplest forms are the trumpet " pipe " and the pipe with the collar about the top of the bowl, composed of several parallel rings, like coiled cord. Other forms are the square topped pipe, the so-called Huronian, and pipes with human and animal effigies on the bowls. These effigy pipes in concept and form oddly resemble the pottery of the Mississippi valley. The caps shown on the heads of effigies are shaped like the old-fashioned beehive. Even designs of face painting are shown and the bear or wolf skin robe is shown over the Indian's head.

Trumpet bowls are found on the early Erie, Onondaga and Mohawk sites, and ringed collar is found on Seneca, Neuter and Huron sites.

Strangely, Iroquois stone pipes are not similar to their clay pipes. As far as decoration and modeling are concerned, they might have been made by another stock. There may be a few exceptions, but in general, the rule applies. An example is the long-tailed animal effigy pipe bowl, studied with much care by Lieutenant G. E. Laidlaw, and reported in the publications of the Ontario Provincial Museum. Many of these stone pipes appear to have been carefully kept; possibly they expressed the art of the earlier Iroquois and were kept as ceremonials or as heirlooms.

Clay pipes from Jefferson county. Loveland Collection

VII
PUBLICATIONS

A list of the scientific publications issued during the year 1912–13, with those now in press and treatises ready for printing, is attached hereto. The publications issued cover the whole range of our scientific activities. They embrace 1391 pages of text and 184 plates.

ANNUAL REPORT

1 Ninth Report of the Director, State Geologist and Paleontologist for the fiscal year ending September 30, 1912. 214p. 50pl.

Contents

Introduction
I The State Museum law
The statutory conception of a "State Museum"
The State Museum idea and its place in the polity of the State
II The educational function of the State Museum of Science
III Condition of the scientific collections
IV Report on the geological survey
Areal geology
Surficial geology
Industrial geology
Seismologic station
Paleontology
V Report of the State Botanist
VI Report of the State Entomologist
VII Report of the Zoologist
Monograph of the New York Mollusca
VIII Report of the Archeologist
Archeological survey
The O. W. Auringer collection
Archeological collections
Folklore
Public interest
IX Publications
X Staff of the Science Division and State Museum
XI Accessions
The Mount Morris Meteorite. H. P. Whitlock
Early Paleozoic Physiography of the Southern Adirondacks. W. J. Miller
The Garnet Deposits of Warren County, New York. W. J. Miller
The Use of the Stereogram in Paleobiology. G. H. Hudson
The Origin of the Gulf of St Lawrence. J. M. Clarke
A Notable Trilobite from the Percé Rock. J. M. Clarke
Illustrations of the Devonic Fossils of Southern Brazil and the Falkland Islands. J. M. Clarke
Index

MEMOIRS

Paleontology

2 The Eurypterida of New York. By John M. Clarke and Rudolf Ruedemann. 1912. 2 vols. 628p. 88pl.

Contents

Preface
Introduction
History of investigations
Eurypterida I Morphology, anatomy, and terminology
II Mode of life
III Geological distribution and bionomic relations
A Conspectus of American species arranged according to their geological occurrence
B Biologic facies of the eurypterid faunas
Eurypterida III C Geological distribution in other countries
D Bionomy of the eurypterid faunas
IV Ontogeny
V Phylogeny
VI Taxonomic relations
VII Synoptic table of North American Eurypterida
VIII Systematic account of the Eurypterida
Eurypteridae
Pterygotidae
Appendix
Bibliography

BULLETINS

Geology and Paleontology

3 No. 162 The Lower Siluric Shales of the Mohawk Valley. By Rudolf Ruedemann. 1912. 151p. 15pl.

Contents

Introduction
Historical sketch
"Utica" shale of authors
Frankfort shale
Schenectady formation
Indian Ladder beds
Summary
Bibliography
Paleontological notes
Explanation of plates
Index

4 No. 166 The Mining and Quarry Industry of New York State. By D. H. Newland. 1913. 114p.

Contents

Introduction
Mineral production of New York
Cement
Clay
Production of clay materials
Manufacture of building brick
Other clay materials

Pottery
Crude clay
Emery
Feldspar
Garnet
Graphite
Gypsum
Iron ore
Mineral waters
Natural gas
Petroleum
Pyrite
Salt
Sand and gravel
Sand-lime brick
Stone
Production of stone
Granite
Limestone
Marble
Sandstone
Trap
Talc
Zinc
Index

Archeology

5 No. 163 The Code of Handsome Lake, the Seneca Prophet. By Arthur C. Parker. 1913. 144p. 23pl.

Contents

Introduction
Handsome Lake
Effects of Handsome Lake's teaching
How the white race came to America
The Gaiwiio code
Sections 1 to 130: The Great Message
Part 2. Field notes on rites and ceremonies
White dog sacrifice
Ganeowo
Cornplanting and maple thanksgiving
Legend of the coming of Death
The funeral address
The death feast
Medicine societies
Dark dance or pygmy ceremony
Society of otters
Society of mystic animals
The eagle society
The bear society
The Buffalo society
Chanters for the dead
Woman's society
Sisters of the Dio' hë'ko
False face company
Husk faces
Iroquois sun myths
Anecdotes of Cornplanter
Key to pronunciation
Index

Entomology

6 No. 165 Report of the State Entomologist for the fiscal year ending September 30, 1912. 1913. 264p. 14pl.

Contents

Introduction
Injurious insects
Codling moth
Hessian fly
Fall army worm
Elm leaf beetle
White grubs and June beetles
Hickory bark borer
Pear thrips
Queen blow fly
Georgian flesh fly
Use of oil on dormant trees
Notes for the year
Fruit tree insects
Forest insects
Miscellaneous
Publications of the entomologist
Additions to collections
Appendix: a study of gall midges
Explanation of plates
Index

Botany

7 No. 167 Report of the State Botanist for the fiscal year ending September 30, 1912. 1913. 76p. 4pl.

Contents

Introduction
Plants added to the herbarium
Contributors and their contributions
Species not before reported
Remarks and observations
New species of extralimital fungi
Edible fungi
Poisonous fungi
Crataegus in New York
Explanation of plates
Index

In press

MEMOIRS

8 Birds of New York, volume 2

BULLETINS

Geology and Paleontology

9 The Geological History of New York State
10 Geology of Saratoga Springs and Vicinity
11 Geology of the North Creek Quadrangle
12 Geology of the Attica-Depew Quadrangles
13 Geology of the Syracuse Quadrangle

Entomology

14 Report of the State Entomologist for the fiscal year ending September 30, 1913

VIII

REPORT ON THE COLLECTION OF COINS, MEDALS AND PAPER MONEY

These collections, by action of the Regents, were transferred to the custody of the State Museum after the Capitol fire, and the following is a report on their present condition.

Catalog of 1856. The only existing record of this collection was issued by the State Library for the year 1856 (dated 1857). In this catalog the numerical contents of the collection are stated as follows: coins (all metals), 1697; medals, 234; paper money, 320.

Fire losses from the collection of 1856. A checking of the record of 1856 by an expert numismatist shows that of the materials above listed the following are the losses: coins, 897; medals, 197; paper money, all. The losses therefore were, for the coins over 50 per cent; medals, about 80 per cent; paper money, 100 per cent.

Coins not in the catalog of 1856. In the salvage from the fire there are, not recorded in the catalog of 1856, 2376 coins and 57 medals. The total number of coins and medals in the salvage is 3270.

General condition of the coin collection. The condition of this collection is bad. With the exception of a very few articles in gold which have been on deposit in the National Commercial Bank, Albany, since 1881, nearly every specimen has suffered, and the majority of them irreparably. This has been due in the first instance to oxidation and discoloration in fire, aggravated by improper treatment of much of the material when first rescued.

Value of this collection. On an expert estimate of the face value of all the coins and the market value of all United States coins, it appears that the face value of the entire collection is approximately $725; that the market value of the *American coins* of all metals is $499.

General character of the collection. This collection is composed of a small number of gold coins and medals of considerable worth, most of them of American coinage, but some of other countries; a large number of silver coins in rather bad condition, and a very great majority of copper coins from all countries of the world and of very little worth. The value of the collection (such as it is) lies in its *United States coins and medals,* very few of which are of superior quality or great rarity. These total about 1500.

Alternative suggestions in regard to the coin collection. These suggestions are of necessity based on the recognized demoralized condition of the collection and are submitted without recommendation. Attention, however, is invited to the fact that this collection has evidently been largely made without any or only very occasional expenditures of State moneys. They have come by gift and it is very probable that like gifts will continue, especially of commemorative medals struck in this and other countries. It would seem that the University should be at least receptive of such gifts whether or not expenditures for the collection be approved.

1 Any action whatever regarding the collection may be suspended and the collection kept as it is at the present time, subject to additions by gift.

2 The collection might be sold as a whole, with the specific permission of the Legislature, the returns therefor to revert to the State treasury.

3 The collection might be deposited on temporary or permanent loan with any society that the Regents might choose to designate, subject to the permanent supervision of the collection by the Board of Regents.

4 *Gift.* It appears very doubtful, in the opinion of the law officer of the Department, whether even the Legislature could empower the Board to dispose of the collection by gift.

5 *Possibility for the development of the collection.* It may be worth while to consider whether it would not be a proper policy to maintain and build up a representative collection of American coinages. The nucleus therefor now in the custody of the Board is considerable in number although it lacks in quality that which would be required by the connoisseur. Still these examples of American coinages are of such a kind as to indicate satisfactorily their varieties, so far as these extend. Very slight occasional expenditures could be made to acquire additional material and the balance of the collection, not American, could be utilized by way of exchange for the purpose of acquiring solely American coins. Should this suggestion seem a reasonable one, it is well to supplement it by recognition of the evident fact that there is a large degree of public interest in American coinages and that it might be the people of the State may desire to have here in the Regents' custody a representative array of such coins which could be made accessible to students for purposes of comparison and study. The possibility of converting all the other parts of the entire collection into substantial support for the enlargement of the American collection would seem to give this suggestion reasonable encouragement.

IX

STAFF OF THE DEPARTMENT OF SCIENCE

The members of the staff, permanent and temporary, of the Department of Science as at present constituted are:

ADMINISTRATION

John M. Clarke, Director
Jacob Van Deloo, Director's Clerk
Paul E. Reynolds, Stenographer

GEOLOGY AND PALEONTOLOGY

John M. Clarke, State Geologist and Paleontologist
David H. Newland, Assistant State Geologist, *Curator of Geology*
Rudolf Ruedemann, Assistant State Paleontologist, *Curator of Paleontology.*
C. A. Hartnagel, Assistant in Geology, *Curator of Stratigraphy*
Robert W. Jones, Assistant in Economic Geology, *Assistant Curator of Industrial Geology*
D. Dana Luther, Field Geologist
Herbert P. Whitlock, Mineralogist, *Curator of Mineralogy*
George S. Barkentin, Draftsman
H. C. Wardell, Preparator, *Assistant Curator of Paleontology*
John J. Bryan, Stenographer
Charles P. Heidenrich, Mechanical Assistant
Joseph Bylancik, Page

Temporary experts

Areal geology

Prof. H. P. Cushing, Adelbert College
Prof. C. H. Smyth, jr, Princeton University
Prof. James F. Kemp, Columbia University
Prof. W. J. Miller, Hamilton College
Dr C. P. Berkey, Columbia University
G. H. Hudson, Plattsburg State Normal School
Dr W. O. Crosby, Massachusetts Institute of Technology
Prof. George H. Chadwick, St Lawrence University
James C. Martin, Princeton University

Geographic geology

Prof. Herman L. Fairchild, University of Rochester
Prof. James H. Stoller, Union College

Paleontology

Edwin Kirk, Washington, D. C.

BOTANY

Charles H. Peck, State Botanist
Homer D. House, Assistant, *Curator of Botany*

ENTOMOLOGY

Ephraim P. Felt, State Entomologist
D. B. Young, Assistant State Entomologist, *Curator of Entomology*
Fanny T. Hartman, Assistant, *Assistant Curator of Entomology*
Anna M. Tolhurst, Stenographer
Charles W. Swim, Clerk

ZOOLOGY

Willard G. Van Name, Zoologist, *Curator of Zoology*
Arthur Paladin, Taxidermist

Temporary experts

Prof. E. Howard Eaton, Canandaigua
Dr H. A. Pilsbry, Philadelphia
Charles E. Mirguet, Rochester
B. M. Hartley, West Haven, Conn.

ARCHEOLOGY

Arthur C. Parker, Archeologist, *Curator of Archeology and Ethnology*
Noah T. Clarke, Technical Assistant, *Assistant Curator of Archeology and Ethnology*

Temporary assistant

Howard A. Lansing, Albany

X

ACCESSIONS

ECONOMIC GEOLOGY

Collection

Newland, D. H. Albany

Building stones from southeastern New York	5
Feldspar crystallized and massive, Bedford	3
Large beryl crystal, Bedford	1
Ground feldspar, Bedford	1
Molding sands from Albany and Rensselaer counties	15
Red slate, with quartz veinlets, Washington county	1
Iron ores and wall rocks, Adirondacks	20
Anorthosite, building stone, Keeseville	5

Jones, R. W. Albany

Clay, sand and brick, Mechanicville	5
Fire clay, Shenandoah	2
Talc, Shenandoah	2
Paving and building bricks, clays etc., Corning	13
Molding sands, Albany and Greene counties	2
Evaporated salt, Ithaca	3
Cement and cement materials, Portland Point	6
Sand-lime brick and raw materials, Glens Falls	3
Building brick and crude clays, Glens Falls	8
Building bricks, raw materials, etc., Troy	15
Clays, sands and brick, Kreischerville	21
Clays, sands and brick, Long Island	20
Building brick, drain tile, etc., Albany	19
Feldspar, quartz and beryl, Bedford	9
Emery and garnet, Peekskill	5
Natural cement and cement rock, Kingston	7
Paving and building brick, Catskill	4

Donation

Onondaga Coarse Salt Association. Syracuse

Exhibit of solar salt	7

International Acheson Graphite Co. Niagara Falls

Artificial graphite	11

The Carborundum Co. Niagara Falls

Exhibit of carborundum, aloxite, emery etc	25

Alpha Portland Cement Co. Cementon, Pa.
Exhibit of cement and cement materials 9
Clinton Metallic Paint Co. Clinton
Metallic Paint 2
Furnaceville Iron Co. Ontario Center
Samples of Clinton ores 2
Alpha Portland Cement Co. Martin's Creek, Pa.
Portland cement and raw materials 7
Glens Falls Portland Cement Co. Glens Falls
Exhibit of cement and cement materials 9
William Connors Paint Mfg. Co. Troy
Crude and finished mineral paints 6
Pepson, Charles. Albany
Old sewer tile from Phoenix Place, Albany 2
St Lawrence Talc Co. Natural Bridge
Crude and ground talc 3
Pass, James, Onondaga Pottery Co. Syracuse
Exhibit illustrative of pottery manufacture 31
Emerson-Norris Co. New York
Artificial stone from Tuckahoe marble 6
Norton Company. Worcester, Mass.
Exhibit of alundum, crystolon etc., from plants at Niagara Falls 36
United States Gypsum Co. Chicago, Ill.
Exhibit of gypsum and gypsum products from Oakfield . . . 14
German Kali Works, Inc. New York
Specimens of German potash salts, including hartsalz, sylvinite, kainite and carnallite 20
Cheever Iron Ore Co. Port Henry
Iron ore, concentrates and tailings 3
Benson Mines Co. Benson Mines
Iron ore, concentrates and tailings 3
Hinckley Fibre Co. Hinckley
Pyrite from Cole mine, St Lawrence county 1
Atlantic Terra Cotta Co. New York
Architectural terra cotta, Staten Island plant 12
New York State Sewer Pipe Co. Rochester
Floor tiles, conduit and sewer pipe 9
St Lawrence Pyrite Co. De Kalb
Pyrite, crude ore and concentrates 6
Blake, P. X. Potsdam
Polished granite slab from Parishville 1

North River Garnet Co. North River
Garnet rock and garnet concentrates.................... 4
Keystone Emery Mills. Frankford, Pa.
Crude and prepared emery from Peekskill............ 4
Witherbee, Sherman & Co. Mineville
Exhibit of ores, concentrates and tailings.............. 10
Retsof Salt Co. Scranton, Pa.
Rock salt, crude and prepared......................... 5
International Salt Co. Scranton, Pa.
Exhibit of brine salt.................................. 4
Asbestos & Asbestic Co. Ltd. Asbestos, P. Q.
Large blocks of serpentine veined with asbestos.......... 2

GENERAL GEOLOGY

Collection

Clarke, John M. Albany
Calcite vein, faulted, Percé, P. Q...................... 1
Jones, R. W. Albany
Weathered limestone and pegmatite, Shenandoah, N. Y. 3
Newland, D. H. Albany
Banded gneiss, Dublin, Westchester county............ 2
Folded and faulted Yonkers gneiss, Kensico............ 2
Graphic granite, Bedford............................. 2

Donation

Kelley Island Lime & Transportation Co. Cleveland, O.
Large limestone slab, glaciated......................... 1
Vermont Marble Co. Proctor, Vt.
Polished slab of faulted marble from True Blue quarry.. 1

MINERALOGY

Donation

Wait, Charles. Crown Point
Wernerite in calcite (large), Crown Point.............. 1
Manchester, James G. New York City
Pectolite, apophyllite and stilbite (large), West Paterson, N. J. 1
Clarke, John M. Albany
Halite, Alfeld, Prussia................................ 1
Amphibole (Jade), locality?............................ 1

Ruedemann, R. Albany

Gypsum, Brunswick, Germany 11
Celestite, Jena, Germany 2

Purchase

Law, E. S. Schenectady

Quartz on limestone, Sprakers 1
Quartz crystals, Sprakers 14

Foote Mineral Co. Philadelphia, Pa.

Stibnite, Iyo, Japan 1
Stibnite, Felsobanya, Hungary 1
Stibnite, Wuchow, China 1
Galena, Colquechaca, Bolivia 1
Galena, Benthen, Prussia 1
Galena, coated with marcasite, Prussia 1
Chalcopyrite on dolomite, Granby, Mo 1
Chalcopyrite on dolomite, Siegen, Prussia 1
Chalcopyrite and pyrite, Bingham, Utah 1
Chalcopyrite, Ugo, Japan 1
Pyrite, Saratoga mine, Col 1
Pyrite, Franklin, N. J 1
Pyrite, York county, Pa 1
Marcasite, Joplin, Mo 1
Marcasite altered to limonite, Richland county, Wis 1
Tetrahedrite, Kapnic, Hungary 1
Tetrahedrite, Felsobanya, Hungary 1
Tetrahedrite, Ouray county, Col 1
Rutile in quartz (polished), Japan 1
Corundum (sapphire), Butte, Mont .... 1 lot
Pickeringite, Tucumcari, N. M 1
Iron (Josephenite) water-worn pebbles, Oregon .... 1 lot
Sphalerite, translucent cleavage, Chivera, Mexico 1
Boulangerite, Oberlahr, Prussia 1
Anorthoclase (crystals), Sardinia .... 1 lot

Krantz, Dr F. Bonn, Germany

Calcite, St Goar, Prussia 1
Calcite, Andreasberg, Germany 1
Calcite with dolomite and quartz, Baden, Germany 1
Calcite, Pribram, Bohemia 1
Calcite (twinned crystals), Durham, England 1
Calcite (twinned crystals), Egremont, England 2

Calcite (large group), Egremont, England............. 1
Calcite (unique crystals), Egremont, England.......... 1
Calcite (large crystals colored red), Egremont, England.. 1
Calcite (pyramidal crystals), Wisby, Sweden........... 1
Calcite (large group), Poretta, Italy.................... 1
Calcite on quartz, Guanajuato, Mexico................. 1
Calcite (lilac colored), Guanajuato, Mexico............ 1

PALEONTOLOGY

Donation

Allardyce, Mrs Constance. Port Stanley, Falkland islands
Devonic fossils from Pebble island, Falkland islands.... 25

Grant, Colonel C. C. Hamilton, Ontario
Siluric fossils, Hamilton................................ 8

Hobart College, The trustees of
(On indefinite loan) Castoroides ohioensis. The original skull described by Hall & Wyman and obtained in the pleistocene marshes near Clyde..................... 1

Kelly, F. Helderberg Cement Co.
Trilobites from Howes Cave quarry.................. 1

Moore, Prof. E. S. State College, Pa.
Graptolites from Spring Creek formation (Beekmantown) of Pennsylvania 6

Post, W. J. Harriman
Mastodon tusk found about 2 miles south of Harriman station (Erie R. R.), Orange co...................... 1

Purchase

American Museum of Natural History. New York
Restoration of the skeleton of the Permic reptile Eryops. 1
Devonic fishes from Migouasha, P. Q................. 20

Gebhard, W. D. Schoharie
Collection of fossils from the Schoharie valley (Inventory to be given in next report)

Fink, Alvin J. Dayton, Ohio
Collection of trilobites................................ 200

Kinnear, W. T. Kirkbuddo, Forfar, Scotland
Upper Siluric and Lower Devonic fishes from Scotland... 11

Krantz, Dr F. Bonn, Germany
European trilobites from various localities.............. 25

Ward's Natural Science Establishment. Rochester
Proetus rowi from the Hamilton shales............ 1

Collection

Hartnagel, C. A.
Fossils from the Ordovicic-Siluric series of Arisaig, Nova Scotia 300

Exchange

Carnegie Museum (Dr C. R. Eastman)
Restorations of Devonic fishes........................ 6

ENTOMOLOGY

Donation

Hymenoptera

Crawford, G. W. Ballston Spa. Lophyrus abbotii Leach, Abbott's pine sawfly, larvae on pine, October 1

Lossoe, F. R. Troy. Janus integer Norton, current stem borer on currant, February 21

Smith, F. A. Ticonderoga. Kaliofenusa ulmi Sund., European elm leaf miner, larvae on elm, June 4

Chase, F. Loon Lake. Hylotoma pectoralis Leach, birch sawfly, larvae on birch, July

State Department of Agriculture. Trichiosoma tibialis Steph., European hawthorn sawfly from England, cocoon on rose, November 27. Same as preceding, cocoon on barberry from Flushing, February 27

Bethel, E. Denver, Col. Aylax pisum Walsh, gall on Lygodesmia juncea, September 30

Gardner, Mrs E. P. Canandaigua. Through S. H. Burnham. Rhodites gracilis Ashm., regal rose gall, galls on Rosa blanda, September 29. Same as preceding, October 5. Also R. globulus Beutm., globular rose gall, gall on rose, October 5

Bethel, E. Manitou, Col. Myrmecocystus melliger Llave, honey ant, adult, November 30

Coleoptera

de Vyver, J. James. Bronxville. Eccoptogaster quadrispinosa Say, hickory bark borer, larvae on hickory. January 28

Matthiessen, C. H. Irvington. Corthylus punctatissimus Zimm., pitted Ambrosia beetle, adult on Rhododendron, September 13

Goodyear, Charles. Tarrytown. Same as preceding, work, October 1

Hilligas, William. Rensselaer. Cryptorhynchus lapathi Linn., mottled willow borer, grubs and work on poplar, June 18

Gillett, J. R. Kingston. Lixus concavus Say, rhubarb curculio, adult, March 31

Anderson, E. H. Mount Kisco. Pissodes strobi Peck, white pine weevil, work on pine, January 20

Pease, E. R. Poughkeepsie. Same as preceding, larvae and work on pine, July 14

Iceland, Mrs A. C. Middletown. Galerucella luteola Müll., elm leaf beetle, adults in house, May 28

Tilly, G. W. Mechanicville. Nodonota tristis Oliv., strawberry root worm, adult on strawberry, June 23

McDonough, W. F. Albany. Typophorus canellus Fabr., strawberry root worm, May 8

Sullivan, J. J. Valley Mills. Chrysochus auratus Fabr., gold gilt beetle, adults, November 6

Von Schrenk, Hermann. St Louis, Mo. Neoclytus erythrocephalus Fabr., adult and work on ash, September 3

Van Deusen, Mrs C. A. Hudson. Chion cinctus Dru., banded hickory borer, adult, March 16

State Department of Agriculture. Euphoria inda Linn., bumble flower beetle, adult on apple, September 4

Robertson, W. D. Rosyln. Allorhina nitida Linn., green June beetle, adult, July 3

Farrar, E. R. South Lincoln, Mass. Anomala lucicola Fabr., light-loving grapevine beetle, adult, July 7

Miller, W. S. East Greenbush. Lachnosterna fusca Froh., white grubs infested by the peculiar fungus, Cordyceps ravenelii Berk., February 14

Saugerties Manufacturing Company. Saugerties. Sitodrepa panicea Linn., drug store beetle, larvae, adults and work in account book, June 12

Coffin, C. A. Locust Valley. Agrilus ? bilineatus Web., two-lined chestnut borer, work on oak, October 30

Merkel, H. W. Scarsdale. Melanophila fulvoguttata Harr., spotted hemlock borer, larvae on hemlock, December 2

Downer, J. New York City. Same as preceding, January 30

Torbert, C. L. Syracuse. Same as preceding, bark of hemlock, May 16

McMillan, Charles. Cambridge. Dicerca divaricata Say, divaricated Buprestid, adult, June 20. Also Alaus oculatus Linn., owl beetle, adult, June 20

Titus, E. V. Glen Cove. Same as preceding, July 28

State Conservation Commission. Lake Clear. Anatis 15-punctata Oliv., 15-spotted lady beetle, adult on balsam, June 9

Lacky, Andrew. Johnsburg. Dytiscus harrisii Kirby, water beetle, adult, September 17

Diptera

Gillett, J. R. Kingston. Frontina frenchii Will., adults, March 31

Smith, W. F. White Plains. Bibio albipennis Say, white-winged Bibio, larvae on stable manure, March 28

Albright, Thomas. New Baltimore. Contarinia pyrivora Riley, pear midge, larvae on pear, May 7

Theobald, F. V. Wye, Kent, England. Same as preceding, adult, September

McAtee, W. L. Carlisle, Miss. Thecodiplosis ananassi Riley, galls and larvae on cypress, October 29

Garman, H. Louisville, Ky. Clinodiplosis florida Felt, gall on oak, May 27

Goodyear, Charles. Tarrytown. Same as preceding, June 13

Frost & Bartlett Co. Roslyn. Monarthropalpus buxi Lab., box leaf miner, larvae on box, August 21

Latham, Roy. Orient Point. Hormomyia crataegifolia Felt, coxcomb thorn gall, gall on Crataegus, August 12

Gardner, Mrs E. P. Canandaigua. Cincticornia pilulae Walsh, oak pill gall, gall on oak, October 5

McAtee, W. L. Riverdale, Md. Same as preceding, October 24

Shelter, Henry. Springwater. Schizomyia coryloides Walsh and Riley, clustered grape gall, gall on grape, August 8

Cosens, A. Toronto, Ont., Can. Lasioptera corni Felt, ocellate dogwood gall, gall on Cornus, September 21

Jackson & Perkins Company. Newark. Dasyneura rhodophaga Coq., rose gall midge, larvae on rose, July 16

Rorty, Mrs P. A. Goshen. Dasyneura communis Felt, galls on red maple, October 9

Garman, H. Lexington, Ky. Same as preceding, May 27

Bethel, E. Denver, Col. Rhabdophaga strobiloides Walsh, pine cone gall, gall on willow, September 30

Merkel, H. W. Scarsdale. Camptomyia tsugae Felt, larvae on hemlock, December 2

Siphonaptera

Sherwood, Miss Marcia J. Barker. Ceratophyllus gallinae Schrk., hen flea, adults in hens' nests, May 29

Heilman, J. R. Poughkeepsie. Ctenocephalus canis Curtis, house flea, adult, August 26

Lepidoptera

Goodyear, Charles. Tarrytown. Laertias philenor Linn., pipevine swallowtail, larva on Dutchman's pipe, June 24

Carl, Miss Nina. Breesport. Automeris io Fabr., Io caterpillar, larvae on sweet clover, August 27

Cushman, R. L. Yonkers. Same as preceding, larva on corn, September 4

Reed, C. M. Sinclairville. Halisidota caryae Harr., hickory tussock moth, larvae on hickory, September 27

State Department of Agriculture. Rochester. Peridroma margaritosa Haw., var. saucia Hubn., variegated cutworm, larvae on apple and grass, July 15

Bartlet, Miss Isabella M. New Hamburg. Xylina antennata Walk., green maple worm, larva on linden, May 19

Clark, C. A. Castleton. Same as preceding, larvae on apple, June 9

Von Schrenk, Hermann. St Louis, Mo. Papaipema ? merriccata Bird, stalk borer, larvae on May apple, May 13

Reed, C. M. Sinclairville. Datana integerrima Grote & Rob., black walnut caterpillar, larva on hickory, September 27

Heilman, J. R. Poughkeepsie. Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae, July 8

Carl, Miss Nina. Breesport. Hemerocampa leucostigma Sm. & Abb., white-marked tussock moth, larvae on wisteria, August 27

Levison, J. J. Brooklyn. Malacosoma disstria Hübn., forest tent caterpillar, eggs, December 17

Appleton, F. R., jr. Jericho. Through State Forester. Same as preceding, larvae on oak, May 26

Hechler, Charles. Roslyn. Same as preceding, May 30

Terry, S. S. Elizabethtown. Same as preceding, cocoons, June 21

Wynkoop, Irving. Granville. Same as preceding, larvae and cocoons on maple, June 23

Seely, J. A. Ogdensburg. Same as preceding, eggs on apple, September 5

Dunwald, Peter. Rio. Cladora atroliturata Walk., imago, April 11

Interstate Tree Treating Company. Mount Vernon. Anisopteryx pometaria Harr., fall canker worm, males, females and eggs, December 3

Dunwald, Peter. Rio. Phigalia titea Cram., imago on forest trees, April 11

Bartlet, Miss Isabella M. New Hamburg. Erannis tiliaria Harr., ten-lined inch worm on linden, May 19

Niles, H. W. Rye. Through State Department of Agriculture. Lagoa crispata Pack., flannel moth, caterpillar on apple, September 18

Cooper, Mrs E. H. Saratoga Springs. Acoloithus ? falsarius Clem., cocoons on Virginia creeper, September 5

Harris, A. G. Pelham. Zeuzera pyrina Linn., leopard moth, larva, May 31

Goodyear, Charles. Tarrytown. Same as preceding, larvae, September 4

Merkel, H. W. New York City. Sesia rhododendri Beutm., Rhododendron clearwing, work and larvae on rhododendron, September 29

Schoonmaker, C. B. Stone Ridge. ? Crambus caliginosellus Clem., larvae on corn, June 19

State Department of Agriculture. Westchester County. Pinipestis zimmermanni Grote, pine tip moth, work on Austrian pine, July 1

Eberle, F. W. Albany. Tinea granella Linn., European wolf moth, larvae on sweet corn, November 13

Ward, G. E. Ravena. Tmetocera ocellana Schiff., bud moth, larva on apple, April 16

Haney, Theodore. Ravena. Same as preceding, larva on apple, April 17

Jansen, C. B. Kingston. Same as preceding, larva on plum, April 26

Hunt, Fred. Kingston. Same as preceding, larva on pear, April 28

Vincent, H. B. Old Chatham. Same as preceding, April 30

St John, Clyde. Canajoharie. Same as preceding, May 15

Collamer orchard. Hilton. Through State Department of Agriculture. Archips argyrospila Walk., fruit tree leaf roller on apple, July 7

Lintner, George. Squirrel Island, Me. Tortrix fumiferana Clem., spruce bud moth, larva, adult and work on spruce, July 6

Gardiner, Mrs J. T. Northeast Harbor, Me. Same as preceding adults on spruce, July 15

Levison, J. J. Brooklyn. Eulia politana Haw., pine tube builder, work, November 12

Goodyear, Charles. Tarrytown. Coleophora limosipennella Dup., elm case bearer, work on elm, June 24

Albright, M. C. West Coxsackie. Coptodisca splendoriferella Clem., resplendent shield bearer, larvae and cases on apple, January 22

Hicks, Isaac & Son. Westbury. Argyresthia thuiella Pack., Arbor vitae leaf miner, pupae on Arbor vitae, June and October 4

Torbert, E. L. Syracuse. Phyllonoryter hamadryadella Clem., white-blotch oak leaf miner, larval mines on oak, May 28

de Vyver, J. James. Mount Vernon. Same as preceding, work on oak, October 22

Corrodentia

Gardner, J. H. Fort Covington. Caecilius pedicularius Linn., nymph and adult, October 14

Hemiptera

Miller, Mrs M. S. Boonville. Philaenus lineatus Linn., lined spittle insect on grass, June 23

Pierce, D. C. Hamburg. Through State Conservation Commission. Phylloxera caryaecaulis Fitch, hickory gall aphid, galls on hickory, June 20

Paine, H. S. Glens Falls. Same as preceding, July 10

Coffin, J. W. L. Katonah. Through State Conservation Commission. Chermes pinicorticis Fitch, pine bark aphid, adult on white pine, December 6

State Department of Agriculture. Brentwood. Same as preceding, adult on pine, May 5

Neilson, Miss N. Nyack. Same as preceding, June 18

Crosby, M. S. Rhinebeck. Through State Conservation Commission. Chermes abietis Linn., spruce gall aphid, galls on spruce, January 20

Harris, S. G. Tarrytown. Same as preceding, gall on Norway spruce, June 16

Laney, C. C. Rochester. Same as preceding, June 17

Gott, P. V. D. Goshen. Same as preceding, July 10

Miller, Mrs M. S. Boonville. Chermes strobilobius Kalt., woolly larch aphid, adults and eggs on larch, June 23

Nill, John. Star Lake. Chermes floccus Patch, galls on spruce, August 23

Frost & Bartlett Company. Stamford, Conn. Tetraneura ulmisacculi Patch, English elm pouch gall, galls on Ulmus campestris, June 5

Goodyear, Charles. Tarrytown. Pemphigus ulmifusus Walsh, slippery elm gall, gall on elm, June 24

Frost & Bartlett Company. Stamford, Conn. Same as preceding, August 23

Cox, Townsend, jr. Setauket. Pemphigus tessellata Fitch, alder blight, adults on soft maple, July 5

Harrer, Richard. New York City. Schizoneura lanigera Hausm., woolly apple aphis, aphis on apple, November 5

Patten, G. M. Poughkeepsie. Same as preceding, adults on apple, June 28

Seely, J. A. Ogdensburg. Same as preceding, young on apple, September 5

Rose, J. F. South Byron. Longistigma caryae Harr., hickory aphis, adults, June 4

Latham, Roy. Orient Point. Aphis maidis Fitch, corn leaf aphis on corn, November 2

Conkling, C. S. Gouverneur. ? Nectarophora solanifolii Ashm., potato plant louse on potato, September 27

State Conservation Commission. Lake Clear. Mindarus abietinus Koch., balsam aphid, work on balsam, June 9

Terry, S. S. Elizabethtown. Same as preceding, adults and work on balsam, June 21

Nill, John. Star Lake. Through State Conservation Commission. Same as preceding, June 14

Woolworth, C. C. Castleton. Gossyparia spuria Mod., elm bark louse, females on elm, June 13

Neilson, Miss N. Nyack. Same as preceding, adults on elm, June 18

Voorhis, A. M. Nyack. Phenacoccus acericola King, false maple scale on hard maple, October 18

Harrer, Richard. New York City. Same as preceding, November 5

Naramore, N. J. Ossining. Same as preceding, adults on bark, February 17

Patten, G. M. Poughkeepsie. Same as preceding, adults on maple, June 28

de Vyver, J. James. Bronxville. Same as preceding, females and young on sugar maple, September 26

Goodyear, Charles. Tarrytown. Pulvinaria acericola Walsh, adults on Cornus, June 13 and 24

Towson, C. R. New York City. Through State Conservation Commission. Pulvinaria vitis Linn., cottony maple scale, adults and eggs on soft maple, June 14

George, E. L. New York City. Same as preceding, June 18

Macey, Carleton. Hewlett. Same as preceding, July 14

Devers, M. J. Hoosick Falls. Same as preceding, adults on sugar maple, July 15

Livingston, J. H. Tivoli. Toumeyella liriodendri Gml., tulip tree scale, adults and young on tulip, February 1 and 5

Powell, Mrs T. W. Flushing. Same as preceding, August 15

Goodyear, Charles. Tarrytown. Same as preceding, adults and young on tulip, September 4

Latham, Roy. Orient Point. Eulecanium lintneri Ckll. & Benn., sassafras soft scale, adults and young on sassafras, July 21

Stene, A. E. Kingston, R. I. Eulecanium rugosum Sign., quince soft scale, adults on quince, June 3

Porter, E. H. New York City. Coccus hesperidum Linn., soft scale, adults on fern, May 29

Huested, P. L. Blauvelt. Physokermes piceae Schr., spruce bud scale on spruce, January 29

Dummett, Arthur. Mount Vernon. Same as preceding, eggs on Norway spruce, June 12

Hammond, Benjamin. Hudson Heights, N. J. Chionaspis euonymi Comst., Euonymus scale, adults on privet, probably Ligustrum bota, November 21

Haney, Theodore. Ravena. Chionaspis furfura Fitch, scurfy scale, eggs, April 17

Levison, J. J. Brooklyn. Chionaspis pinifoliae Fitch, the pine leaf scale, adult on Austrian and white pine, November 12

Terry, S. S. New York City. Same as preceding, adults on pine, July 12

Seaver, F. J. Diaspis echinocacti Bouché, Cactus scale, adults and young on cactus, from Porto Rico, September 30.

Barron, Leonard. Garden City. Diaspis carueli Targ., Juniper scale, adults on Arbor vitae, June 23

Cockerell, T. D. A. Los Banos, P. I. Drosicha lichenoides Ckll., fig scale on Ficus nata. Coll. C. F. Baker, 1912, cotypes, October 22

Niles, T. F. Through State Department of Agriculture. Aonidia lauri Bouché, Bay tree scale on Bay tree, October

State Department of Agriculture. Albany. Aspidiotus perniciosus Comst., San José scale, adults and young on rose, January 15

Albright, M. C. Coeymans. Same as preceding, young on elm, March 3

Bullard, T. E. Schuylerville. Same as preceding, adults and young on pear, July 8

Doyle, H. M. Oswego. Aspidiotus ostreaeformis Curt., European oyster scale, adult on apple, May 15

Stubing, F. J. Mount Vernon. Aspidiotus osborni Newell & Cockerell, oak scale, adults on white oak, October

Gordinier, H. W. Troy. Lepidosaphes ulmi Linn., oyster shell scale on poplar and maple, December 9

Strickland, L. F. Lockport. Neurocolpus nubilis Say, adult on sumac, July 12. Also Paracalocoris scrupeus Say, nymphs on grape, June 13 and July 12

Griffith, L. C. Lynbrook. Lygus pratensis Linn., tarnished plant bug, adults on crysanthemum, September 4

Plecoptera

Atwood, G. G. Albany. Pteronarcys ? biloba Newm., May 8

Blunt, Miss Eliza S. New Russia. Pteronarcys proteus Newm., giant stone fly, adult, June 6

Thysanoptera

Brooks, F. M. Athens. Euthrips pyri Dan., pear thrips, adults, April 25

Thysanura

Rodgers, E. H. Mount Kisco. Through State Department of Agriculture. Schoturus nivicola Fitch, snow flea, adults, December 26

Acarina

Hunter, Miss Louise. Cornwall. Eriophyes quadripes Shimer, gall on maple, May 12

Bethel, E. Denver, Col. Eriophyes abnormis Garm., gall on linden, September 30

Barron, Leonard. Garden City. Bryobia pratensis Garm., red spider, adults and eggs on Arbor vitae, June 23

ZOOLOGY

Donation

Mammals

Corbin, Austin. New York

Buffalo bull, Bison bison (Linnaeus) 1

Hartley, B. M. New Haven, Conn.

Jumping mouse, Zapus hudsonius (Zimmerman) . 4

Taylor, H. L. Albany

Newfoundland caribou, Rangifer terrae-novae Bangs, head

Birds

Newland, D. H. Albany

Night heron, Nycticorax nycticorax naevius (Boddaert) 1

Birds' eggs

Philips, Mrs J. Kay. Menands

Brown pelican, Pelecanus occidentalis Linnaeus 1

Night heron, Nycticorax nycticorax naevius (Boddaert) 1

Spotted sandpiper, Actitis macularius (Linnaeus) 3

Ruffed grouse, Bonasa umbellus (Linnaeus) ... 10

Mourning dove, Zenaidura macroura carolinensis (Linnaeus) 1

Cooper hawk, Accipiter cooperi (Bonaparte) . 1

Flicker, Colaptes auratus luteus Bangs..... 3

Night hawk, Chordeiles virginianus (Gmelin).	1
Kingbird, Tyrannus tyrannus (Linnaeus).....	1
Crested flycatcher, Myiarchus crinitus (Linnaeus)..	2
Phoebe, Sayornis phoebe (Latham)..........	5
Crow, Corvus brachyrhynchos Brehm......	11
Cowbird, Molothrus ater Boddaert...........	1
Red-winged blackbird, Agelaius phoeniceus (Linnaeus)..................................	4
Meadow lark, Sturnella magna (Linnaeus)....	2
Orchard oriole, Icterus spurius (Linnaeus)....	2
Purple grackle, Quiscalus quiscula quiscula (Linnaeus)..................................	6
Chipping sparrow, Spizella passerina (Bechstein)..	4
Vesper sparrow, Pooecetes gramineus (Gmelin)..	2
Savannah sparrow, Passerculus sandwichensis savanna (Wilson)....................	5
Song sparrow, Melospiza melodia (Wilson)..	4
Cliff swallow, Petrochelidon lunifrons (Say)	2
Cedar waxwing, Bombycilla cedrorum Vieillot	1
Catbird, Dumatella carolinensis (Linnaeus).	9
Veery, Hylocichla fuscescens (Stephen)....	2
Bluebird, Sialia sialis (Linnaeus)............	4

Birds' nests and eggs

Van Name, W. G. Albany

Common tern, Sterna hirundo Linnaeus	16	eggs
Roseate tern, Sterna dougalli Montagu	5	"
Night heron, Nycticorax nycticorax naevius (Boddaert)..................nest and	3	"
Night heron, Nycticorax nycticorax naevius (Boddaert).................	5	"
Woodcock, Philohela minor (Gmelin) nest and	3	"
Spotted sandpiper, Actitis macularius (Linnaeus)	3	"

Fish hawk, *Pandion haliaetus carolinensis* (Gmelin)	2 eggs
Chimney swift, *Chaetura pelagica* (Linnaeus)	nest and 2 "
Whippoorwill, *Antrostomus vociferus* (Wilson)	2 "
Kingbird, *Tyrannus tyrannus* (Linnaeus)	nest and 4 "
Phoebe, *Sayornis phoebe* (Latham)	nest and 5 "
Least flycatcher, *Empidonax minimus* (Baird)	nest and 4 eggs
Blue jay, *Cyanocitta cristata* (Linnaeus)	nest
Bobolink, *Dolichonyx oryzivorus* (Linnaeus)	nest and 5 eggs
Cowbird, *Molothrus ater* Boddaert	1 egg
Red-winged blackbird, *Agelaius phoeniceus* (Linnaeus)	nest and 4 eggs
Orchard oriole, *Icterus spurius* (Linnaeus)	nest and 4 "
Purple grackle, *Quiscalus quiscula quiscula* (Linnaeus)	nest
Goldfinch, *Astragalinus tristis* (Linnaeus)	nest and 5 eggs
English sparrow, *Passer domesticus* (Linnaeus)	nest and 6 "
Vesper sparrow, *Pooecetes gramineus* (Gmelin)	nest and 4 "
Savannah sparrow, *Passerculus sandwichensis savanna* (Wilson)	nest
Seaside sparrow, *Passerherbulus maritimus* (Wilson)	nest and 4 eggs
Chipping sparrow, *Spizella passerina* (Bechstein)	4 "
Field sparrow, *Spizella pusilla* (Wilson)	nest and 3 "
Song sparrow, *Melospiza melodia* (Wilson)	nest and 5 "
Towhee, *Pipilo erythrophthalmus* (Linnaeus)	nest and 2 "

Barn swallow, Hirundo erythrogastra Boddaert .... nest
Cedar waxwing, Bombycilla cedrorum Vieillot .... nest and 4 eggs
White-eyed vireo, Vireo griseus (Boddaert) .... nest and 3 "
Yellow-breasted chat, Icteria virens (Linnaeus) .... nest and 4 "
Yellow-breasted chat, Icteria virens (Linnaeus) .... nest and 3 "
Redstart, Setophaga ruticilla (Linnaeus) .... nest and 4 "
Catbird, Dumatella carolinensis (Linnaeus) .... nest and 4 "
Brown thrasher, Toxostoma rufum (Linnaeus) .... nest and 5 "
House wren, Troglodytes aedon Vieillot .... 6 "
Wood thrush, Hylocichla mustelina (Gmelin) .... nest and 4 "
Robin, Planesticus migratorius (Linnaeus) .... nest
Bluebird, Sialia sialis (Linnaeus) ..... nest and 3 eggs

Fish

Gloeckner, William. Albany
Red horse mullet, Moxostoma aureolum (Le Sulur) 1

Invertebrates

Pearse, A. S. Madison, Wis.
Compound ascidian, Botryllus schlosseri (Pallas) 1
Van Alstyne, William T. New York
Collection of foreign shells and corals

Purchase

Mammals

Hartley, B. M. New Haven, Conn.
Rat, Epimys norvegicus (Erxleben) 2

Leach, B. J. Averill Park
Weasel, Mustela noveboracensis (Emmons).. 1
Ward's Natural Science Establishment. Rochester
Puma, Felis couguar Kerr.................... 2
Fisher, Martes pennanti (Erxleben)........... 2

Birds

Barker, Fred. Parker's Prairie, Minn.
Caspian tern, Sterna caspia Pallas.............. 1
American merganser, Mergus americanus Cassin. 1
Red-breasted merganser, Mergus serrator Linnaeus...................................... 1
Lesser snow goose, Chen hyperboreus (Pallas). 2
Canada goose, Branta canadensis canadensis (Linnaeus)................................ 1
Bittern, Botaurus lentiginosus (Montagu)... 1
Black-crowned night heron, Nycticorax nycticorax naevius (Boddaert)................... 1
Wilson phalarope, Steganopus tricolor Vieillot. 1
Western sandpiper, Ereunetes mauri Cabanis.... 2
Long-billed curlew, Numenius americanus Bechstein.................................... 1
Black-breasted plover, Squatarola squatarola (Linnaeus)................................ 2
Sharp-shinned hawk, Accipiter velox (Wilson). 1
Pigeon hawk, Falco columbarius Linnaeus..... 1
Pileated woodpecker, Phloeotomus pileatus abieticola (Bangs)........................... 2
Hartley, B. M. New Haven, Conn.
Bluebird, Sialia sialis (Linnaeus).............. 1
Milton, B. New Haven, Conn.
Starling, Sturnus vulgaris Linnaeus.......... 1
Vernon, M. L. Troy
Robin, Planesticus migratorius (Linnaeus) albino...................................... 1

Fishes

Purchased in Albany markets
Atlantic salmon, Salmo salar Linnaeus........... 1
Pike, Lucius lucius (Linnaeus)................ 1
Chub mackerel, Scomber colias Gmelin......... 1

Striped bass, Roccus lineatus (Bloch)	1
Sea bass, Centropristes striatus (Linnaeus)	1
Sheepshead, Archosargus probatocephalus (Walbaum)	1
Sea trout, Cynoscion regalis (Bloch and Schneider	1
Summer flounder, Paralichthys dentatus (Linnaeus)	1

ETHNOLOGY

Purchase

Women's leggings, beaded (3 pairs)	6
Towesas rattle, made of box turtle	1
Turtle rattles, greatfeather dance	2
Husk faces used by Husk Face Company	2
False face, medicine mask	1
Small baskets	2
Husk basket	1
Berry basket	1
Beaded belt or sash	1
Snowshoes — short type	2
Baby board, Onondaga	1
Bark bowl	1
Wooden spoons	3
Worsted belt or sash	1
Paddles	4
Eagle wands (2 sets)	2
Eagle dance rattles, of gourds (set)	1
Eagle rattles, of horn (set)	1
Wooden spoon	1
Plum stone dice (set)	1
Peach stone dice (set)	1
Bone dice (set)	1
Calabash rattle	1
Gourd rattle	1
Drum and carved stick	1
Beaded sash	1
Old spoons of carved wood	4
False face	1
Husk basket	1
Husk jug or bottle	1

Brooches	2
Gambling bowl	1
Bark rattle	1
Old paddle	1
Pot hook of twisted wood	1
Woodchuck hide	1
False face	1
Turtle rattle	1
Pair earrings (natural silver)	1
Feast bowl	1
Silver rings	2

A. A. Schmidt. Albany

Indian bead-work bag	1

ARCHEOLOGY

Purchase

The R. D. Loveland Collection. Watertown.

Bone and horn arrow-heads	39
Stone axes	2
Bone awls	380
Banner stone	1
Copper bead	1
Small quantity charred corn	..
Celts	85
Small stone dart	1
Stone disks, diameter 4″ to 5″	4
Bone fish hook	1
Phalanges	70
Gorgets	9
Gouges	7
Bone and horn harpoons	6
Hammer stones	25
Slate knives	11
Stone mortars	6
Mullers	30
Parts of antlers, worked	16
Human arm bone, worked	1
Small stone pigment bottle	1
Tattooing bone	1
Bone needles	8
Bone paddles or spatulas	1
Stone paddles or spatulas	1

Steatite plummet	1
Slate plummet	1
Stone pestles	3
Stone pendants	7
Stone balls	14
Part of turtle carapace, perforated	1
Worked bears' teeth	9
Clay pipes	139
Steatite pipes	4
Bone spear heads	2
Skull	1
Parts of clay pipes	7 qts.
Potsherds	about 350
Clay disks	41
Stone disks	18
Small stone ornaments	6
Beaver teeth, worked	6
Small stone cones	2
Small flat round stone, on one side effigy of human face	1
Bone shuttles	6
Stone pick	1
Stone hatchet, perforated	1
Antler spoon	1
Several lumps mineral paints	4
Small quantity charred wood	3
Clay pot	1
Stone paint grinder	1
Saucer-shaped dish from human skull	1
Stone and slate beads	298
Various small bone objects, worked	..
Stone net sinkers	19
Antler spoon	1
Shell beads	37
Unfinished stone and slate beads	38
Bone beads	75
Arrow points	147
Spear heads	16
Bone punches	3
Plum pits, perforated	3
Gun flints	4

The Raymond G. Dann Collection. Honeoye Falls

Clay pipes	36
Stone pipes	3
Flint spear heads	27
Gun flints	85
Copper arrow points	16
Red catlinite pipe	1
Stone axes	7
Celts	16
Stone maul	1
Flint scrapers	12
Gorgets	3
Shell beads	9
Flint drills	3
Flint knives	13
Chert arrow points	247
Bone awls	6
Bone punch	1
Bone harpoon	1
Bone pins	4
Bone shuttles	2
Sinew stone	1
Stone war clubs	2
Banner stones	2
Stone pestles	3
Stone gouges	4
Wolf tusk necklace, 91 teeth	91
Red stone bead necklace	223
Metal spoon, round bowl, figure of human on end of handle	1
Shell disk	1
Shell object, flat discoidal base, 1¼″ shaft from one side	1
Bear tusk necklace, 56 teeth	56
Carved shell necklace, 78 pieces	78
Bracelet of copper wire	1
Necklace of carved shell, 91 pieces crescent shape	91
Carved shell necklace, 18 pieces	18
Shell necklace, 30 pieces	30
Tortoise shell rattles	2
Cylindrical shell ornament	1
Shell ornament, representation of turtle	1
Shell ornament, representation of duck	1

Shell ornament, representation of owl	2
Small human figure, horn	1
Small cup-shaped stone	1
Small stone saucer-shaped object	1
Iron scissors, rusted	1
Carved shell necklace, 31 pieces	31
String of 38 discoidal shell ornaments	38
Carved shell, representation of duck	1
Shell necklace, crescent shape pieces	61
Discoidal shell object	1
Long shell beads	7
Perforated tortoise carapace	1
String of shell beads	16
Four strings glass beads	..
String red stone beads	22
Loose wampum and other beads	..
One-half pint wampum shells	..
White glazed pottery vase, European, top broken	1
Copper finger rings	9
String wampum beads and wolf teeth	58
Flint lock from gun	1
Remnant of flint lock	1
Pottery ornament, head of duck	1
Iron tube 5¼" long	1
Lead ladle	1
Small piece beaver skin, 2" x 2½"	1
Small round bells, copper	2
Small copper bells	4
Iron wire bracelet, small coil copper wire attached	1
Oblong shell beads, white	7
Small maskette, white shell	1
Trade pipe, bowl broken and large part of stem missing	1
Fragments of worked shell, white, four pieces	4
Shell ornaments and fragmentary pieces	18
Mother of pearl ornament	1
Bone, crescent shape pieces	6
Copper jingles	2
Copper chain, length 37½"	1
Small piece graphite	1
Small fragment leather, copper bead insertion	1
Small figures of animals, bone	4

Lead bullets	175
Copper thimble	1
Copper kettles	4
Earthen vessels	7
Brass kettles	3
Horn and bone combs	17
Brass spoon	1
Iron knife	1
Iron tomahawks	2
Lead spoon	1
Wooden spoons	5
Bone spoons	3
Shell ornaments	5
Horn knife handles	8
Iron implements, wedge shape	3
Stone implements	10
Shell pendant	1
Bear tusks	2

String wampum and other beads, multi-colored, 60 yards.

The Fred H. Crofoot Collection. Sonyea

Copper axe	1
Celts	810
Stone implements	19
Stone axes	212
Stone war clubs, heads	242
Hammer stones	254
Brass kettles	2
Cylindrical stone pestles	174
Bell pestles	8
Iron axes	11
Mullers	199
Copper bullets	38
Stone balls, picked	59
Flint drills	138
Bone awls	11
Large clay council pipe	1
Stone mauls	29
Sinew stones	47
Stone net sinkers	46
Stone gouges	17
Flattened pitted stones, several pits on one side	7

Stone mortars	4
Flint arrow and spear heads	5832
Flint scrapers	642
Brass arrow heads	2
Small earthen pot	1
Flint knives	676
Bear teeth	6
Gun flints	53
Small stone mortar and ball	1
Bone whistle	1
Silver brooches	4
Silver totem	1
Copper pipes	2
Steatite platform pipe	1
Copper spear head	1
Gorgets	20
Parts of gorgets	27
Banner stone	1
Parts of banner stones	11
Copper beads	4
Iron knives	17
Iron scrapers, spoon shaped	2
Turtle back stone	1
Iroquois clay pipe	1
Steatite paint cup	1
Lead seal	1
Flint semi lunar knives	3
Stone tube	1
Shell gorget	1
Bone scrapers	2
Games, stones	2

The C. A. Holmes Collection. New Berlin

Iron axes	2
Flint arrow points, drills, spear heads, scrapers......about	550
Flint knives	6
Gun flint	1
Gorgets	6
Stone pestles	10
Crude chipped flint fragments	33
Stone net sinkers	10
Celts	11

Hammer stones	8
Stone axes	2
Stone war clubs	2
Sinew stone	1
Small mortar	1
Muller	1
Bell pestle	1
Plaster cast Mound Builders pipe	1
Plaster cast large spear head	1
Stone gouges	3
Banner stones	2

The W. E. Bryan Collection. Elmira

Small oblong stone, effigy of human face on one side	1
Small bottle, charred cover	1
Potsherds	138
Stone net sinkers	59
Crude chipped stone implements	7
Celts	66
Stone mortars	2
Bone awl	1
Parts of gorgets	6
Flint knives	25
Stone pestles	14
Lapstone	1
Stone gouges	2
Pieces of steatite, parts of pots	54
Flint spear heads	4
Flint scrapers	13
Flint drills	38
Part of banner stone	1
Arrow points	604
Gun flints	4
Stone balls	2
Mullers	4
Hammer stones	33
Stone war clubs	12
Iron axe	1

The R. E. Van Valkenburg Collection. Mount Upton

Shell disks, center perforation	5
Flint drills	5
Flint scraper	1

Flint knives	3
Flint spear head	1
Smoothing or lapstone	1
Stone pestles	6
Flint harpoon	1
Mullers	2
Stone net sinkers	27
Worked stones	29
Sinew stones	2
Celts	2
Hammer stones	43
Flint arrow points	203

The Charles P. Oatman Collection. Liverpool (Collected in Jefferson county)

Clay pipes	93
Steatite pipes	4
Diminutive clay cup, diameter about 1¼″	1
Small clay effigy of human head	1
Small clay effigy of human head, part missing	1
Small bone from mouth of sturgeon	1
Small oblong flat bone fragment, worked, two perforations	1
Part of lip of platform pipe, red catlinite	1
Miniature bone paddle, 4½″ long	1
Clay pipe fragments	about 150
Bone awls	251
Bone and horn arrow points	39
Worked phalanges	57
Bone beads	53
Celts	68
Bone bodkins	8
Bone harpoons	7
Shell beads	5
Stone mortars	2
Small pieces perforated skull	2
Hammer stones	7
Bone knives	3
Mullers	15
Copper beads	4
Stone beads	6
Small quantity charred wood	..
Pieces of pigment	4

The Alva S. Reed Collection. Livonia

Miniature bone effigy, human foot	1
Shell ornaments	10
Shell beads	61
Shell implements	1
Copper bead	1
Stone beads	8
Small pieces bones, notched	2
Clay bead	1
Shell gorget	1
Bone harpoons	5
Bone needles	13
Bone whistle	1
Bone pitching tools	13
Bone ornament	1
Bone fish hooks	5
Brass arrow point	1
Worked animal teeth	70
Bone implements	16
Worked antlers	2
Bone beaming tools	6
Bone awls	52
Bone arrow point	1
Bone shuttle	1
Bone beads	71
Bone pendants	2
Flint arrow points	about 300

McCombs, Mrs F. A., Rushville

Broken adult female skull	1
Broken abnormal juvenile skull	1
Stone tubes	3
Gorget	1
Small copper celt	1
Antler punch	1
Ivory blade, broken	1
Amulets	2
Strings shell beads	2

The Vander Veer-Auringer Collection, from headwaters of the Hudson, Warren county

Glass and bone string beads	75
Copper thimble	1

Small crescent-shaped bone ornament, two perforations..	1
Brass arrow point	1
Small lead bird effigy	1
Stone spatula	1
Bone jingler	1
Bar amulets	3
Large bell mortar, stone	1
Double stone mortar	1
Mullers	7
Sinew stones	2
Stone pestles	8
Stone grinder	1
Stone war clubs	4
Stone balls	5
Part of banner stone	1
Flint knives	41
Flint gouge	1
Celts	5
Flint pick	1
Hammer stones	14
Stone spades or hoes	4
Stone axes	14
Stone paint grinder	1
Stone net sinkers	10
Crude chipped stone fragments	50
Iron axe	1
Iron ball	1
Steel trade arrow or lance	1
Gun flints	2
Eskimo knives	16
Worked steatite fragments	6
Bone punch	1
Flint drills	10
Bone implement	1
Flint scrapers	24
Flint spear heads	41
Flint arrow points	168
Bone awls	5
Pigment lumps, small	3
Brass bracelets	2

Collection

The D. D. Luther Collection. Naples

Small red stone effigy of human face	1
Smoothing or lapstones	13
Stone gouge	1
Stone pestles	10
Stone sinkers	50
Stone balls	3
Muller	1
Stone mortar	1
Celts	6
Stone war clubs	2
Hammer stones	226
Stones, worked	35
Potsherds	27
Flint arrow points	60
Flint scraper	1
Gun flints	2
Clay pipe	1

APPENDIX

THE ORIGIN OF MAN

(Adapted from a paper by Dr E. Rivet, of the Museum d'histoire naturelle, Paris)[1]

The progress of recent investigations into the prehistory of the human race has plainly shown that the common expression which has come into use as the summation of the evolutionist theory of the origin of man, "man is descended from the ape," is not only unfortunate but untrue. When this expression became current it attracted attention and controversy by its implied defiance of traditional doctrines, and this very fact has given it a certain popularity, made it the target of polemic discussions and has indeed cast ridicule upon the fundamental scientific principle of evolution. The responsibility for the diffusion of this formula rests in part upon scientific men themselves. The time is not far past when such men as Haeckel and Mortillet imagined and even portrayed the precursor of man as a strange compromise between man and the anthropoid, and to these imaginary creatures they gave some such significant names as Pithecanthropus or Anthropopithecus, and Schaafhausen made out the man of Neanderthal to be a sort of man-ape.

The views of Haeckel and contemporary writers were not, however, without excuse. After the first discoveries relative to fossil man had been made, they were prone to believe that the problem of our origin was of quite simple solution; but this is not at the present time so regarded. The new data acquired in the course of late years show that the problem is much more complex than it has appeared to be. It is this fact that I wish specially to lay emphasis upon in bringing together here what we now know with scientific certainty regarding this matter and the conclusions which it is legitimate to draw therefrom.

It is well known that the history of the earth has been divided by geologists into four great periods, Primary, Secondary, Tertiary and Quaternary. The first era is characterized by a fauna composed of invertebrate animals and of the lower vertebrates; the Secondary era is the era of reptiles; the Tertiary and Quaternary eras those of the mammals. The Tertiary era has been divided

[1] Printed in *Biologica,* March 15, 1914.

GEOLOGICAL DIVISIONS			CLIMATE	CHARACTERISTIC ANIMALS	INDUSTRY	HUMAN OR ANTHROPOMORPHIC TYPES
Quaternary	Recent or Holocene		Like that of the present	Living species and domestic animals	Metals. Neolithic Azilian	*Homo sapiens*
	Early or Pleistocene	Upper....	Postglacial period Climate cold and dry	Fauna of the Steppes Abundance of Reindeer	Magdalenian Solutrian Aurignacian	*Homo sapiens*........... Cro-Magnon-type, Chancelade-type
		Middle...	Climate cold and moist Glacial advance Climate cold and moist	Mammoth Hairy rhinoceros Reindeer	Mousterian Acheulian	*Homo sapiens*........... Grimaldi-type *Homo neanderthalensis*.... Gibraltar. 1848; Neanderthal. 1856; La Naulette. 1866; Spy. 1886; Malarnaud. 1889; Krapina. 1899; La Chapelle-aux-Saints. 1908; La Moustier. 1909; La Ferrassie. 1909–10; La Quina. 1911
		Lower....	Interglacial period Climate mild Glacial advance Climate cold and moist	Hippopotamus *Elephas antiquus*	Chellian	*Homo heidelbergensis* *Eoanthropus dawsoni*
Tertiary	Upper Pliocene		Interglacial period Climate warm Glacial extension Climate cold and moist	*Elephas meridionalis*	Eolithic (?)	*Pithecanthropus erectus*

also into four periods, Eocene, Oligocene, Miocene and Pliocene. In our present theme only this last and most recent period, the Pliocene, interests us. At this epoch the climate of Europe was warm and its fauna included such a characteristic animal as the northern elephant. The Quaternary, also, has been divided into the present Quaternary or Holocene, characterized by a climate and a fauna very like those of the present, and into an ancient Quaternary or Pleistocene. The latter comprises three periods: Lower Pleistocene, with a mild climate, during which the hippopotamus and the Elephas antiquus abounded in our region; the Middle Pleistocene, with a cold and humid climate, the fauna of which included the mammoth, the hairy rhinoceros and the reindeer; finally, the Later or Upper Pleistocene, with a cold, dry climate, often called the *Reindeer age,* on account of the extreme abundance of this animal. Toward the end of this epoch the fauna was very like that of the steppes.

Thus arranged, what are the discoveries relating to man and his predecessors which have been made in the different beds corresponding to the divisions just enumerated? It is believed that we have found traces of the existence of man, or at least of a being resembling man, in the Tertiary epoch, shown by the discovery of incised bones and, in many places, of stones which bear traces of use, the so-called *eoliths.* These eoliths have given rise to lively discussions, but today, thanks to the work of MM. Boule and Breuil, it is proved that flints may acquire the aspect of stones intentionally retouched merely by the effect of contusion in torrential waters or under the pressure of the rocks themselves, and it is admitted now almost unanimously that even if a human being living in the Tertiary epoch actually made use of stones, it would be impossible, in the present state of our knowledge, to distinguish them from those which have been bruised and broken by the action of natural causes. It has, moreover, not been proved that incisions found on certain Tertiary bones are the work of man. Of the being who might have modeled these eoliths or made these incisions, there has not, thus far, been found in our country the slightest vestige, and the expression of Nadaillac in 1885 is today the exact truth: "Man might have been able to live during Tertiary times. Nothing in the climate or geologic conditions, nothing in the fauna or in the flora is opposed *a priori* to his existence then, but up to the present time there is no known fact, no discovery, no proof which can really permit us to affirm this with any degree of certitude."

I have not as yet taken account of the famous discovery made in Java in 1891–92 by Dr Eugene Dubois of certain fragmentary bones, a calvarium, a femur and a molar of a being which has received the name of Pithecanthropus erectus. The age of these bones has been discussed at length and is not yet definitely determined, but it does not seem to carry us back to an epoch earlier than the period of transition from the Pliocene to the Pleistocene. They are nevertheless the most ancient anthropomorphic remains which we possess and I shall have to refer later to their interpretation.

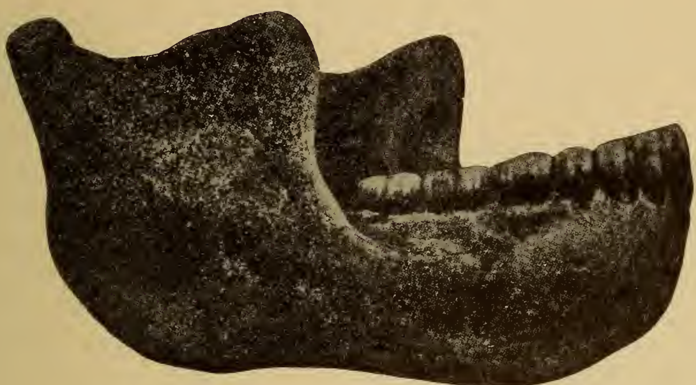
Up until 1907 we knew the human being who lived in Europe during the Lower Pleistocene only by his industry, but, in the course of the last three years, two sensational discoveries have brought us the first definite proof of the physical characteristics of this being. There was, first of all, the discovery in 1907 of a lower jaw in the sands of Mauer, near Heidelberg; then in 1912 the discovery of a portion of the cranium and the lower jaw in the gravels of Piltdown, in Sussex.

Much more numerous and more important are the documents which we possess relating to the man of the Middle Pleistocene. Following the chronological order and retaining only the undebated and undebatable examples, we may cite: the cranium of Gibraltar, 1848; the calvarium of Neanderthal, 1856; the jaw of La Naulette, 1866; the cranium and bones of Spy, 1886; the jaw of Malarnaud, 1899; the multiple debris of Krapina, 1899; the skeleton of La Chapelle-aux-Saints, 1908; the skeleton of Moustier, 1909; the two skeletons of La Ferrassie, 1909–10; and, finally, the skeleton of La Quina, 1911.

From the epoch intermediate between the Middle Pleistocene and the Later Pleistocene there have been reported two skeletons discovered in the lower beds of one of the caves of Grimaldi, near Menton, and described by M. Verneau. Finally, the Later or Upper Pleistocene has furnished so many evidences of fossil man that a list of them would be too long to give here.

This is a summary of the paleontologic human documents which we possess today. Let us now see the data which the study of these precious remains affords for the determination of the morphology of our ancestors.

A rapid examination shows, first of all, and this is a capital point, that man of the Later Pleistocene had already the characters of living man, or, in other words, to employ the language of the systematists, that at that epoch he entered into the group of Homo sapiens. True enough, even then he afforded a large variety of types analogous to if not identical with those which we find today: the Grimaldi-type with negroid characters very strongly expressed; the Chancelade-type which approaches the type of the Eskimo; and, finally, the Cro-Magnon-type, much more widely diffused and whose descendants Professor Verneau has found among the almost contemporary Guanchos of the Canary islands. It is fair then to say that living humanity was already in possession of its essential traits and even of its principal varieties in the Later Pleistocene. Because of this fact our study finds itself restricted to human fossils of the Middle and Early Pleistocene. The Middle Pleistocene man, which has generally been designated



Jaw of the Heidelberg man (Homo heidelbergensis)

by the name of Homo neanderthalensis, is actually very well known morphologically, thanks to the beautiful work of M. Boule.

We know much less of the man or the anthropoid creatures which preceded Homo neanderthalensis; in fact, we have as documents here only insufficient and scattered bone fragments. The lower jaw, the only relic of the creature to which the name of Homo heidelbergensis has been given, is remarkable for the association which it presents of pithecoid and human characters. It is striking throughout by its massive appearance, by the large size of its ascending branches and by the complete absence of a chin. The mandibular angle is truncated, the semilunar groove but slightly marked, the coronoid apophysis obtuse and with rounded edges, the articular surface of the condyle much

1 2 3

Superior surface of the crania of (1) the chimpanzee, (2) the fossil man of La Chapelle-aux-Saints, (3) a Frenchman.

Side views corresponding with the foregoing.

extended. Finally, if the bone is placed on a horizontal plane it will be seen that there is a large open space under the median symphysis. All these characters give this jaw more the aspect of an anthropoid than of a human jaw, and it is certain that if it had been deprived of its alveolar border it would have been greatly to the embarrassment of paleontologists; but the teeth are distinctly human and the canines no more prominent than the adjoining teeth.

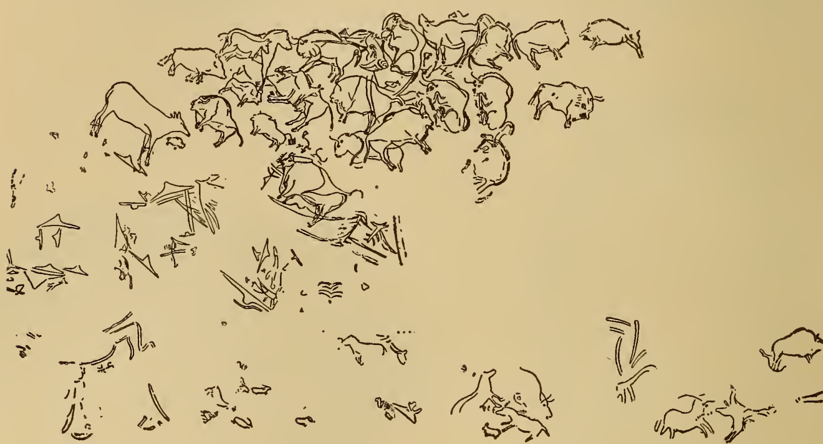
Again, we find the association of such pithecoid and human characters, in a fashion perhaps still more pronounced, in Eoanthropus dawsoni; that is to say, in the being whose remains have been discovered at Piltdown. Morphologically, this jaw is the jaw of a chimpanzee, and the recent discovery of the canine tooth notably more developed than the human canine accentuates this resemblance; but the cranium, as far as one is able to judge from the deteriorated condition in which it was found and after somewhat varying reconstructions which have been made of it, is much more allied to the cranium of the existing man than to that of Homo neanderthalensis.

With Pithecanthropus erectus the phenomena are inverted. Here, in fact, are a femur and a molar which are clearly human, while the cranium is very far removed from the cranium of H. sapiens. Its aspect recalls that of the cranium of the Middle Pleistocene man, although it exaggerates those characters. The orbital ridge is sharper and consequently more pithecoid, the frontal more depressed, the vault more depressed, the occipital region more prominent and, finally, the cerebral capacity, which in Homo neanderthalensis is 1400 cubic centimeters, in Pithecanthropus certainly did not exceed 1000 cubic centimeters. In Pithecanthropus we have reached the most ancient known representative of human beings or anthropomorphs which excavations of the last fifty years have brought us. It is now necessary for us to inquire how it is possible, in the present state of science, to interpret these documents and with their help to solve the problem of the origin of man.

Homo neanderthalensis constitutes naturally the keystone of the whole edifice which we attempt to construct with the elements I have briefly described, because chronologically it is the first positively human being different from living man which has reached us, and especially because it is best known to us.

The morphological study of this fossil brings out two capital facts: one, the extraordinary homogeneity of the ethnic type which it represents, the other, the profound difference which exists between it and the human beings which immediately followed it.

Wherever discoveries have been made of remains of the Middle Pleistocene man, whether in Croatia, in Prussia, in France, or in the south of Spain, everywhere the type shows a remarkable uniformity which contrasts in a singular way with the ethnic polymorphism of later epochs. However long may have been the period of geological times in which the race lived, all discoveries of Homo neanderthalensis show only a slight evolution, manifesting itself by noticeable skeletal variations. Everywhere and always it remains like itself.



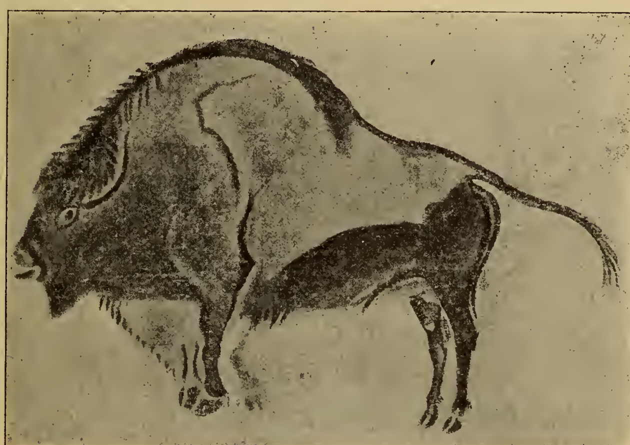
Miniature diagram of frescoes from the ceiling of Altamira cavern, showing how the figures are thrown together with little regard for composition or position.

After Cartailhac and Breuil *Courtesy American Museum of Natural History*

The absence of the morphological link between Homo neanderthalensis and Homo sapiens is a fact no less remarkable. It is, moreover, like a corollary of the first. When one compares the Middle Pleistocene man with the Later Pleistocene man (of Grimaldi, Chancelade or Cro-Magnon) or even with the lowest representatives of living humanity, it is evident that back of these superficial similarities relating to certain isolated particulars one can not bring forward sufficient evidence of conformity of characters to establish any admissible morphological affinity between Homo neanderthalensis and Homo sapiens.

It is a remarkable fact that this morphologic hiatus coincides with a culture hiatus, as has been strongly insisted on by the Abbé Breuil. Homo neanderthalensis had an extremely rudimentary industry in which nothing of the slighest esthetic tendency has revealed itself. On the contrary, the man of the Upper Pleistocene possessed very varied culture; with equal skill he worked in stone, reindeer antlers and bone, and finally and especially he appears to have been a marvelous artist whose multiple productions in sculpture, engravings, designs and paintings are often veritable chefs d'oeuvre.

Far from finding a satisfactory term of passage between the cranium of La Chapelle-aux-Saints and the crania of Grimaldi or



Magdalenian painting from the cave of Altamira

Cro-Magnon, one finds no transition between the fragmentary Mousterian civilization and the admirable cultures of the Aurignacian, Solutrian and Magdalenian man. In order to concede any relation between these types or between these industries, it is necessary to suppose that at the end of the Middle Pleistocene a mutation was produced which abruptly transformed Homo neanderthalensis into Homo sapiens. Need I say that this hypothesis can no more be seriously entertained than the creationist hypothesis? In reality this morphologic and industrial hiatus simply proves that living man, like the man of the Upper Pleistocene of which he is the issue, was not the direct descendant of Homo neanderthalensis; that the latter represents a divergent line of the genus Homo which became extinct before the present era, while Homo sapiens represents the development of another line which paleontological discoveries made up to the present time do not permit us to follow into the Middle Quaternary.

The recent discoveries at Piltdown and Heidelberg have a definite bearing on this hypothesis; although greatly different in many details of structure from the Homo neanderthalensis, the Heidelberg jaw nevertheless does not present any essential differences from the latter. It is without doubt more robust, shows more pronounced primitive characters, but M. Boule has shown that it might well be adapted to the cranium of La Chapelle-aux-Saints

A reindeer grazing, from the cavern of Kesslerloch near Thayugen, Switzerland, engraved on a shaft-straightener. A Magdalenian masterpiece.
After Sollas *Courtesy American Museum of Natural History*

without sensibly changing its general aspect, and if we consider that it carries us back to an epoch anterior to that in which the man of the Middle Pleistocene lived, we can see in it one of the primitive stages of the latter; or, otherwise speaking, we may suppose that Homo heidelbergensis represents in the Lower Pleistocene the ancestral form of Homo neanderthalensis.

The discovery at Piltdown is of more delicate interpretation and this is because of the fragmentary condition of the remains. The jaw is distinctly pithecoid, although the cranium appears much more related to that of recent man than to that of the Homo neanderthalensis. At first sight one can not fail to be surprised

Group of two Bisons, modeled in clay. From the cavern of Tuc d'Audoubert

at the association in the same individual of simian and human characters so emphatically developed, and when one considers that the first are localized in the mandible, the second in the cranium, it is reasonable to question whether the sands of Piltdown may not have furnished the bones of two different individuals, an anthropoid and a man. The improbability of this hypothesis, which has been suggested by savants of distinction, of course, *a priori,* can not be escaped. It is necessary, nevertheless, to remark that as yet no anthropoid has been discovered in the European Lower Pleistocene. If the duality of the Piltdown discovery is rejected, Eoanthropus dawsoni would be one of the surprising synthetic forms of which paleontology has revealed to us the existence in other fossil groups. In any case, if the reconstructions submitted

Engraving on horn, partly restored, from the cavern of Lorthet, regarded as one of the finest examples of Magdalenian art.
After Ray Lankester *Courtesy American Museum of Natural History*

by the English anthropologists are exact, this being can not in any wise, on the basis of its cranial characters, take its place in the phylum of Homo neanderthalensis, and it will be logical to suppose that it represents the ancestral form from which Homo sapiens has been derived by an evolution whose stages have escaped us in the course of the Middle Pleistocene. We should have thus found at the opening of Quaternary time, the duality of types which we have vainly searched for in the Middle Quaternary. Their discovery would be here of great interest. Nevertheless, it is necessary to await other evidence before drawing any conclusions regarding this.

The absence of all remains of Homo sapiens in the Middle Quaternary can be explained in a quite simple manner. A certain number of paleontologists, among them notably M. Boule, are disposed to believe that we have not yet found our direct ancestor in the Middle Pleistocene, it is really because that creature did not exist in our regions at that time, and that he invaded them only during the last period of the early Quaternary, bringing with him his magnificent civilization. In this hypothesis the country of origin of this creature would be probably Asia, from which so many later invasions departed toward Europe.

The discovery of the remains of Pithecanthropus in Java long ago turned the attention of paleontologists in this direction toward an epoch in which the problem of the origin of man does not present itself with its present complexity. It was in Asia, it is supposed, that the development took place of the hypothetical being, the probable parent of Pithecanthropus, from which was descended Homo neanderthalensis, and which later in its turn gave origin to Homo sapiens. We have seen that the second part of this hypothesis is not favored at the present time, but it is recognized that the first part can still be defended with serious arguments. It is certain, in fact, that, *morphologically,* the cranium of Pithecanthropus affords an excellent passage term between the great apes and the man of the Middle Quaternary. At the same time nothing proves that, *phylogenetically,* it represents the transition between the Pliocene ancestors of those apes and itself, for one must bear in mind that it is with the anthropoids of those ancient epochs and not with the living anthropoids that the affinity must be searched for and demonstrated, and in the absence of documents we have no evidence bearing on this point.

Another conception consists in seeing in Pithecanthropus a Gibbon of great size. This rests in part upon morphologic comparisons and in part also, as M. Boule has remarked, on the frequent occurrence in the geological epoch to which the Java fossil belongs of gigantic animals whose living representatives are of greatly reduced dimensions. Pithecanthropus would stand to the Gibbons as Megatherium and the Glyptodon of America do to the Armadillos and the Sloths, the Diprotodon of Australia to the Marsupials, the Trogontherium of Europe to the Beavers, the Megaladapis of Madagascar to the Lemurs. Consequently Pithecanthropus could not properly be attached to the human line but is related to a different line, that of the anthropoids; and just as Homo neanderthalensis represents a divergent branch and terminal of the genus Homo, Pithecanthropus erectus would be a divergent branch and terminal from the trunk of which have issued the great anthropomorphic apes.

In resumé, the incontestable advances of paleontology have everywhere served to clear up these later discoveries. They have given precision to the problem of the origin of man, although without bringing any definite and final solution. Recent discoveries have established the fact that there developed in Europe during the Lower Quaternary, a human type absolutely different from the modern type, having certain pithecoid characters more marked than the lowest contemporaneous races, but nevertheless unquestionably meriting the name of man. The interpretation of these discoveries leads us to suppose that at the same time with this inferior creature there probably existed another human type (of which the Piltdown skull is perhaps the first evidence as yet known), the evolution of which comes out in the human races of the Later Quaternary, and consequently in the living races. But nowhere in *Europe*, so far as we have gone back into the past, have we yet found an anthropoid form from which might have issued the various types of the genus Homo.

Man has then behind him a long series of ancestors of human form of which we have as yet recognized only a few.

All that we know today of the history of the fossil apes proves that, as in the human branch, the simian branch plunges back into the depths of the past, with no present fact known that permits us to fix upon the epoch at which these two branches united into one common trunk.

The most ancient Primates known appeared in the Lower Eocene, near the opening of the Tertiary era, in North America, as creatures of a generalized type, on account of which it is very difficult to distinguish them from certain contemporary animals which it is necessary to place at the origin of other orders, such, for example, as the Insectivores. The most differentiated among them may be related to the living Lemurs. These Primates living primitively on the North American continent or in a boreal American-European continent, probably emigrated in part toward South America where they gave origin to the Platyrhine apes, partly toward Europe where they are known to have appeared during the Middle Eocene and to have multiplied in the Upper Eocene and Lower Oligocene, afterward passing into Asia, then into Africa, and finally to Madagascar where they have given birth to the various species of Lemurs in this island.

The discoveries made at Fayoum in Egypt in 1910 and studied by Schlosser, show that in the course of the Oligocene these lower types of Primates gave rise to forms which have been regarded in part as the ancestors of the Catarhine apes and, in part, of the anthropoids. In fact, it is at about this epoch that the differentiation took place, for on leaving the Miocene all the remains of apes discovered present very close affinities with the living species. I may cite for the Miocene epoch the Pliopithecus antiquus, a close ally of the gibbons, the Mesopithecus pentelici, intermediate between the macaque and the Semnopithecus, and for the Plio-Miocene epoch the Cynocephalus subhimalayanus, which is a true baboon; the Palaeopithecus sivalensis, which presents the characters both of the orang and of the chimpanzee; the Sivapithecus indicus which has certain affinities with the gorilla. In the Pliocene, and much more emphatically during the Pleistocene, the identity of the fossil with the living species must be regarded as probable.

It is then evident that the human phylum and the simian phylum have developed in parallel lines, each dividing and subdividing ever since time of extremely ancient date, and without paradox one may say that if Homo neanderthalensis had had, like ourselves, a curiosity in regard to his origin, the problem he set before himself would be almost in the same terms as that which presents itself to us. That at a geological epoch still more remote, so far back that our present knowledge will not permit us to fix it with precision, these two phyla were but one, losing themselves then in a common ancestor, we can not doubt. That paleontology will bring us some day documents which will permit us to establish the complete chain of this double genealogy, human and simian, the capital discoveries of the last years permit us to hope. One must give credit to the science which has already resolved so many secrets of dead nature, and we may affirm now that when this work is complete, man and the ape will appear as the ultimate forms of lines which have evolved independently for so long a time that there has never been any veritable parent of both.

Karl Vogt said he would rather be a perfected ape than a fallen angel. We do not have to choose between these alternatives. We know that man is neither one nor the other.

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Appendix 1

Geology and paleontology

Museum Bulletins 171, 172

171 Geology of the Syracuse Quadrangle

172 Geology of the Attica-Depew Quadrangles

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 171

THE GEOLOGY OF THE SYRACUSE QUADRANGLE

BY

THOMAS CRAMER HOPKINS

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The University of the State of New York
Department of Science, October 31, 1913

Hon. Pliny T. Sexton LL.D.
Vice Chancellor and Acting Commissioner of Education

My dear sir :

I beg to communicate herewith a manuscript, with maps, entitled *The Geology of the Syracuse Quadrangle,* and to recommend this for publication as a bulletin of the State Museum.

Very respectfully
John M. Clarke
Director

Approved for publication this
5th day of November, 1913
Pliny T. Sexton,
Vice Chancellor of the University

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THE GEOLOGY OF THE SYRACUSE QUADRANGLE

BY

THOMAS CRAMER HOPKINS

INTRODUCTION

The Syracuse topographic quadrangle, which is here specially under consideration, includes an area one-fourth of a degree square, in latitude 43°–43° 15′ N. and longitude 76°–76° 15′ W. Situated near the geographic center of the State of New York, including part of two of the great physiographic regions of the State, and the outcropping edges of many of the stratigraphic units of the paleozoic rock series, it has many features in common with, and hence may be taken as typical of, a rather broad belt extending east and west through the middle of the State.

The city of Syracuse is on the line of the Erie canal; lies at the intersection of the east-west (New York Central and West Shore) and the north-south (Delaware, Lackawanna and Western) railways, and has besides several branch lines radiating from the city and several suburban electric lines. Central location and excellent transportation facilities make it an important commercial center.

This quadrangle is located on the border line between the lake plains on the north and the Alleghany plateau on the south, two of the distinctive physiographic regions of the State. It has a varied physiography, which is somewhat intensified by glacial action. Passing across the quadrangle are the outcropping edges of the Siluric rocks with the lower and middle Devonic rocks on the hills near the city. Several of the stratigraphic type localities are near the city, namely, Camillus, Manlius, Onondaga, Marcellus, Cardiff, Skaneateles, Tully and Salina.

The soils in the vicinity of the city consist of mixed glacial clays, sand and gravel on the upland, and muck, marl, alluvium, lacustrine deposits, sand, gravel and boulder clay on the lowlands.

The map shows the topography and the outcrop of the different units in the sedimentary series. No attempt has been made to indicate the different soils or the special glacial features.[1]

GEOLOGIC COLUMN OF THE SYRACUSE AREA

Devonic	Erian	14 Cardiff shale
		13 Marcellus shale including Cherry Valley or Agoniatites limestone
	Ulsterian	12 Onondaga limestone
	Oriskanian	11 Oriskany sandstone
	Helderbergian	10 Coeymans ? limestone
Ontaric or Siluric	Cayugan	9 Manlius limestone
		8 Rondout waterlime
		7 Cobleskill dolomite
		Salina beds
		6 Bertie waterlime
		5 Camillus shale including Fiddler's Green limestone and gypsum
		4 Vernon shale
		3 Pittsford shale
	Niagaran	2 Lockport limestone
		1 Clinton beds including Rochester shale

[1] The soils are mapped and described in the Soil Survey of the Syracuse Area, New York, by F. E. Bonsteel, William T. Carter jr, and O. L. Ayres in the Field Operations of the Bureau of Soils 1903. Washington 1904.

Certain glacial features, especially the east-west channels and the drumlins, have been mapped and described by H. L. Fairchild in State Museum Bulletins 111, 127 and 160.

STRATIGRAPHY

As indicated on the foregoing table, there are 14 units, with a few subdivisions, of the paleozoic rock series of New York represented on the Syracuse quadrangle. Of these, 12 are represented in color on the map. The lowest group on the area is that of the Clinton shale in the midst of the Siluric, and the upper one is the Cardiff shale of the Mesodevonic.

NIAGARAN GROUP

CLINTON-ROCHESTER SHALES

These oldest rocks of the Syracuse region consist of shales which outcrop in the village of Brewerton at the west end of Oneida lake, exposed in the dredgings of the barge canal at Brewerton and in a cutting on the same canal near Three River point. These exposures occur in a rather wide area between the dark (Lockport) dolomite on the south and the red (Medina) sandstone on the north, the remainder of the intervening area being covered with a thick mantle of glacial drift. The entire area is underlain by the Clinton and the Rochester shales but present data are not sufficient to distinguish the two areas separately. The shales exposed in the village of Brewerton are an olive green which oxidizes to a reddish and yellowish brown. The shale is friable and not very resistant to the action of the weather. That dredged from the canal has a bluish color and crumbles very rapidly on exposure to the weather. It is calcareous and contains many fossils.[1]

A test hole drilled at Brewerton about 75 yards west of the highway bridge near the Onondaga-Oswego county line gave the following section:[2]

14 feet		Clay
42 feet	4 inches	Olive gray shale with a few thin bands of limestone. At 19 feet from surface there is a 4 inch band with black pebbles
	2 inches	Fossil ore inclosed in shale
23 feet		Shale with limestone bands 3 to 4 inches thick at regular intervals. Cavities lined with crystals; ore in threadlike veinlets in the limestone

[1] See page 57 for a discussion by Dr Burnett Smith of the paleontology of this group, and all the other groups of the area.

[2] D. H. Newland and C. A. Hartnagel. State Mus. Bul. 123, p. 37.

58 feet 10 inches.	Shale with thin bands of limestone. Traces of ore at 133 feet
16 inches	Oolitic iron ore
5 feet 4 inches	Sandstone and shale
145 feet	Total depth

Analysis of the oolitic iron ore from the drill hole at Brewerton.[1]

Fe_2O_3	48.71
SiO_2	9.69
TiO_2	.244
Al_2O_3	3.21
MnO	tr.
CaO	13.8
MgO	4.23
SO_3	.141
P_2O_5	2.38
CO_2	15.45
H_2O	2.33
	100.185
Iron	34.1
Phosphorus	1.038

A deep well-boring at Chittenango in 1890 indicated a thickness of 323 feet of Clinton shales between 567 and 890 feet below the surface, according to the interpretation of Prosser.[2]

The State well drilled at the south end of Onondaga lake in the city of Syracuse in 1884 gave, according to the interpretation of Prosser and Englehardt,[3] a thickness of 98 feet of Clinton and 332 feet of Niagara, and the Gale well on the east side of the lake, according to the same authorities, gave 149 feet of Clinton and 320 feet of Niagara.[4]

[1] Ibid, p. 38.

[2] C. S. Prosser. Bulletin of the Geological Society of America, v. 4, p. 98, 1893.

[3] Ibid, p. 102.

[4] For further particulars concerning the distribution of the Clinton in central New York, see Bulletin 123 of the New York State Museum by Newland and Hartnagel; and Thickness of Devonian and Silurian Rocks in Central New York by C. S. Prosser, in Bul. Geol. Soc. of America, v. 4, 1893, p. 91.

LOCKPORT LIMESTONE

Overlying the Rochester-Clinton shale is the Lockport limestone, known in the older reports as the Niagara limestone. It consists of a very dark colored, in places black, dolomitic limestone and associated shales. It contains numerous small geodic cavities lined with calcite and dolomite crystals.

This limestone forms a rather broad belt across the Syracuse quadrangle. The rock is more resisting to the action of the weather than the shales above and below and hence is characterized by a slight topographic relief. This relief is even less than one might expect from the difference in the rocks, which is probably due in part to the leveling action of the ice during the glacial period and the inequalities of the glacial deposits; possibly also the area was nearly base-leveled before the advent of the glacier.

The outcrops of the Lockport limestone, while not numerous owing to the heavy glacial covering, are more extensive than that of the underlying shales. The best exposure on the Syracuse area is at the quarry on the South Bay electric road about one mile south of Oneida lake. The greater part of the rock here is a nearly black dolomite. The upper layer is evenly bedded, varies from 1 to 2 feet in thickness, has a finely crystallized, even texture and is a fairly good building stone. The layers immediately underlying the top bed are more thinly bedded and interlaminated with black carbonaceous shale. At a depth of 4 to 6 feet the limestone occurs in rough irregular masses with no regular lamination or grain. In the bottom portion of the quarry the shale prevails over the limestone.

On the White farm immediately south of the quarry the rock has been removed over an area several acres in extent. It has been nearly all used for foundations, culverts and bridge piers. Its extended local use is due rather to the fact that it is the only rock obtainable for building purposes between the plateau south of Syracuse and the Medina sandstone area some miles to the north.

A similar rock at or near the same horizon as that at the quarry mentioned above has been quarried to a limited extent for local use at the village of Cicero, two and a half miles southwest of the barge canal at Oak Orchard on the Oneida river, and in the bank of the Seneca river a half mile south of Three River point. There is another quarry in this rock two and a half miles northwest of Baldwinsville and another on the western border of the village of Lysander. Both of these localities are on the Baldwinsville quadrangle. There is a small abandoned quarry near Clay station and a small outcrop at Bridgeport on the Chittenango quadrangle.

The outcrop of the comparatively hard Lockport limestone under the less resistant Vernon shale with both strata dipping south caused an obstruction to the north flowing streams. In the base leveling of the region the limestone would remain as a ridge after the overlying softer shales were worn down to a plain which on subsequent uplift would cause a damming of the streams and overflow over the area of the softer rocks. During the glacial period the erosion by the ice and the glacial waters further lowered the shale areas south of the limestone outcrop, causing a depression in which the water stood after the melting of the glacier, thus producing the flooded area of Cicero swamp and the westward extension of the flooded area in the Montezuma swamp district.

CAYUGAN GROUP

Salina Beds

PITTSFORD SHALE

The Pittsford shale has not as yet been recognized in the Syracuse area but this may be due to the fact that this horizon is concealed by the heavy mantle rock rather than to the absence of the shale. The first rock that has been observed outcropping above the Lockport limestone is the Vernon shale.

VERNON RED SHALE

Overlying the Lockport limestone is a great thickness of argillaceous shales, red and variegated at the base, gray to drab colored toward the top. Mingled with the upper gray shales are beds of calcareous and magnesian limestones, gypsum and rock salt, merging at the top into argillaceous dolomites or waterlime beds. In many of the older reports which followed Dana's classification, this whole series of beds is called the Onondaga Salt group and the argillaceous division at the bottom is called the Salina group, in distinction from the overlying waterlime beds. The Onondaga Salt group was divided into four divisions, the lower being the red shale, now called the Vernon shale, from the village of Vernon, in Oneida county.

It is difficult to determine accurately the exact thickness of the Vernon shales in this area. According to Prosser and Englehardt's interpretation of the Gale's well record made in 1884, there are 392 feet in that well boring; the well started in the shale, but how far from the top is not known, probably 50 to 100 feet. A rough determination from the outcrop of the shales and the dip of the strata would indicate a thickness of nearly 700 feet, but the dip of the shales may differ from that of the rocks in the plateau to the south; nor is there at present, without some well records, anything to show the uniformity or lack of it in the strata under the heavy overburden of rock.

The Vernon shale is a soft, argillaceous, hematite-red shale, but in a number of places the red is mottled with green. In places the green occurs in small masses the size of one's hand; elsewhere it forms huge masses of the deposit and sometimes there is an intermingling of the two colors.

The bright red color is due to diffused anhydrous ferric oxid. In the outcrop on the bluff on the north side of Onondaga lake some of the hematite occurs in brilliant crystals, but the greater part of it is intimately diffused through the mass of the shale. The green color in the shale is due to iron in the ferrous or lower oxid state. Part, if not all, of the color comes from the glauconite. The presence of some organic matter in the green spots has prevented the oxidation of the iron to the ferric state or has reduced any ferric iron that may have been present.[1]

Probably the largest outcrop of the Vernon shales on the Syracuse quadrangle is in the bluffs on the north side of Onondaga lake along the Oswego canal. Near the bottom of this outcrop there are several layers of rather coarse sandstone, the only sand that has been observed in the shale in this area. About 40 feet of the shale are exposed on the bank of the canal, and at the schoolhouse an eighth of a mile north of the canal is another exposure of about 20 feet, more than 100 feet above the bottom of the lower opening.

The shale is to be seen in a number of places north of the Erie canal, the best exposures being those at the north end of Wolf street, on the Syracuse-Oak Orchard road south of Cicero swamp, and at the New York Central railway yards at Dewitt. It underlies and forms the base of the hill in the north part of the city of Syracuse, and surrounds and probably underlies part or all of Onondaga lake. It may underlie the depression in which the Erie canal passes through the city, but there are no excavations or drill records by which to locate its boundaries here. There is one outcrop on the south side of the Erie canal, at Belle Isle on the west margin of the quadrangle, where the shale has been quarried and used for the

[1] W. J. Miller. N. Y. State Museum Bul. 140, p. 153.

manufacture of red brick. It has been used in large quantities for the same purpose at the village of Warner, a few miles west of Syracuse, and also near Kirkville some miles east of Syracuse.

The glacier that passed over this region removed large quantities from the outcrop of these red shales, distributing the material over the area south of the outcrop, thus leaving a rather broad belt across the area in which the soil covering is prevailingly red from these shales.

CAMILLUS BEDS

The Camillus includes a large part of the upper division of the Salina beds and embraces all the series of shales, gypsum, salt and limestones between the red Vernon shales below and the Bertie dolomite above. In this area it consists, from the top downward of:

1 Gypsum and gypseous shales
2 Thin bedded limestone (Fiddler's Green)
3 Gray to greenish colored shales inclosing deposits of salt and gypsum, with vermicular limestone and other calcareous layers.

The total thickness of the Camillus beds in the Syracuse area is about 600 feet and the outcrop forms a broad band across the quadrangle next in size to that of the Vernon shale. The upper gypsum bed, the underlying thin bedded (Fiddler's Green) limestone, and the vermicular limestone are well-defined lithologic units and mark definite horizons in the great bed of gray shales.

The *upper gypsum bed* varies from 25 feet to 63 feet in thickness in different parts of the area. It is an impure mass of gypsum with a variable percentage of intermingled shale and mud layers, but is the bed from which almost all the great quantities of gypsum quarried in the county have been obtained. The large and old quarries, some of which were operated more than a century ago, at Lyndon, between Lyndon and Jamesville, and those in the vicinity of Fayetteville and Manlius are all at this horizon. It contains a thin layer of salt at Lyndon.

Fiddler's Green limestone, immediately underlying the upper gypsum bed, varies from 20 to 40 feet in thickness and is a persistent bed across the quadrangle and beyond. It is a thin-bedded limestone dolomitic in character and, being more resistant than the overlying gypsum and the underlying shales, has a strong topographic relief, so that the surface exposures are much greater than any other portion of the entire Camillus group. The weathered surface of some of the layers is characterized by many sharp narrow grooves as though made by a knife, frequently forming two series cutting

Plate 1

Cobleskill

Bertie

Gypsum

Gypseous shale (Camillus) overlain by Bertie dolomite. In Miller's gypsum quarry near Lyndon, N. Y. Gypsum exposure 40′ and 20′ extends below floor of quarry

the surface into rhomboidal figures. Some of the layers are characterized by great numbers of the small ostracod Leperditia scalaris.

The limestone was quarried many years ago in the hill a half mile southeast of the university campus, and several other places in the region, for use in foundations, but its use has been very limited because as a building material it is inferior to the limestones in the overlying strata. It has been used locally in large quantities for constructing stone fences where the principal object was probably to rid the surface of the stone to make the land tillable.

Good exposures of this rock may be seen in the area north of the Split Rock quarries, in Chrysler's glen, in the Elmwood valley, in the rock cut on the Delaware, Lackawanna and Western Railroad south of Syracuse, at the east end of the railway channel, over large areas between the railway channel and the city, between Lyndon and the gypsum quarries and nearly continuous for several miles along the south side of the channel extending east from Real's station on the Jamesville trolley line, and best of all in the gorge below the falls at Fiddler's Green, which suggests the local name used for this bed. At Fiddler's Green both in the gorge and along the trolley line below the gorge it contains several well-marked thrust faults. Several smaller faults also occur in the rock cut in the railway channel. Stylolite markings occur at several exposures in this limestone, but are not limited to this horizon as they show to even better advantage in some of the dolomites higher in the series.

The remainder of the Camillus group underlying the Fiddler's Green limestone, nearly 500 feet in thickness, consists of argillaceous shales with several beds of limestone, rock salt and gypsum scattered through them. The limestones and the salt beds form distinct strata in the series but the gypsum occurs in threads, veins, and masses, diffused through the shale and nowhere forms persistent beds of any great thickness. Some of the gypsum is of the fibrous or satin spar variety and some of it is the transparent and translucent selenite. Considerable quantities of the selenite variety of gypsum were exposed in excavations on the university campus and in the quarries on the bank of the canal north of Fayetteville.

The shales are exposed in many of the excavations in building construction in the city and they outcrop on the surface in many places through the glacial drift covering. Among the many exposures where the shale may be seen and studied are the stream banks at Chrysler station on the Auburn suburban line, the cuttings along the same line, the bluff back of the Cold Spring brewery, in Elmwood park, the Delaware, Lackawanna and Western Railroad cut at Croton street, excavations on the university campus, along University and Crouse avenues and East Genesee street, several places along the Erie canal east of the city, and along the Suburban line to Manlius.

The *vermicular limestone* was described by Vanuxem in 1842[1] as follows: "It is a porous or cellular rock strongly resembling porous or cellular lava. It derived its name from the several holes, which were still lined with a kind of tubular calcareous shell or crust, in some measure resembling the tubular covering of the Serpula . . . but evidently the result of the simultaneous forming of the rock and of a soluble mineral whose removal caused the cells in question."

There are layers of a similar porous rock in the dolomites overlying the Camillus group. In the layers of the Cobleskill and Rondout waterlimes in the cutting for the trolley line at Fiddler's Green, near Jamesville, the spaces in the fresh rock were filled with celestite crystals. These were first described by Dr E. H. Kraus.[2] This led to the conclusion that the cavities in the vermicular limestone at several horizons in the Camillus group were also due to this mineral which had been dissolved on the weathered exposures. So far as known to the writer, no celestite crystals have been found in the vermicular limestone of the Camillus group, but the similarity of the rock to that at Fiddler's Green justifies the conclusion that the origin of the cavities is the same.

There is a fairly persistent bed of this vermicular rock in the city of Syracuse. It outcrops on the Delaware, Lackawanna and Western Railroad at Croton street, on Van Buren street, Henry street, on Crouse and University avenues at the same horizon, again on East Genesee street, and at several places east of the city, the best and largest exposure of all being along the Chenango branch of the West Shore Railroad a mile north of Fayetteville. There is a bed of limestone at or near the same horizon on the hill south of the Erie canal about a mile east of the city of Syracuse which is probably part of the same bed but here it has no vermicular cavities. There are calcareous and dolomitic layers in the Camillus shales at other horizons, notably near the bottom of the series in the hill in the north part of Syracuse. These limestones, so far as observed,

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[1] Geology of New York, pt 3, by Lardner Vanuxem, pp. 101, 273, 279.

[2] Am. Jour. of Science, v. 18, July 1905.

Plate 2

Fiddler's Green limestone in the gorge at Fiddler's Green

Fiddler's Green limestone (Camillus) a mile west of Elmwood park, Syracuse, N. Y., overlain and underlain by soft shale

are thin bedded and sometimes very hard, but tend to crumble on exposure to the weather, so that they do not appear at the surface in many places except where exposed by excavations.

BERTIE WATERLIME

The upper division of the Salina series immediately overlying the gypsum of the Camillus group, consists of a gray to buff-colored waterlime or dolomite. In this vicinity it is from 6 to 10 feet thick, made up of evenly bedded layers varying from a fraction of an inch to a few inches thick.

The stratum has been named from the town of Bertie, 6 miles west of Buffalo, in the province of Ontario. In Ontario and around Buffalo in western New York the Bertie waterlime is characterized by a rich eurypterid fauna, but no eurypterids, or in fact fossils of any kind, have been found in it in the Syracuse area. Since there is no unconformity of erosion at either the bottom or the top of this limestone and since it resembles lithologically the other waterlimes of the area, it has been separated from the other strata only by tracing it from the west where it is distinguished from the others by its fossil contents.

The upper part of the waterlime has been quarried extensively for the production of cement at Buffalo, Williamsville and Akron in western New York. At Buffalo it is 53 feet thick. Very little use has been made of it in the Syracuse area because the Manlius waterlime in the overlying rocks furnishes a superior quality of waterlime to the Bertie in this locality. A small quantity of it was used for cement in the Miller quarry a mile south of Lyndon in order to lessen the expense of quarrying the gypsum as the limestone had to be removed in order to get the underlying gypsum.

COBLESKILL DOLOMITE

The Cobleskill dolomite immediately overlies the Bertie waterlime in this locality without any sharp line of separation. In most places the Cobleskill contains numerous cavities about the size of a walnut or smaller, caused by the leaching out of a small coral, Cyathophyllum hydraulicum. In some places there are many irregular masses or lumps of chert scattered through the Cobleskill, and in general the bedding planes are more irregular than in the Bertie. It also resists the action of the weather better so that it stands out more in relief. In some localities, especially at Fiddler's Green, near Jamesville, the stylolite or suturelike markings are very pronounced. They can not be said to characterize the Cobleskill dolomite since they occur, though not so abundantly, in the other dolomites, particularly in the Fiddler's Green limestone. The stylolite markings are described by Vanuxem in his report in 1840; he calls them Epsomites and says they are due to the crystallization of epsom salts or magnesium sulphate in the limestone muds.[1] Several other explanations have been offered to account for these peculiar markings but none of them are altogether satisfactory.[2]

The best exposures of the Cobleskill dolomite and Bertie waterlime on the Syracuse quadrangle are at the Miller and Heard gypsum quarries a mile south of Lyndon and a half mile north of White lake; and in the ravine south of Chrysler's station on the Auburn suburban line. Other good exposures of the same rocks are on the hill above Manlius Center, on the electric line north of Jamesville, and at several localities near the western margin of the map.

At Cobleskill, the type locality for this limestone, it is about 6 feet thick, the same as at Syracuse. It thins out to some extent in Ontario county to the west and then increases in thickness to 14 feet in Erie county, where it is known as the "bullhead" or "pumpkin" limestone. In the older reports it is the "Coralline limestone" of Hall, with which it was correlated by Hartnagel in 1902. Previous to that time it was considered part of the Manlius limestone in the Syracuse area.

RONDOUT WATERLIME

The upper portion of the dolomite beds has been correlated by Hartnagel with the Rondout waterlimes. In this locality it comprises a greater thickness than the Bertie and Cobleskill beds combined. By greater lithologic changes it indicates a greater change in geographic conditions than do the others. So far as this area is concerned, it marks a long, fluctuating, transitional stage from the gray argillaceous dolomites of the underlying groups to the more compact, less magnesian, blue limestones of the overlying Manlius formation.

The Rondout of this region consists of gray dolomites interstratified with shaly layers grading, in places, into argillaceous shales. The upper part of the bed contains many finely straticulate layers with narrow bands of more calcareous limestone. Some of the layers near the base are richly impregnated with celestite crystals,

[1] Nat. Hist. N. Y., Geol. Surv. Third District, 1842.
[2] Am. Jour. Sci., 4:142, 1897.

and surfaces where these crystals have been leached out give the rock a vermicular texture similar to that of the vermicular limestone in the Camillus group.

Good exposures of the entire thickness of the Rondout are not frequent in the Syracuse quadrangle, because it is in general less durable than the overlying Manlius and Onondaga limestones which form cliffs and their fragments form talus slopes covering the Rondout. The best exposure on the quadrangle is in the ravine south of Chrysler's station on the Auburn electric line, where nearly every layer at this horizon is exposed. There is a good exposure along the electric line between Dunlop station and the penitentiary near Jamesville. This is on the northern margin of the Tully quadrangle. Other exposures near Syracuse are at Kimber springs on the west side of Onondaga valley (Tully quadrangle) and several places along the escarpment between Jamesville and Manlius.

The Rondout limestone is not used commercially at Syracuse, except locally for road ballast or rough building stone, because it is inferior to the overlying limestones as a waterlime, quicklime, or building stone.

MANLIUS LIMESTONE

The name Manlius was first used by Vanuxem[1] in 1842 as the "Waterlime group of Manlius," apparently including under this term the waterlimes of the underlying Bertie and Camillus groups. The name subsequently gave way to Tentaculite limestone until it was revived by Clarke and Schuchert[2] in 1899. In the type locality at Manlius, Hartnagel[3] gives a total thickness for the Manlius of 77 feet from the upper waterlime bed at the top to the Rondout, into which the Manlius grades without any sharp line of separation. This conception differs somewhat from that of Schuchert[4] and from that of Harris.[5] The difference seems to be in the delimitations at the top and base. There is still some question as to whether the Manlius properly terminates with the upper waterlime or should include the overlying Stromatopora layer and some of the accompanying blue limestone and, if so, how much. As the waterlimes are persistent and quite uniform in character in the Syracuse region,

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[1] Geol. N. Y., Third District, 1842, p. 110–16.

[2] Science, 10:874–78, 1899.

[3] N. Y. State Mus. Bul. 69, Rep't of State Pal. 1902, p. 1165.

[4] On the Manlius Formation of N. Y. Schuchert. Am. Geol., March 1903, p. 160.

[5] American Paleontology. Bul. 19. Ithaca, N. Y. 1904.

Hartnagel's section terminating the Manlius with the upper waterlime is very satisfactory for this area from a lithologic standpoint. Since the Manlius group terminates the Siluric sediments of this region, it has exceptional interest to the geologist. The thickness and general characteristics of the beds in the group are remarkably uniform across the Syracuse quadrangle, more so than that of the immediately overlying limestones.

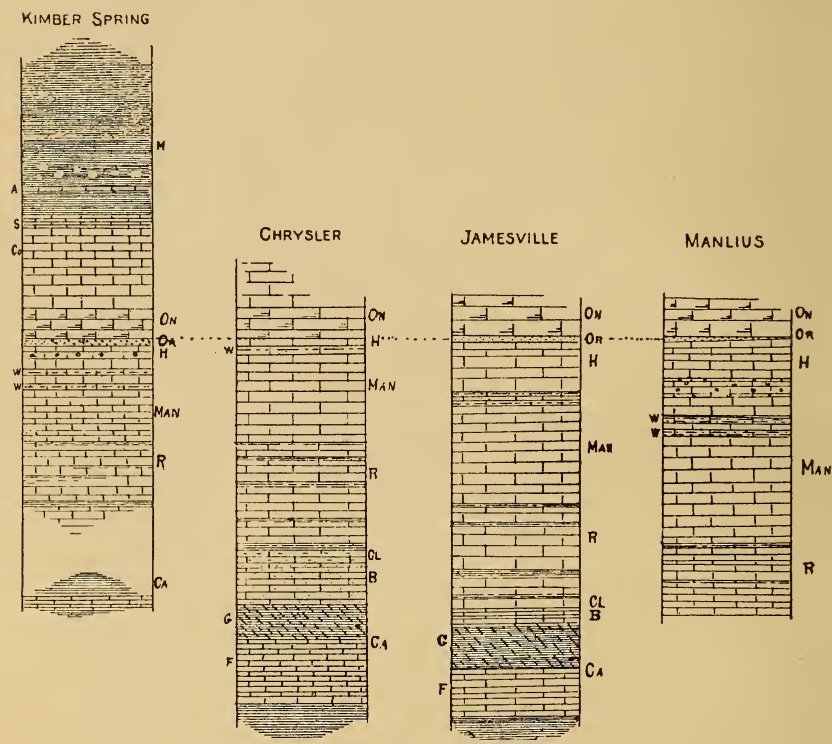

Fig. 1. Vertical sections of Manlius and associated groups

At the top of the group is a bed of waterlime generally about 4 feet thick, varying slightly in different localities, underlain by 4 to 5 feet of blue limestone known in the local quarries as the "diamond blue." It is a compact, calcareous limestone, comparatively pure, with many joint and fracture planes so that it comes from the quarry in small fragments. The blue limestone is underlain by a second bed of waterlime similar in character and thickness to the upper one. Or we might think of it as one bed of waterlime separated into two by a bed of blue limestone 4 to 5 feet thick through the middle of it.

The waterlime is an argillaceous dolomite in which the clay is intimately mixed through the carbonates in about the right proportion to make a good quality of hydraulic cement when it is burnt and ground. It was first used in large quantities about the year 1820 in the construction of the Erie canal and has been quarried and burnt for cement in variable quantities from that time to the present. The extent of the industry is indicated by the great number of quarries which are almost continuous along the outcrop across the area. The largest quarries are in the vicinity of Manlius, Fayetteville, Jamesville and along the escarpment between Onondaga valley and the Split Rock quarries. The industry has declined in recent years owing to the rapid increase in the manufacture of the Portland cement.

The portion of the Manlius limestone underlying the waterlime layers consists mostly of blue, in places nearly black, limestone in layers of varying thickness. Mingled with these compact calcareous layers are some drab colored finely straticulate layers of dolomite. In some layers the straticulation is so fine as to be scarcely perceptible until intensified by weathering.

The Manlius limestone is well exposed on the Syracuse quadrangle, forming an almost continuous outcrop across the quadrangle from High Bridge on the east to the Split Rock quarries on the west. It forms an important part, generally the middle portions, of the limestone escarpment that marks the northern limits of the Alleghany plateau.

The waterlime is barren of fossils in this locality. Some of the blue layers below the waterlime are very fossiliferous, the small brachiopod Spirifer vanuxemi being especially abundant near the base of the series. In the midst of the series Stromatopora is abundant, in places one layer, and in some places two layers, being composed entirely of this fossil. The Stromatopora of these lower layers strongly resembles that of the beds overlying the waterlime, but Hartnagel has found mingled with the Stromatopora in the upper bed a number of fossils of Helderbergian or Devonic age. Thus both the fossils and stratigraphy indicate that in this locality there was no very great geographic change separating the Siluric and Devonic periods.

DEVONIC

HELDERBERGIAN LIMESTONE

Overlying the Manlius limestone and occupying the interval between it and the Oriskany sandstone is a deposit of blue limestone over the greater part of this area that is correlated with the Helderbergian limestones farther east and is probably the equivalent of the Coeymans division of that group. There is a little uncertainty concerning the parting between this limestone and the underlying Manlius in this area.

If the upper limit of the Manlius is the upper waterlime layer of that group, as stated by Hartnagel,[1] then the problem is solved and the Helderbergian limestones extend west almost to the western border of the quadrangle; but if the upper Stromatopora layer and some of the associated blue limestone is Manlius, rather than Helderbergian as implied by Harris,[2] then Harris's further statement that the western limit of the Helderbergian is in the vicinity of Manlius is true and this group is scarcely represented on the Syracuse quadrangle. The limestones at this horizon are not markedly different from the blue limestones below the waterlime and the separation must be based on a refined study of the paleontology of the two. In the construction of the map the stratigraphy is based on the Hartnagel section and the Helderbergian extended westward until the upper waterlime and the Oriskany sandstone come together near the Split Rock quarries in the western part of the area.

Some 2 miles southwest of Manlius, in the southeastern part of the Syracuse quadrangle, there is a thickness of 50 feet of blue limestone at the Helderbergian horizon between the Oriskany sandstone and the upper Manlius waterlime. In this section the crystalline crinoidal layer of the Manlius section does not appear at all and the Stromatopora beds have a greater thickness; in fact, almost the entire thickness of 50 feet shows Stromatopora in abundance. At Jamesville, a few miles farther west, the thickness is 40 feet and at Britton's quarry, 3 miles farther west, it is 12 feet. At the Split Rock quarries on the west side of the Syracuse quadrangle it is not present at all, as the Onondaga limestone rests directly upon the Manlius waterlime.

ORISKANY SANDSTONE

The Oriskany sandstone occupies the interval between the Helderberg-Manlius limestones below and the crystalline Onondaga limestone above, and, in connection with the Onondaga limestone, forms the best key rock in working out the stratigraphy of the area. It is a coarse-grained sandstone lying in the midst of a great thickness of limestones and its position in the column need never be mistaken.

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[1] Loc. cit.

[2] American Paleontology. Bul. 19. Ithaca, N. Y. 1904.

Plate 3

In Britton's limestone quarry 3 miles south of Syracuse. The part above the man's head is the Stromatopora limestone (Helderbergian (?)). The lower layers are the Manlius waterlime, the middle layer a compact blue limestone.

Plate 4

Weathered surface of the Stromatopora (Helderbergian) limestone at Manlius

The prevailing color of the Oriskany is a light gray, generally with a yellowish stain from the hydrous iron oxid. In two places in the Syracuse region it has a reddish tint from the small admixture of red hematite. In a few places it contains some pyrite crystals which on the weathered surface have oxidized to the yellowish brown oxid.

In nearly every exposure where there is any appreciable thickness of the Oriskany, it contains black nodules of calcium phosphate, nodules varying from a fraction of an inch to several inches in diameter. These phosphate nodules characterize the Oriskany in many other localities and in some places through the Alleghany ranges in Pennsylvania the nodules are quarried for use as fertilizer.[1]

In many of the exposures the rock is fossiliferous, characterized by the number of individuals rather than by number of species. The fossils are largely brachiopods, Spirifer arenosus, Rensselaeria ovoides and Orthis hipparionyx, in which the calcium carbonate of the shells has been leached out by the ground waters, leaving the large casts which makes the rock very porous. Thus where the rock is below the water table and has any appreciable thickness, it makes an excellent water reservoir.

The Oriskany sandstone varies in thickness from a small fraction of an inch to about 12 feet in the Syracuse region. It increases in thickness to the east and south, reaching a thickness of about 700 feet in central Pennsylvania. The thickest exposure in this vicinity is on the hill above Rockwell springs, on the east side of the Onondaga valley, a mile northeast of Onondaga Castle, where it is 12 feet thick, consisting in part of thin bedded reddish sandstone. On the west side of the valley above Kimber spring it is 4 feet thick. Westward from the Onondaga valley it thins out rapidly, disappearing on the west margin of the sheet, to reappear again farther west. At the Split Rock quarries it is a mere fraction of an inch in thickness, and a mile east of the quarries it does not occur at all. In Russell's quarry at East Onondaga, it is about 2 feet thick; at Britton's quarry a half mile northeast, it is nearly 3 feet thick. At Green lake, 3 miles farther east, it is 2 inches thick. On the hill east of Jamesville it is nearly 4 feet thick. Farther east in the vicinity of Manlius it is in places a few inches thick and in places absent. Clarke[2] has explained these variations in thickness as more or less

[1] M. C. Ihlseng. Bul. 34, Pa. State College Agr. Exp. Sta., Jan. 1896.

[2] Lenticular Deposits of the Oriskany Sandstone: Science 1900.

discontinuous deposits laid down on a broken coast line. The continuation of these sands westward into Erie county is striking evidence of the increasing transgression of the early Devonic deposits over the Siluric lands.

In a number of places there is a mingling of the Oriskany sand and phosphatic nodules through the bottom part of the overlying Onondaga limestone, and in some places there are fragments of the underlying Helderbergian limestones embedded in the Oriskany or with the Oriskany sand embedded in the Onondaga limestone.

The Oriskany sandstone has no commercial value in the Syracuse area, since the bed is too thin and the rock too friable for building stone and it contains too much iron for glass sand. In the Juniata valley in central Pennsylvania it is used in large quantities for glass sand. There it is several hundred feet thick and almost free from iron. In some localities in Pennsylvania it is used in limited quantities for the phosphate content for fertilizer.

ONONDAGA LIMESTONE

The term Onondaga limestone includes that great mass of limestone about 100 feet thick between the Oriskany sandstone below and the Marcellus black shale above. It now embraces all the terms formerly designated by the names Onondaga, Corniferous and Seneca. The name was improperly applied by Dana and by some of the older writers to the salt and waterlime groups of the Salina period.

The lower portion of the limestone mass is known among the local quarrymen as the "gray limestone." It has a pronounced crystalline texture and, if it were white or bright colored, would pass in the market as marble. It has a thickness varying in this vicinity from 10 to 30 feet, and occurs in fairly heavy beds from 1 to 4 feet or more in thickness. It is quite fossiliferous throughout the area, containing many well-preserved corals, crinoid stems, brachiopods, gastropods, bryozoans and trilobites. The corals are especially abundant so that in many places it suggests a coral plantation. The fossils are calcite like that of the inclosing rock and are difficult to separate from the matrix without fracturing them. They are a little more resistant to the agents of disintegration than the matrix, become easily affected by secondary silicification and hence stand out in relief on the weathered surfaces.

The Onondaga limestone is the most durable rock in the section and hence stands out in bolder relief on the surface than any of the

Plate 5

Onondaga limestone at the north edge of the Allegheny plateau. Glacial and water-swept surface. Solution along joint planes

others. Except where buried under the floor of Onondaga valley and Butternut valley, it forms a continuous outcrop across the quadrangle. In most places it is the top layer at the northern edge of the plateau escarpment, as in the steep cliffs around the Green lake and Blue lake basins and along many of the deep depressions cut into the plateau. In many places the upper surface of this rock free from any soil covering extends over a width varying from a few feet to several hundreds of feet back from the cliff edge. The older residual material was scraped off by the glacier and the surface washed clean by the glacial waters. There has been very little disintegration from the temperature changes. Decay goes on almost entirely by solution and the rock is such a pure carbonate of lime that any slight residual matter left on the surface is washed away by the rains. As in other limestone regions, disintegration has been by the descending ground waters acting along the joint planes which have been opened up in this way into fissures varying from a few inches to several feet in width and extending down in places more than a hundred feet below the surface. These fissures in some places open up into caverns of some size. At the "Syracuse caves," 3 miles southeast of the city, some of these fissure caverns have been explored to a depth of more than a hundred feet and some hundreds of feet in length. Where this fissuring has been intensified it produces the well-known karsten topography.

In a few places there has been a little deposition of calcite on the walls of the fissures, but in general the deposition is very slight in comparison with the solution since most of the material dissolved has been carried away into the streams or deposited in the deeper portions of the underlying rocks.

Some of these fissures are open enough at the top to permit large quantities of snow to enter them during the winter months, and remain in the form of snow and ice during the greater part of the summer, forming what is known locally as the "ice caves." These occur in the cliffs around Blue lake and at the Split Rock quarries.

Overlying the lower crystalline portion of the Onondaga limestone is a thickness of 60 to 70 feet of a compact blue limestone containing many scattered concretionary masses of chert and hornstone. In the older reports this is known as the Corniferous because of the prevalence of the hornstone. The chert is very irregularly scattered through the limestone, yet it occurs in sufficient quantities and so distributed that no considerable body of the stone is anywhere entirely free from the chert, and thus it seriously injures the rock for industrial uses such as building stone or quicklime. Still it is suitable for crushed stone and is used in considerable quantities for road and railway ballast and concrete work.

The upper portion of the limestone was formerly known as the Seneca limestone and is characterized by great numbers of a small brachiopod, Chonetes lineatus. Many of these small shells have a decided pink color. This portion of the limestone is generally free from chert but contains considerable clay disseminated through the mass so that it crumbles rapidly on exposure to the weather and hence has no economic use.

The Corniferous portion of the limestone between the Seneca and the crystalline, while it contains many trilobites and other fossils, is much less productive of organic remains than the top and bottom layers.

MARCELLUS AND CARDIFF SHALES

Overlying the Onondaga limestone is a great thickness of Devonic shales that forms the higher hills and in fact the great plateau of southern and south-central New York. Only a few hundred feet of these shales occur on the Syracuse area. The overlying higher ones appear as one goes southward over the higher portions of the plateau.

Immediately overlying the Onondaga limestone is a bed of argillaceous fissile shale about 275 feet thick. Formerly it was all classed as the Marcellus shale but recently this term has been limited to the lower part, about 100 feet in thickness, and the upper portion is called the Cardiff shale.

The contact between the Marcellus and the overlying Cardiff shale is not sharply defined. The Marcellus is typically a black bituminous shale with numerous iron carbonate concretions scattered through certain portions of it, most abundant near the middle of the bed. The carbonate concretions vary in size from a few inches to several feet in diameter, sometimes nearly spherical in shape and sometimes flattened or lenticular. Some of the concretions have been shattered and the cracks filled in, forming typical septaria. Calcite, siderite, and barite are the common minerals filling the cracks in the septaria. In places the shale is twisted and distorted around the concretion caused by pressure exerted by the growing nodule.

As indicated on the map, the Marcellus shale crops out over an area about 4 miles in length across the southwestern corner of the Syracuse quadrangle. Good exposures of it may be found in the

Plate 6

The *Karsten,* showing effect of surface and ground water on Onondaga limestone. The water dissolves the rock along the joint planes forming deep fissures which widen into caves in places. Some of these fissures extend to a depth of 100 feet or more. On top of cliff at Blue lake

Outcrop of Marcellus shale showing the numerous joint planes and the effect of the joint planes on the rapidity of weathering. The exposure is on the bank of a brook which carries away the talus as it is formed

Plate 7

Concretions in shale. The curving of the shale is due to the pressure from the growing concretion

ravines at Onondaga hill and at the reservoir near the county almshouse, a mile west of Onondaga hill.

With the exception of the Agoniatite limestone, which carries a very prolific fauna, the Marcellus shale is nearly barren of fossil remains in the Syracuse area. Fish remains have been found in the carbonate nodules.[1]

No economic use has been made of the Marcellus shale in this vicinity. It contains possibilities in the source of material for the manufacture of brick and tile, but as yet no attempt has been made to so utilize it. Considerable money and energy have been wasted in digging in this shale in different places in search of coal. The similarity in color and structure of this shale to that usually accompanying coal beds is doubtless the cause of this ancient but vain search for coal.

AGONIATITES LIMESTONE

In the Marcellus shale about 15 feet above the base is a bed of impure limestone about 3 feet thick, known as the Cherry Valley or Agoniatites limestone. The latter name is from the numerous large coiled cephalopods, *Agoniatites expansus* Vanuxem, found in this limestone. It is very fossiliferous at every exposure in this vicinity, containing large numbers and varieties of goniatites and other cephalopods such as Orthoceras, Cyrtoceras and Gomphoceras. This limestone is a fairly persistent bed in this locality. It is exposed in a ravine a mile west of Onondaga Hill, and on the hill above Kimber spring on the west side of Onondaga Valley. It may be seen at a number of places along the road east of Jamesville on the Tully quadrangle. This limestone extends as far east as Schoharie county and west beyond Union Springs in Cayuga county.

The Agoniatites limestone has no economic value in this region. It is too crumbly for use as building stone and contains too many impurities for use as quicklime.

CARDIFF SHALE

The Cardiff shale overlies the Marcellus without any very sharp line of separation. It is typically a bluish gray argillaceous shale grading into the black Marcellus shale below and the Skaneateles shale above. It is named from the village of Cardiff, 10 miles

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[1] On some Dinichthyid armor plates from the Marcellus shale, by Burnett Smith. The American Naturalist, v. 43, Oct. 1909.

south of Syracuse, where it is about 175 feet thick. The maximum thickness represented on the Syracuse area is less than a hundred feet owing to the erosion of the upper layers. So far as known, the Cardiff shales are barren of fossils in the Syracuse area.

The higher divisions of the Devonic shales do not occur on the Syracuse area but are exposed farther south on the Tully quadrangle and are described in the bulletin relating to that region.[1]

ECONOMIC GEOLOGY

The mineral resources of the Syracuse area are varied and many of them important. They include (1) building stone, (2) crushed stone, (3) cement and lime, (4) sand and gravel, (5) gypsum and plaster, (6) clay and shale, (7) salt, (8) peat, (9) marl, (10) soil.

Many of these products have been mentioned in the preceding pages and most of them have been discussed in previous publications of the State Geological Survey. The brief account here given will serve as a local summary.

BUILDING STONE

All the limestones of the area, including the Onondaga, Helderberg, Manlius, Rondout, Cobleskill, Bertie, Fiddler's Green (Camillus) and the Lockport, have been used to some extent for building purposes. The most valuable of all for structural use is the lower or crystalline division of the Onondaga limestone, locally known as the "gray limestone." The Helderberg and Manlius blue limestones underlying the Onondaga have an extensive use for foundations, bridge piers, retaining walls, stone fences, and as crushed stone for macadamizing highways, for railway ballast, for concrete work, and with the Onondaga limestone for the manufacture of soda ash at Solvay. The underlying limestones, the Rondout, Cobleskill, Bertie, Camillus and Lockport, are all dolomitic and are all inferior to those mentioned above for structural purposes. They are used locally along the outcrops for rough building work for such structures as will not justify the expense of transporting the better stone from a distance.

All the limestones of the area are suitable for and all have been used for *crushed stone, concrete, macadam* and *railway ballast*. The largest quarries producing crushed stone for such purposes are those of the Rock Cut Stone Company in the railway channel 3 miles southeast of the city of Syracuse.

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[1] D. D. Luther. Geologic Map of the Tully Quadrangle. N. Y. State Mus. Bul. 82. 1905.

Economic features of the Onondaga limestone. The upper, Seneca, division of the Onondaga limestone, because of its poor weather-resisting qualities, has little or no commercial importance. The middle cherty or "Corniferous portion" is used extensively for crushed stone and locally for rough building purposes such as retaining walls, bridge piers and stone fences; but the scattered chert masses prohibit its use as a stone in superstructures. There are many miles of fences built of this stone in Onondaga county where it has been used largely to get rid of the many boulders scattered over the fields. Many of these fences are now being used to furnish stone for the macadamized roads in process of construction.

The underlying crystalline portion of the Onondaga limestone is among the best building stones in the State. Its durability is shown by its strong relief on all the outcrops and in the buildings in which it has been used. The interlocking crystalline grain has destroyed to a large extent the lamination of the rock, so that under the stonecutter's tools it acts like a marble. In fact, it is only the absence of bright color that prevents its use as marble. It has the strength, elasticity and somewhat similar structure of the best marbles.

The Onondaga limestone is as easily cut or drilled as the compact limestones of the region, but its texture makes it much more difficult to break. This quality renders it not only desirable for use in the walls of buildings, but especially so for purposes where great transverse strength is required, as in trimmings, sills, lintels, curbing, sewer caps and bridge work. It is the purest lime carbonate in the region and for that reason it was long used almost exclusively by the Solvay Process Company in the manufacture of soda ash. After exhausting the available supply of this stone at the Split Rock quarries, the company opened other quarries at Jamesville where at present it is using the underlying blue limestone.

The crystalline Onondaga limestone has had a more extensive use for building stone in Syracuse and vicinity than any other rock. It may be seen in the Hall of Languages and the Steele Hall of Physics on the university campus, in the City Hall, in the old Court House, and in many of the dwellings of the city. In most of the better class of dwellings it is used for the part of the foundation exposed above the surface, while the bottom or concealed portion of the foundation is of cheaper limestone. It has been used also in the better class of farm houses and suburban residences around Syracuse, and considerable quantities have been shipped by rail and canal to other points in the State. It has had an extensive use for bridge work, culverts, sewer caps, curbing, manholes and retaining walls.

The Split Rock quarries are the largest in the county but, as already stated, the stone from these quarries was used in the making of soda ash. The largest quarries from which the stone has been taken for building purposes are on the Onondaga Indian Reservation, about 6 miles south of the city and located in the Tully quadrangle. From the reservation quarries stone for buildings in Syracuse and elsewhere has been quarried for more than a century; much of the labor in the quarries was done by the Indians.

Besides the two large quarries mentioned, there are a great many smaller ones within the Syracuse region, from which large quantities of the Onondaga limestone have been taken.

Economic features of the Helderberg and Manlius limestones. The blue limestone layers of the Manlius have had an extensive use for structural purposes in the city of Syracuse and vicinity, for foundations, retaining walls and bridge piers. Large quantities of it are crushed for use in macadamizing roads, for railway ballast and for concrete. One of the largest quarries is that of the Rock Cut Stone Company, formerly the Alvord quarry, about 3 miles southeast of Syracuse on a sidetrack of the Delaware, Lackawanna and Western Railroad. The product of this quarry is shipped by rail to more distant points. The recently abandoned quarries of the Solvay Process Company at Split Rock have produced large quantities of the Manlius limestone in connection with the overlying Onondaga limestone. Other quarries in this rock are Britton's 2 miles south of the city; the Russell quarries at East Onondaga 2½ miles south; Dunlop's quarry; the Penitentiary quarry; and the new quarries of the Solvay Process Company at Jamesville, and numerous others at Fayetteville and Manlius and along the escarpment west of Onondaga valley. In fact there is an almost continuous chain of quarries in this stone across the Syracuse quadrangle.

The Manlius limestone has also been used for the making of quicklime at many places in the vicinity. Besides the continuous kilns located at many of the quarries above mentioned, there are numerous temporary kilns at many places along the outcrop. Most of these are abandoned now and at present very little quicklime is manufactured in this vicinity.

CEMENT AND LIME

While cement or hydraulic lime can be made from nearly all the argillaceous dolomites of the area, the two waterlime layers in the upper part of the Manlius group are so superior to the others that they are used almost exclusively for this purpose in the Syracuse area. They consist of a mixture of clay and the carbonates of lime and magnesia in about the right proportions to make a strong quick-setting hydraulic cement when burnt and ground. In portland cement the materials are mixed by man; in the waterlimes the mixing was done by nature in the deposition of the materials. The Manlius waterlime has been quarried and used in this area for nearly a century. It was first used extensively in 1821 in the construction of the Erie canal through this county. Owing to the great expense involved in removing the overburden the quarries are generally small and do not extend far back from the outcrop of the stone, but the quarries are numerous and form an almost continuous line across the quadrangle and beyond. The largest quarries are near Jamesville, Fayetteville and Manlius and the mills for grinding the cement are located in or near these villages.[1]

Quicklime for local use has been produced at many different points along the limestone outcrop. Both the large continuous kilns and the smaller intermittent kilns have been used for this purpose. The best quicklime is obtained from the blue Manlius, Helderberg and Onondaga limestones. The production of both the lime and the cement has nearly ceased in this area at the present time.

GRAVEL AND SAND

Gravel and sand are now used in ever increasing quantities in construction work, not only in mortars and masonry, but also in concrete in the foundations for buildings, roads and different engineering operations. The largest and best supplies of these materials are taken from the postglacial terraces which extend for miles along the sides of the Onondaga valley in and south of the city. Many pits large and small have been opened in these terraces on both sides of the valley. In some places sand alone is obtained, in other places gravel, and sometimes the sand and gravel occur together and are separated by screening at the pit or at the place where it is used. Besides the terrace deposits, there are vast quantities of both sand and gravel underneath the floor of the valley. The Onondaga valley has been filled in to a depth of several hundred feet and much of this filling consists of sand and gravel. Numerous pits have been opened in various parts of the city from which these materials have been taken out.

[1] For further particulars see 49th Rept. of N. Y. State Mus., 1895, p. 237–315.

GYPSUM

Gypsum, the hydrous sulphate of calcium ($CaSO_4$, $2H_2O$) occurs in large quantities on the area of the Syracuse quadrangle and the adjoining areas to the east and west. As its locus is in the Camillus shales, its distribution in the area is indicated on the map by the outcrop of the Camillus group. While it occurs at several different horizons in the shales, the largest and most continuous bed is at the top of the series immediately underlying the Bertie dolomite. Nearly all the gypsum quarries will be found along the line of contact of these two groups, the Bertie and the Camillus.

The maximum thickness of the gypsum in the area is reached in the quarries a mile south of Lyndon near the southeast corner of the quadrangle, where it has a thickness of 60 feet from which it varies to about 20 feet near the southwest corner of the map. The deposit is not all pure gypsum but contains carbonates and argillaceous material ranging from 1 or 2 up to as high as 20 per cent of the mass. The impurities are rather intimately mixed through the deposit, and the clayey matter appears to make up a larger percentage of the mass than it really does.

There is sufficient quantity of impurities in the gypsum to discolor it and make it unfit for finishing plasters, but the impurities do not seriously injure it for use in portland cement and land plaster. In the early days of the industry in this region nearly all the product was used for land plaster, for which purpose it was ground into a fine flour before being applied to the soil. Mills for this purpose are located at Jamesville and Fayetteville, but they are falling into disuse as less and less of the gypsum is being used for this purpose and more of it is being used in the cement industry.

The gypsum is added to portland cement as a retarder to prevent the cement from setting or hardening too quickly. While only a small percentage (2½ per cent or less) of gypsum is used in the cement, the aggregate amount so used is large owing to the enormous consumption of cement which has increased tremendously in the last one or two decades. It is for this purpose that much of the gypsum now quarried in this county is sold.

The most important application of gypsum of course is in the manufacture of wall plasters, in which it is replacing the lime mortar formerly used almost exclusively for this purpose. It is not only used as a mortar to apply directly to the wall, but some of it is made up into thin sheets with layers of paper, known as plaster board, which is nailed to walls and ceilings and does away with lath. A thin coat of plaster is put on top of the plaster board to cover the cracks and the nails. Plastered in this way, rooms are habitable as they are finished and the builder does not need to wait months or weeks for the dampness to get out of the wall. Various substances are mixed with the gypsum when used for plaster, some simply as coloring matter and some for other purposes. These mixtures are patented and sold in the market under the patented name.

The largest gypsum quarries are in the area south of Lyndon in an outlier separated from the Alleghany plateau by an east-west glacial channel extending through White lake. Some of these quarries have been in operation for a century and the supply is not yet exhausted. There are numerous abandoned quarries along the north edge of the plateau escarpment between White lake and Jamesville; in fact, it is almost one continuous quarry between these two points. The gypsum has been quarried on the outcrop back into the plateau until the thickness of the overlying rocks became so great that the expense of the removal of the overburden prevented further quarrying with profit. In a few places the attempt has been made to mine the gypsum underground without removing the overlying rock, but so far this has not proved very successful. Some gypsum has been quarried along the Delaware, Lackawanna and Western Railroad east of Butternut creek. The gypsum extends both east and west from the Syracuse area but in this locality most of the product has been derived from the area mentioned between Butternut and Limestone creeks in the southeastern part of the quadrangle. The bed is probably continuous to and beyond the quarries at Union Springs.

SALT

The Camillus shales contain the great beds of rock salt of central and western New York. The names Salina and Onondaga salt group in the older reports indicate the prominence of the salt in this locality; both of these terms, however, include the underlying Vernon shales as well as the Camillus. They were long known locally as the lower Salina red shales and the upper Salina gray shales. While some salt is reported to have been found in the red shales, it is the gray or drab colored Camillus shales that contain the commercial salt beds. The abundance of salt in this group explains the absence of fossils as the concentrated salt water and the arid conditions necessary to produce the same are inimical to both animal and vegetable life.

The larger salt beds occur near the base of the Camillus group in this locality, but there is seldom any salt in the solid form in the shales in the city of Syracuse or on the Syracuse quadrangle, or, in fact, anywhere else on or near the outcrop; because the salt is so soluble in water that near the surface it has all been leached out

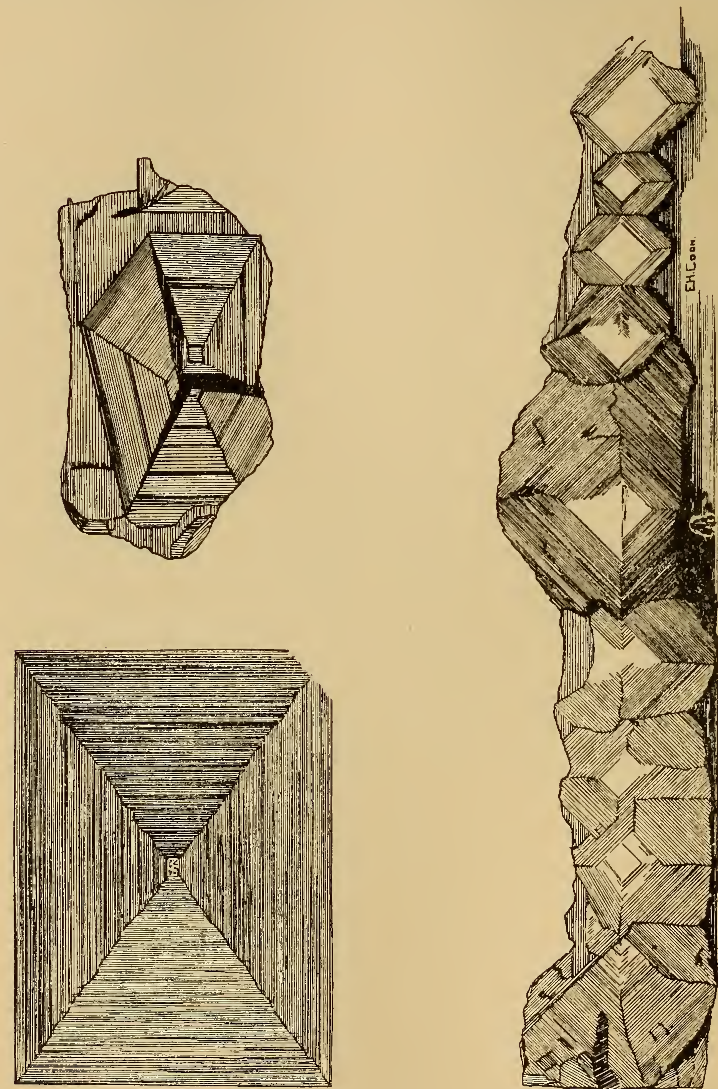


Fig. 2 Hopper casts of fossil salt crystals

by the percolating ground waters. The position in the Salina series of the salt beds as determined by the wells and shafts which penetrate the beds of rock salt, is called the *Syracuse salt horizon.* That salt formerly occurred in the now outcropping portion of the shales in the city is shown by the great number of casts or hopper-shaped imprints of the salt crystals. Under favorable conditions these hopper-shaped crystals were formed several inches in diameter.

The leaching out of the salt permitting the settling of the overlying beds would cause considerable disturbance in structure of these beds. Some folding and faulting does occur but apparently much less than one would expect, from which the inference is drawn that the salt beds probably were never so thick at Syracuse as they are farther south and west.

The salt industry at Syracuse is older than the city. Even before the days of the pioneers salt was obtained here by the Indians and the Jesuit missionaries, and since the first settlement by the whites the industry has been a continuous one. The first salt was obtained by boiling the water from the salt springs. When the springs failed to furnish a sufficient supply, wells were sunk and the water pumped to the surface. These wells are sunk in the sands and gravels on the flat at the east end of Onondaga lake where the water was found to be salty but no rock salt was found. The wells range in depth from 80 to 340 feet. To settle definitely the question whether or not salt occurred in solid beds under the area, two wells were drilled in 1884 to depths of several hundred feet. The State well was drilled at the south end of the lake and the Gale well on the east side of the lake; the former was sunk to a depth of 1600 feet and the latter 1969 feet, but no rock salt was found in either one of the wells. In the latter, brine was found at 485 feet, 532 feet, 1395 feet and 1500 feet.

It was long suspected by geologists that the salt in the brine springs and the wells at Syracuse was leached by the ground waters from beds of salt south of the city where they were protected by a great thickness of overlying rocks from the rapid action of the surface water. The existence of such beds was proved by the borings of the Solvay Process Company in the Onondaga valley south of the city. This company sank a well in 1881 at Jamesville to a depth of 1040 feet and abandoned it without finding rock salt. In 1882 they sank a well at Cedarvale about 10 miles southwest of the city to a depth of 1157 feet. Brine was obtained at a depth of 500 feet but no rock salt. In 1888 the company put down another well said to be near the center of the valley. This well was abandoned at a depth of 400 feet because the tube collapsed in a bed of quicksand. The next well was bored 1400 feet east of the latter and in this a bed of rock salt was struck at a depth of 1216 feet. The first salt bed 45 feet thick was followed by 25 feet of shale and then came a second bed of salt 54 feet thick. The next well was sunk about 4 miles farther north and about 1 mile south of Cardiff and was abandoned at a depth of 844 feet. Since that time the company has sunk many wells near the south end of the valley, finding rock salt in all of them. The salt occurs in several different beds separated by varying thicknesses of shale. The maximum total thickness of salt here found is 318 feet and the maximum thickness of a single bed is 74 feet.

Owing to the great depth of these beds, 1000 feet and more below the surface, the salt is not mined in the solid state, but water is run into the wells, the salt dissolved and pumped out in solution. The brine is then run by gravity through a pipe line to the soda works at Solvay where it is used in the manufacture of soda ash and various sodium compounds.

In the early days of the salt industry at Syracuse, all the salt was obtained by boiling the brine in kettles. The single kettles were in time followed by blocks of 60 or 70 kettles arranged in double rows and heated from a single fire. Some of these kettles were large enough to hold 150 gallons of brine. Many of them may now be seen in the region around Syracuse where they are used as watering troughs. In 1858 there were 312 salt blocks with 16,434 kettles of 90 to 150 gallons capacity. The kettle-boiling process was gradually abandoned and the solar process used more extensively. By the solar process the brine is evaporated in shallow wooden vats by the heat of the sun in the summer season, the vats not being operated in the winter. By this process a coarse salt used largely in meat packing and refrigeration is produced. By the kettle process a finer quality of table and dairy salt is made.

From 1797 to 1904 there were 430,000,000 bushels, or over 12,000,000 tons, of salt produced in the yards around Onondaga lake. The maximum output was in the year 1862 with 9,530,874 bushels. The wells were formerly owned by the State, which exacted a small royalty from the manufacturers, based on the amount of salt produced, but they were recently transferred to private ownership.

SWAMP AND LAKE DEPOSITS

PEAT, MUCK, MARL AND CLAY

In the lake basins and swamp areas of the Syracuse region are quite extensive accumulations of vegetable, animal and mineral matter of considerable economic importance. They have been

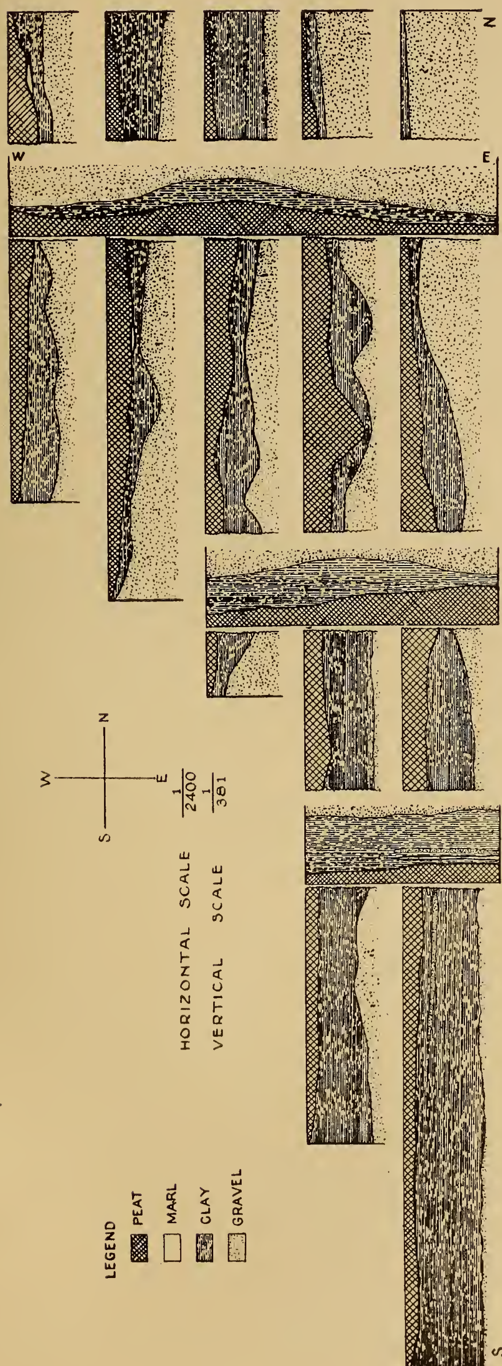


Fig. 3 Vertical sections across Cicero swamp

utilized very little as yet and the extent of the deposits below the surface is largely a matter of conjecture.

A systematic examination of a portion of one of the larger swamp areas of the region was made during the fall and winter of 1912 by two of the graduate students of Syracuse University.[1] In the course of the examination numerous borings were made by means of a clay auger through the swamp deposits to the underlying gravel. The borings were made at intervals of 100 feet along five north and south lines 300 feet apart. These north-south lines across the swamp varied in length from 1400 to 4300 feet, making in all 128 bore holes. From the hundreds of samples thus collected the character and extent of the deposits in this area were determined with a great degree of accuracy.

The results of the investigation showed at the surface of the area a bed of peat varying from 1 to 31 feet thick; thinnest at the margin and increasing toward the middle, but reaching a maximum north of the middle of the swamp as shown on the accompanying diagram. The clay underlying the peat is thinner near the middle of the swamp and thicker toward the margin, with the greatest thickness on the south side at the wider portions of the swamp.

The peat in the area studied is of dark granular material to a depth of 4 feet, below which to a depth of 10 feet it is more fibrous and compact. At the bottom it contains so much water that it forms a semifluid black muck. A sample from the surface of the peat gave 61.44 per cent moisture and one from a depth of 10 feet showed 84.275 per cent. Several tests for calorific value gave an average of 8448 B.T.U. Tests for ash gave an average of 5.12 per cent.

The light colored clays underlying the peat vary considerably in composition. A partial analysis was made of some two dozen samples from different parts of the area, the average of which was 70 per cent insoluble in dilute hydrochloric acid, 20 per cent calcium carbonate and 8 per cent alumina and iron oxid. The insoluble part ranges from 68 to 84 per cent and in one sample as high as 94 per cent. It consists of silica and insoluble silicates which were not analyzed separately. The calcium carbonate varies from 10 to 25 per cent; and the soluble alumina and iron oxid from 4 to 9.6 per cent, mostly alumina as the iron content was so slight that no

[1] The results of their exploration and study are placed on record in a thesis for the master of science degree at Syracuse University. The names of the men who did the work are Arthur E. Brainerd and Clinton W. Perry.

attempt was made to separate it. The source of this white clay is one of the most puzzling problems in the local geology. The great thickness and extent of the deposit rather taxes the imagination to ascribe it entirely to the leaching out of the coloring matter by the growth and decay of the organic matter of the overlying peat beds, especially so since most of the vegetable matter is of plants with small roots. The alternative views are almost equally taxing on the imagination, namely, that it is due (1) to a gradual accumulation of the clay, or (2) to the downward percolation of the swamp water through the bed of clay. Favoring the last view is the fact that the clay is everywhere underlain by a bed of gravel, but opposed to it is the character of clay which is so impervious to the movement of water that it would require such a long period of time.

No attempt has been made as yet to utilize this white clay, probably due to the fact that its existence is unknown to the industrial world. So far as known to the writer, this is by far the largest body of light colored clay in the State of New York.

In nearly all the other swamp areas in this region the peat is underlain by shell marl so far as their contents are known. This shell marl is composed of the remains of small calcareous shells which are still accumulating rapidly in many of the shallow lakes in the region. No systematic examination has been made of the marl deposits in the immediate vicinity of the city. Similar marl deposits were exploited and used in large quantities at the village of Warners, 15 miles west of Syracuse, in the manufacture of portland cement. The cement plant at Warners was abandoned some years ago and at present no marl is used in this portion of the State.

CLAY AND SHALE

Besides the bed of white clay in the Cicero swamp, there are many other clays and shales in the region. The surface clays have been utilized in a number of places in the manufacture of red building brick and tile, and to some extent for paving brick.[1]

The red Vernon shales have been utilized in the manufacture of brick at Belle Isle near the west margin of the quadrangle, near Kirkville in the east portion of the quadrangle, and at Warners 15 miles west of the city of Syracuse. There is an unlimited amount of this shale convenient to rail and canal transportation.

[1] Economic Geology of Onondaga County. 22d Ann. Rep't State Geol. N. Y. 1902. p. 109.

The other shales of this region, the Camillus, the Marcellus and the Cardiff, have possibilities as a source of material for the manufacture of brick and tile, but as yet none of them have been utilized.

SOILS

The soils of the Syracuse area were mapped and described by the United States Department of Agriculture in 1903.[1] This report shows thirteen kinds or classes of soils distributed over the area, as follows:

	ACRES
Miami stony loam	78 464
Miami silt loam	41 536
Miami gravelly loam	39 424
Miami fine sandy loam	19 968
Miami fine sand	14 528
Miami loam	9 728
Alloway clay	24 832
Muck	16 960
Swamp	12 480
Penn clay	3 840
Alton stony loam	3 712
Made land	576
Warners loam	128

The soil map referred to is twice the size of the map accompanying this report. It includes the area of both the Syracuse and Baldwinsville quadrangles of the United State topographic atlas.

The agricultural interests of the area are somewhat varied as are the soils. The dairy interests probably stand first in importance; truck gardening and fruit raising are both important. The rather steady growth of the manufacturing interests in and near the city increases the farming industry by furnishing better home markets.

STRUCTURAL GEOLOGY

The rocks of the Syracuse area are sediments formed in the Paleozoic sea, the shore of which was to the north and east. In the uplift of the area above sea level there was a greater elevation of the old landward side than of the new sea bottom areas which caused a tilting or inclination of the strata toward the south and west. There were probably several periods of uplift and depression, the algebraic sum of which is the present position of the rock

[1] Soil Survey of the Syracuse Area, by Bonsteel, Carter and Ayres. Field Operations of the Bureau of Soils, 1903, published in 1904.

Plate 8

A sharp fold in the Onondaga limestone. The layers where the man is standing are nearly vertical. A short distance to his right and left they are nearly horizontal

beds. While the rocks in most places appear to the eye to be nearly horizontal, if one follows a stratum a short distance north or south, it will be seen to have a marked dip to the south. Hence as one travels north across the area he passes over the outcropping edges of successively older rocks which dip underneath all the newer ones to the south.

In a few places the strata are rather sharply folded and in several places fractured and faulted. The most marked disturbances of the strata follow a nearly east and west direction near the north edge of the plateau and nearly parallel with the edge. The line of disturbance is not a straight one nor is it known to be continuous. It is probably not. The most easterly point at which this disturbance has been observed is near the Seneca turnpike between Jamesville and Manlius near Fillmores Corners. In the channel of a small brook south of the turnpike the Onondaga limestone is bent in a monoclinal fold almost at right angles, as shown in the accompanying view (plate 8). The continuation of the fold eastward is shown in the next ravine and it appears again on the roadside a quarter of a mile west in a cutting in the Marcellus shale.

The disturbance is shown by several thrust faults at Fiddler's Green. There are two faults with the overthrust to the north in the gorge below the falls and two others in the cutting made for the trolley line at the north end of the gorge. The displacement varies from a few inches to about 4 feet. (Plates 9 and 10.)

At Russell's quarry 4 miles west of Fiddler's Green at the southern edge of the Syracuse quadrangle and the north margin of the Tully quadrangle, there is a thrust fault in which the Manlius limestone is thrust northward over the Onondaga and Oriskany. The vertical displacement is 42 feet. At the south end of the quarry there is a sharp monoclinal fold to the south in the Manlius limestone. Half of a mile north of Russell's quarry there are several small thrust faults in the Fiddler's Green limestone in the railway cut.

There are some horizontal faults in the Onondaga limestone at the quarries on the Indian reservation 3 miles south of Russell's quarry. In an abandoned limestone quarry on the hillside southwest of Elmwood the rocks are bent and fractured in a somewhat complex manner.

In Maylie's quarry, a mile southeast of Marcellus on the Skaneateles quadrangle, there is a thrust fault with a vertical displacement of 3 feet.

It is possible that similar faults to those mentioned occur on the area north of the plateau escarpment, but their existence is not known. The covering of mantle rock is so continuous and the exposures of the rock so limited in number and size that no fault planes have been observed; they may or may not be present.[1]

IGNEOUS ROCKS

At several places in the city and in the vicinity molten rock was forced up from the deeper portions of the earth through cracks or fissures to or near the surface, forming dikes of igneous rocks. One of these dikes in the city is exposed on Green street near Lodi and has been traced by means of excavations for a mile or more from that point through the city. If it were not for the heavy covering of mantle rock concealing it, it could probably be traced much farther. The excavation for the Dewitt reservoir a few miles east of the city is in a dike of igneous rock similar to that on Green street. These peridotite dikes and others of similar character are described in the following pages in a paper by B. W. Clark on the *Peridotite Dikes of Central New York*.

PHYSIOGRAPHIC FEATURES

The physiographic features of the Syracuse region, while quite varied in character, are all comprised in two of the great physiographic regions of the State, namely, the Alleghany plateau on the south and the Ontario lake plains on the north. There is sufficient complexity of detail in each of these regions to give variety and interest to the scenic features, some of which are quite striking. The greater part of the Syracuse area is on the lake plains; only a small fraction along the southern margin catches the northern edge of the plateau.

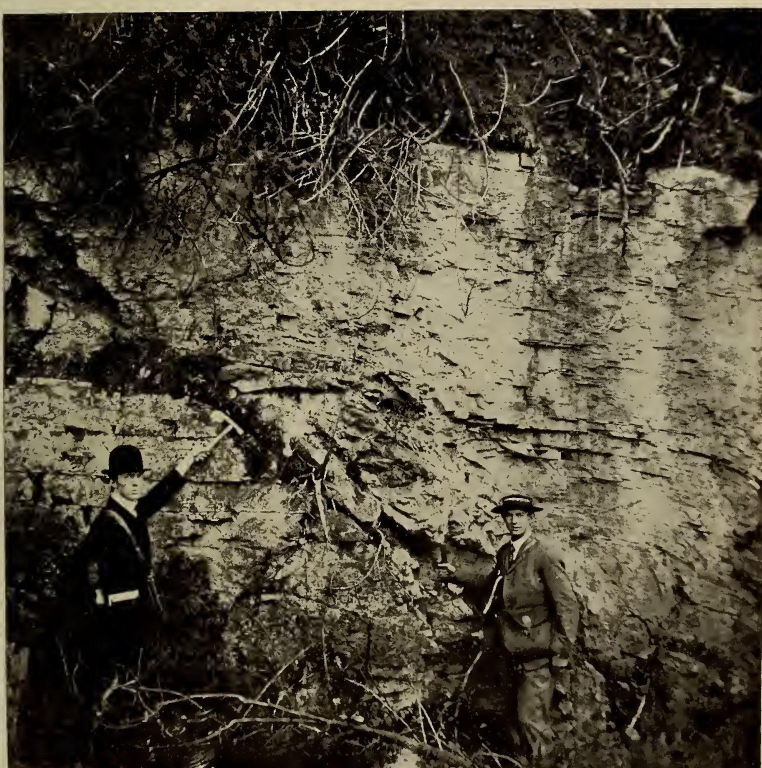
Since the northern edge of the plateau has been beveled by the ice and other weathering agencies, the part on the Syracuse quadrangle does not nearly reach the maximum height of the plateau. The highest point on the quadrangle is a little over a thousand feet above sea level, while farther south the plateau rises to about three

[1] For further account of these faults and folds, see Luther, Economic Geology of Onondaga County. 15th Ann. Rep't N. Y. State Geologist, 1895. Also P. F. Schneider, Note on some overthrust faults in central New York. Am. Jour. Sci., v. 20, Oct. 1905, and The Marcellus Fault, Onondaga Academy of Sciences, 1899.

Plate 9

Fault plane in the gorge at Fiddler's Green, near Jamesville. Thrust fault. Note the curving of the ends of the layers at the break

Plate 10



Thrust fault in the Fiddler's Green (Camillus) limestone along the electric line 200 yards north of Fiddler's Green station

Plate 11

Glacial channel or gorge cut in Manlius limestone by glacial waters 2 miles south of Fayetteville

times this elevation. The lowest point on the area is 360 feet, thus giving a maximum relief on the area of the quadrangle of approximately 640 feet.

CHANNELS

The northern edge of the plateau is a somewhat bold limestone escarpment very irregular in contour. The north-flowing Onondaga and Butternut creeks have cut deep valleys or trenches in the plateau, thus dividing the escarpment on this quadrangle into three parts. Smaller streams have cut notches between the larger creeks thus giving the escarpment a jagged as well as broken appearance.

In addition to the north-south valleys, the north end of the plateau is diversified by a number of east-west valleys or trenches across the interstream areas, some of which are of considerable size and interest; some of them near the escarpment have separated considerable masses or outliers from the plateau, thus adding to the diversity of the relief.

The peculiar interest attached to the east-west valleys is that they were formed in large part by temporary streams sometimes of large size during the closing part of the Pleistocene glacial period and thus become fossil pleistocene channels. During the recession or melting away of the continental ice sheet, there came a time when the southern end of the ice was in the vicinity of Syracuse and the waters from the melting ice and from the plateau having no outlet northward through the St Lawrence valley as at present, found an escape eastward through the Mohawk valley. This eastward flow from the Onondaga valley to the Butternut and from the Butternut to the Limestone valley caused the erosion of a number of deep channels across the ridges separating the north-south valleys. The first of these channels formed on the area of the Syracuse quadrangle is about 3 miles south of the city and over 1 mile north of Jamesville. It is known locally as the Railway channel, as the Delaware, Lackawanna and Western Railroad passes through it. The channel is about 3 miles long and a quarter to a half of a mile wide. The floor of the channel is 150 to 250 feet below the level of the plateau in which it is cut and the western end is 150 feet above the bottom of the Onondaga valley and the eastern end about 80 feet above the level of the Butternut valley. It thus forms a unique type of hanging valley, that is, one that hangs at both ends.

During the time when the water was flowing eastward through the Railway channel, the ice front was probably near the north bank of the channel. As the ice front retreated northward it permitted the escape of at least part of the waters through another channel half of a mile north of the Railway channel. Later part of the waters passed north of east through a shallower channel crossing the southeastern part of the city of Syracuse, and still later the waters passed eastward through the central part of the site of the city, through the depression now followed by the Erie canal and the New York Central Railroad.

While the channels mentioned were being formed through the divide separating the Onondaga and Butternut creeks, other contemporaneous channels were in process of formation west of Onondaga creek and east of Butternut creek, in the southwest and southeast portions of the area of the Syracuse quadrangle.[1]

TERRACES

During the period that the channels were being cut by the east-flowing waters, the north-south valleys, such as the Onondaga and the Butternut, would be partly filled by the impounded waters forming temporary lakes in which the water would stand at successively lower levels as the lower cross-channels were opened one after the other. Where such lakes remained at the same level for a considerable period of time, more or less well-defined shore features would be developed, especially sand and gravel terraces. Besides their interest as topographic features, these terraces are important commercially as from them are obtained the large quantities of sand and gravel required in structural work in and around the city.

The terraces occur at several different levels, at least five fairly distinct ones appearing on the higher hills south of the city. On the area of the Syracuse quadrangle the most prominent terrace is near the level of the 500 foot contour above sea level. It shows on both sides of the Onondaga valley but is more prominent on the east side. It marks the west margin of the Syracuse University campus. Eastward from the campus through the city it has been largely obliterated by building operations, but southward it is nearly continuous as far as the Indian reservation. Large quantities of sand and gravel have been removed from this terrace at the Calthrop residence on South Salina street, at Kelley's coal yard on the Delaware, Lackawanna and Western Railroad and other points. On the west side of the Onondaga valley this terrace is quite promi-

[1] For further details of the surface geology of this region, see the various papers by H. L. Fairchild published as bulletins of the N. Y. State Museum.

Plate 12

In the glacial cross channel a mile west of Elmwood. Looking down the channel. The mound in the middle of the picture lies in the channel near the north side. The north bluff shows through the tree at the left. The south bluff is terraced and covered with forest growth on the right

Plate 13

In the Burnet park cross channel looking west from site of the House of Providence

Plate 14

View from the hill about the Onondaga Indian Reservation, looking northwest across Onondaga valley showing the extensive sand and gravel terrace on the west side of the valley

nent from Hopper's glen southward by Dorwin spring and through the Indian reservation.

The hill in the north part of the city of Syracuse north of the Erie canal was an island in the glacial Lake Iroquois, and the shore terraces of the extinct lake are quite prominent on the north and west side of the hill. A gravel pit a few blocks northeast of the Wolf street car barns shows the beach structure of the terrace (pl. 15).

Terraces probably of a little more recent date show distinctly along the south side of Oneida lake.

LAKE PLAINS AND DRUMLINS

From the plateau ecarpment northward, the area is a somewhat variegated plain stretching to the shore of Lake Ontario and known as the Ontario Lake plain. The area on the Syracuse quadrangle is part of a large area stretching west beyond the Niagara river and eastward until it merges into the plain of the Mohawk valley. Scattered over this lake plain are a few outliers of the plateau, one of which is the hill in the north part of the city of Syracuse, and a great many oval-shaped hills known as drumlins.

Most of the drumlins lie west of the Syracuse area but there are a few in the city and east of the city. On the plains west and northwest from the city there are scores of these drumlins. One of the drumlins known as Mount Olympus occurs on the southern margin of the university campus and several others east and southeast of the campus.

The surface of the drumlins in the Syracuse area consists of a reddish till or boulder clay derived in large part from the outcrop of the Vernon shale. The north end of the drumlin on the campus has been cut away in the building operations of the university and shows a bedrock core of the drab colored Camillus shales. To what extent the other drumlins of the area have rock cores, constituting what are known as rocdrumlins, is not known.

HYDROLOGY

The area of the Syracuse quadrangle all drains through the Oswego river into Lake Ontario. The central and southwestern part of the area drains into Onondaga lake through Ley, Onondaga and Ninemile creeks and their tributaries and thence into the Seneca river, the junction of which with the Oneida river forms the Oswego river. The southeastern part of the area is drained by Butternut and Limestone creeks which flow into Oneida lake and thence through the Oneida river to the Oswego river at Three River point.

The divide between the Onondaga lake drainage and that of Oneida lake is only a few feet above either lake in some places. It would be close to a line drawn from a point north of the middle of the west margin of the map in a southeastern direction to near the middle of the east margin and thence southwesterly through the southeastern part of the city and then south to the middle of the southern margin.

The area contains part of Oneida lake, the largest lake in the State of New York, all of Onondaga lake and two small lakes, White lake and Evergreen lake, in the southeastern corner of the quadrangle. There are also several artificial ponds or reservoirs on the area.

The area lies near the eastern end of the Finger Lake district of New York. Of the Finger lakes, Onondaga and Oneida are the only ones that lie wholly on the lake plains, the others occurring in depressions in the Alleghany plateau. Hence these two lakes are much shallower than any of the other Finger lakes. Onondaga lake is 5 miles long, 1 mile wide and 66 feet deep. Oneida lake is 22 miles long, 6 miles wide and 60 feet deep.

There are numerous small springs and seepages that help supply the water for the lakes, swamps and streams. Much of the spring water is classed as hard water because of the large quantities of carbonate of lime carried in solution. Considerable quantity of the lime carbonate in the form of calcareous tufa has been deposited in places by these calcareous springs. Extensive deposits of shell marl in lakes and swamps indicate the great quantities of lime carried in solution. Some of the best known springs in the vicinity of the city are Kimber and Dorwin springs on the west side of Onondaga valley and Rockwell springs on the east side of the valley (on the Tully quadrangle). There are many calcareous, sulphur and chalybeate springs east, west and south of the city.

As indicated by the numerous springs, lakes, swamps and streams, the water table lies near enough to the surface to be easily accessible for wells all over the area. Any place not accessible to the water pipe lines of the city or villages or to good springs can obtain a local supply of water from wells. The wells producing the most copious supply of water will be those which reach the water table in beds of sand or gravel in the mantle rock in the bottom of the valley or on the lake plains. Wells sunk in the bedrock will vary in the

Plate 15

Gravel pit near the Wolf street car barn, showing beach structure on the shore of glacial Lake Iroquois

Plate 16

"Mt Olympus," a drumlin on the Syracuse University campus

supply of water as the strata differ in porosity, but none of the strata in the area are exceptionally good aquifers so that the supply of water from many of the wells is limited, yet for the most part sufficient for household and farm purposes.

Deep wells in the middle portions of Onondaga valley will get salt water similar to that in the wells at the east end of Onondaga lake.

THE PERIDOTITE DIKES OF SYRACUSE AND VICINITY [1]

There are several localities in central New York in which dikes of basic rock cut through the Paleozoic sedimentaries. There is such a dike in the city of Syracuse, one at the Dewitt reservoir, 3 miles east of the city, another near Otisco lake, some 15 miles southwest of the city. Other dikes somewhat similar to these are known to occur near Itahaca farther to the southwest and at Manheim farther to the east.

The occurrence of these dikes in the midst of the great area of Paleozoic sediments far removed from any volcanic or batholitic areas have naturally aroused considerable interest. The Syracuse dikes are here described, brief notice is taken of the other localities, and the bibliography aims to cover all the literature available relating to the different dikes. The literature of the subject is listed chronologically at the end of the chapter and numbered serially. Reference to these papers in this chapter is given by the serial number.

HISTORICAL

The Syracuse peridotite dike, commonly known as the Green Street dike, was discovered in 1837, by the late Professor Oren Root of Hamilton College, at that time principal of the Syracuse Academy. He recognized the rock as a serpentine and brought it to the attention of Lardner Vanuxem who was then engaged upon the geological survey of the Third District. Vanuxem's description of the dike in his report on the Third District of New York, 1839 (1), is the first mention of it in geological literature. He there says: " The green and traplike rocks observed near the top of the hill to the east of Syracuse, have been examined so far as time would

[1] Much of the material for this chapter was collected by Burton W. Clark and presented by him in a thesis for the M.S. degree at Syracuse University in 1908. The dikes near Clintonville were discovered after his thesis was written. I am responsible for the form and arrangement as here presented. T. C. H.

admit. They are all serpentine, more or less impure, and of various shades of bottle green, black, gray etc. They all produce sulphate of magnesia by oil of vitriol. These serpentines are at least new varieties for our country. Some have a peculiar appearance like bronze, owing to the small goldlike particles, with a lamellar structure, resembling bronzite or diallage metalloid. Also other particles highly translucent, like precious serpentine, with frequently small nuclei resembling devitrifications or porcelanites, colored white, yellow, blood red, variegated etc. The grain of this kind is like common serpentine. In other kinds, the mass seems to be made of small globuliform concretions, varying in size, being centers of aggregation; some are of dark vitreous and serpentine, others of the compact kind, the enveloping part of a light color. The first impression of this rock is like some of the New Jersey trap rocks, where amphibole is in imperfect crystals, or like pyroxenic lava, with its imperfect crystals embedded in the more compact material.

" These two principal varieties produce endless mixtures upon the small scale, to say nothing of those derived from the difference of shades of color, the presence of veins and mixtures with the associated shales."

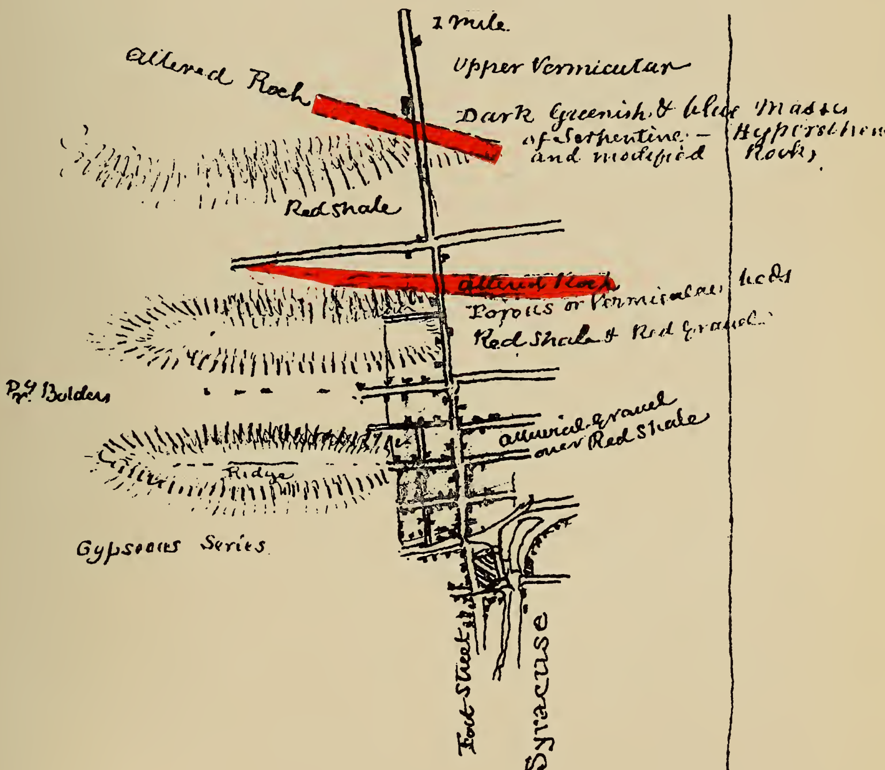
" These serpentines seem to resemble the ophiolites of Tuscany and Florence, and should the views of Brocchi be correct, they must not only be similar in origin but in age."

Vanuxem in his final report in 1842 (2) again describes this rock under metamorphic rock and says: " The great interest of all these metamorphic products is that they have not been caused by a dry heat or fire, no evidence of the kind existing; nor is any needed to effect the change there observed, though it can, and has, and does produce the same results. All that is required, is the presence of the elements of the products observed at Syracuse, and in a state admitting of solution and of moisture, to which every degree of heat added, would greatly aid their mutual action upon each other; and from solution crystallization would take place, and thus metamorphic products or rocks would be formed, no igneous action commonly so-called being requisite, but a thermal one only."

In the same year as Vanuxem's final report, 1842, Lewis C. Beck in his Mineralogy of New York refers to this dike under the caption *Serpentine* and quotes from Vanuxem's report.

In 1858 Dr T. Sterry Hunt (History of Ophiolites (4)) says: "At Syracuse, the strata between the two beds of porous limestone just described, are much altered; the shales are rendered harder,

Plate 17



A sketch of the serpentine dikes at Syracuse, copied without change from a field notebook of the New York State Geological Survey, 1841, and drawn by R. C. Taylor, an English geologist who accompanied the State geologists during that field season. It will be observed that in this sketch two dikes are represented, although at the present time but one is known.

and some portions of the calcareous rocks have become crystalline and are filled with crystals of celestite and calcite, while other beds are converted into a calcareous ophiolite. . . . I found a portion of this ophiolite in powder to be readily attacked by acetic acid, which dissolved a large amount of carbonate of lime, besides a little magnesia, and traces of alumina and iron. The analysis of the serpentine gave me: silica 40.67; magnesia 32.61; protoxyd of iron 8.12; alumina 5.13, and water 12.77."

So far as known, this is the first analysis made of this rock.

Doctor Hunt describes this rock as metamorphic. He says: "Ophiolites have generally been regarded as intrusive rocks. In southern Europe they occur in injected masses traversing the disrupted nummulitic strata, but they are also found in the same region interstratified with limestones, and with micaceous, chloritic and talcose schists which are regarded as altered Triassic strata. In North America the ophiolites of the Laurentian, Silurian and Devonian formations are all apparently magnesian sediments which have been metamorphosed *in situ* and never so far as I am aware assume the form of intrusives. . . . I have already shown that the action of a solution of alkaline carbonate at a slightly elevated temperature upon mixtures of earthy carbonates and quartz suffices to convert the bases of these into hydrous silicates. The same agent has at the same time given rise to the feldspar and mica of the associated strata."

George Geddes (5) in his Report on the Geology of Onondaga County in 1860 described the dike rock as follows: "There are two masses of this vermicular rock, one low down, of about 20 feet in thickness, appearing on James street, Syracuse, and at various other places; the upper mass is thinner but its thickness is not uniform. In the lower mass on James street, are some specimens of crystalline character, being serpentines, the action of crystallization having been very powerful but local, producing mica, and even nodules of granite, or rather syenite."

The next mention of the dike was by Dana in the second edition of his Manual of Geology, 1875, (6) in which he says: "Near Syracuse, there is a bed of serpentine in this formation (Salina), along with whitish and black mica, and a granitelike rock, in which hornblende replaces the mica, making it a syenite; there is little evidence of heat in the beds adjoining these metamorphic rocks. (The position of this locality is not now known)." The same statement is made in the third edition but omitted from the fourth edition.

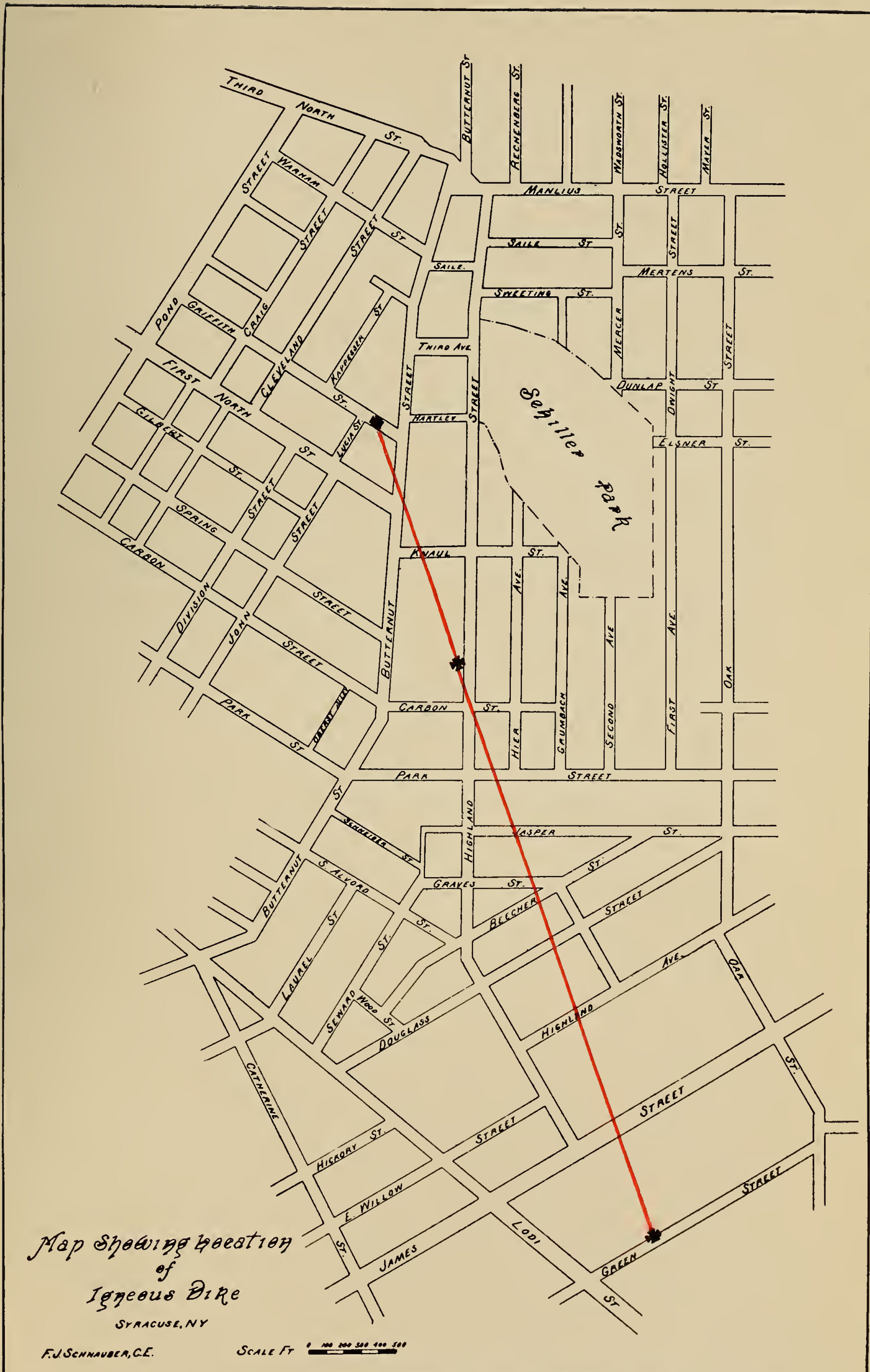
George H. Williams published a preliminary account of this rock in March 1887 (9) and in August of the same year he gave (10) the most complete account up to this time. He showed that the rock was not metamorphic in origin but a peridotite dike of igneous origin. In his article he says: "The main points of evidence, therefore, that the serpentine at Syracuse was originally an igneous and intrusive rock, belonging to the family of peridotites, are as follows: (1) the structure of the rock, which is such as is only known to be produced by crystallization from a molten magma; (2) the existence of a more granular and porphyritic modification, as is so often the case in eruptive dikes; (3) the inclusion in the rock of fragments of the adjacent limestone and possibly of other rocks brought up from below; (4) the indication that these limestone fragments have been modified by the action of heat; (5) the fact, stated by Mr Wilkinson, that 50 feet away from the exposure, on the strike of the rocks, only gypsum was encountered." He adds: "This evidence has been developed at such length, because aside from its bearing upon Doctor Hunt's theory of the origin of serpentine, this rock is interesting as being the only known instance in the unaltered and undisturbed Paleozoic strata of New York."

This last statement overlooked the records already published on the Manheim, Ithaca and Ludlowville dikes.

Williams compares the Syracuse peridotite with that of Elliot county, Kentucky, in which he says: "In structure, the two rocks present the closest possible similarity. The size and form of the large porphyritic olivine crystals appear to be identical in both; the ground mass of both also has the same appearance, containing in each case an abundance of opaque and transparent octahedral crystals. Nevertheless, certain mineralogical differences are apparent. The pyrope with its alteration rim, described by Mr Diller, is wanting in the Syracuse rock; ilmenite too, estimated to compose 2.2 per cent of the Kentucky peridotite, was not detected in the Syracuse occurrence. On the other hand, biotite and enstatite are much more important constituents in the latter than in the former. . . . The little transparent crystals in the Kentucky peridotite are considered by Mr Diller as anatase (octahedrite) while those in the Syracuse rock must, however, be regarded as perofskite."

Following Williams's paper were others by J. F. Kemp (35) and by P. F. Schneider (19), (24), (27), (29); D. D. Luther (21); C. H. Smyth, jr (25); and E. H. Kraus (31).

Plate 18


Map Showing Location of Igneous Dike
Syracuse, N.Y.
F. J. Schnauber, C.E.
Scale Ft 0 100 200 300 400 500
Schiller Park
Third North St.
Butternut St.
Rechenberg St.
Wadsworth St.
Hollister St.
Mayer St.
Manlius Street
Saile St.
Mertens St.
Sweeting St.
Third Ave.
Dunlap St.
Elsner St.
Knaul St.
Carbon St.
Park Street
Jasper St.
Graves St.
Beecher St.
Highland Ave.
Douglass
Catherine
Hickory St.
E. Willow St.
James
Lodi St.
Green Street
Oak St.
Mercer
Dwight
First Ave.
Second Ave.
Grumbach Ave.
Hier Ave.
First North St.
Gilbert St.
Spring St.
Division
John Street
Cleveland
Pond
Griffith
Craig
Warham
Lucia St.
Kappesser St.
Hartley
Schneider St.
S. Alvord
Laurel St.
Seward
Wood St.

THE DEWITT DIKE

In 1894 P. F. Schneider discovered a new occurrence of peridotite, similar to the Green Street rock, at the Dewitt reservoir. This rock was described by N. H. Darton (35) (36) and J. F. Kemp (35). It was also described by Luther in his Report on Onondaga County (39) and an analysis of the rock was published by H. N. Stokes in Bulletin 148 of the United States Geological Survey.

DESCRIPTION OF THE SYRACUSE AND DEWITT DIKES [1]

The Syracuse dike is known to extend about seven-eighths of a mile north from Green street; how much farther is not known owing to the heavy mantle of glacial drift that covers the adjoining area. It is now exposed on Green street in the middle of the street and on the bank on the north side of the street. During the past decade it has been exposed in excavations for sewers along Highland avenue and Farmer street, some of which extending down to depths of 20 feet or more exposed the fresh unweathered rock. From these excavations the dike, or rather system of dikes, is known to extend nearly a mile; how much farther will not be known until future excavations expose it to view.

Excavations into the dike mass showed not a single dike but a complex of them in several places more or less parallel dikes varying from 5 to 35 feet thick; some of these have been traced for some distance, but the excavations were too limited to map the separate dikes. It is quite probable that these separate dikes are all united at some point or points below the surface and form parts of a single igneous intrusion that has found its way to or near the surface through a series of cracks. There seems to be no way of determining definitely whether or not these dikes poured any of their contents out over the surface of that time, nor is it possible to tell how great a thickness of rocks has been eroded from the present surface since the dike was intruded, but the bending upward of the shales in the walls of the dikes in several places would indicate, although it does not prove it, that there was not a

[1] This description is based on the papers of the writers referred to above, supplemented by my own observations. I never saw the original exposure on the "Foot Street Road" (now James street) nor that in the Dewitt reservoir, but did see the exposures in the sewer excavations along Highland avenue, Farmer and Butternut streets. T. C. H.

great thickness of rocks above the present surface. The dike rock in some places appeared to have spread out like a sill between the layers of shale. The excavations were too limited fully to establish this.

Fig. 4 Section of Green street dike along excavation made by electric light company, November 24, 1905. Sh = shale P = peridotite

Both the Green street and the Dewitt dike occur in the lower part of the Camillus shales which here contains intercalary vermicular limestone. The limestone and the shales show the effect of heat at the contact to a very limited extent, indicating that the temperature of the intrusive rock was not excessive nor the high temperature long continued, another evidence that the rocks at the present surface were not deeply buried at the time of the intrusion.

The intrusion at the Dewitt reservoir and those in the city of Syracuse at Green street, Highland avenue and Butternut street, and at Griffith street are all larger than the dikes at Manheim, Ithaca, Ludlowville and Clintonville.

Petrography. As already observed, Williams (14) was the first to prove the igneous or intrusive origin of the Syracuse dikes as previous to his examination they were considered to be metamorphosed sedimentary rocks. Smyth was the first to make a microscopic examination of the Butternut street exposure which he determined to be a porphyritic peridotite with phenocrysts of olivine. With the olivine he found some colorless pyroxene, probably augite. Biotite of a pale brown tint occurs in large irregular plates and shreds of small size; the latter appears to be secondary. Perofskite is abundant in minute crystals of sharp outline, honey-yellow and translucent. There is some magnetite and a granular mineral with a high index of refraction, which is probably a garnet. The inclusions are so numerous in some places, he says, as to equal or even exceed the dike rock in quantity. "The garnet appears rather scantily in irregular rounded grains 4 millimeters to 5 millimeters in diameter. The color is bright red." Smyth's statement regarding the size and number of the garnets was evidently based on the few specimens of rock which he had, as at the exposure there were scores of these garnets much larger than he describes.

In comparing the dike rocks, Smyth says that the Butternut street rock bears a strong family resemblance to that at Green street and at Dewitt, with perhaps less mica, and rather more perofskite, while only one section showed the tiny crystals of pyroxene that are so abundant in the Dewitt dike.

In speaking of the dikes of the county he says: "Apparently, then, the petrographic affinities of this group of dikes is with the melilite rocks rather than with the peridotites, and this is very interesting in bringing them into close relationship with the Manheim dikes, and in determining another occurrence of a rare variety of rock (alnoite)."

As might be expected, the larger Syracuse dikes contain many inclusions or fragments of the underlying rocks that were torn off from the sides of the fissure during the ascent of the molten rock. There are fragments of the inclosing and immediately underlying sedimentary shales, limestones and sandstones as well as of the deeper underlying Precambric crystallines. Most numerous are the fragments of the inclosing Camillus shales. Mr P. F. Schneider has in his possession a piece of limestone containing Trenton fossils that was taken from the dike rock. One fragment of gneiss was taken from the Green street dike that measured 8 by 14 inches, one of the largest inclusions.

Neither the inclusions or the wall rock show much metamorphism. The limestone and the shale fragments have a very thin crust, a mere fraction of an inch, that is baked by the heat of the dike.

The age of the dikes remains unknown. The Syracuse and Dewitt dikes penetrate the Camillus shales, the Ithaca and Ludlowville ones penetrate the Upper Devonic. It is probable that they are of the same age. There have been two great disturbances of the Paleozoic rocks of the eastern states: one at the close of the Ordovicic, the Taconic revolution, and one at the close of the Carbonic, the Appalachian revolution. If the Syracuse intrusions are of the same age as the others, the intrusion could not have been during the Taconic disturbance. While it is possible that the intrusions might have taken place during the Appalachian disturbance, there is no evidence to prove that they might not have occurred at a still more recent date, as during the Mesozoic period when the great trap intrusions took place along the Appalachian area. The absence of any glacial materials in the dike rock would indicate that the intrusion took place before the glacial period.

CLINTONVILLE DIKES

In the summer of 1909 Dr Burnett Smith discovered two small dikes near Clintonville, about 15 miles southwest of Syracuse. These dikes occur at the surface in rocks intermediate in age between those at Syracuse and the ones at Ithaca. Doctor Smith describes these dikes (46) as follows: "The dikes in question are exposed on the south wall of the Clintonville ravine at a point approximately 50 feet above the level of the Marietta road. The more western is a fine-grained porphyritic rock resembling peridotite. What appear to be serpentine grains, produced by the alteration of olivine, protrude from the weathered surface and have the appearance of small pebbles. Another conspicuous feature is furnished by large scales of bronzy mica. This dike has a uniform width of from 7 to 8 inches and is displayed for about 12 feet on the south bank of the ravine. On the north side it is obscured by talus. Its plane is verti-

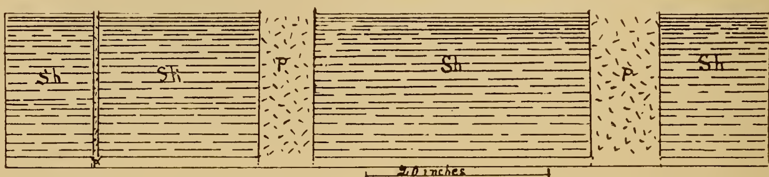


Fig. 5 Vertical section of Clintonville dikes, March 23, 1910
Sh = shale P = peridotite dike

cal while its direction is north and south, agreeing in the latter respect with the Ithaca dikes. Wherever examined it presents a very uniform texture, is apparently free from fragments of the sedimentary rocks through which it passed, and has produced little contact metamorphism.

"The second dike lies about 2 feet and 4 inches to the east of the first and was not observed until the wall at this point had been cleaned. It has a width of about 8 inches. Like the first dike, it is vertical and north and south in direction. It differs, however, from the first dike in being much weathered in places and in containing many shale fragments, some of which have a long diameter of 3 inches or more."

In a visit to this dike in the summer of 1910 I found in the shale 18 inches east of the two dikes another small dike or stringer parallel to the other two and, like them, following joint planes of the shale. It was less than an eighth of an inch in thickness, which would indicate an extreme fluidity of the dike material, as it was exposed for several feet on the wall of the ravine and continued parallel with the other dikes below the outcrop.

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NOTES ON THE FOSSILS OF THE PALEOZOIC FORMATIONS WITHIN THE SYRACUSE QUADRANGLE

BY BURNETT SMITH

From the standpoint of the collector, the local Paleozoic formations fall naturally into three classes — the readily accessible and highly fossiliferous Devonic and late Siluric strata, the accessible though nearly barren beds of Midsiluric age, and the drift-covered but sometimes prolific rocks of the earlier Siluric. The first group is finely displayed in the hills southeast and southwest of the city of Syracuse, that is, in the southern portion of the quadrangle. The second group of almost unfossiliferous strata is well exposed in and about the city itself and in a belt which passes across the quadrangle both east and west of the city. The rocks of the third group occupy the low drift-mantled area which lies north of Syracuse and extends to the northern limits of the quadrangle. Throughout this last area the Paleozoic strata are rarely exposed by the erosive processes and we are therefore almost wholly dependent upon excavations for such meager knowledge as we possess.

FOSSILS FROM THE NIAGARAN FORMATIONS

At one locality on the Syracuse quadrangle and at two localities on the adjoining Baldwinsville quadrangle, excavations for the barge canal have brought to light identifiable fossils. Those from Brewerton (Syracuse quadrangle) occur in an olive shale or in concretionary limy masses in the shale and have been obtained in deepening the channel of the Oneida river. At Phoenix (Baldwinsville quadrangle) there is likewise an olive shale quite similar to that from Brewerton and here it has been possible to collect from the rock in place. The third locality, situated between Phoenix and Brewerton, has furnished a few fossils from a calcareous shale which is harder and of a more grayish tint.

At Phoenix we are apparently dealing with a homogeneous fauna from a single formational unit, but at the other two localities (more especially at Brewerton) it is highly probable that the excavations have penetrated more than one fossiliferous horizon.

The chief interest attaching to these strata is the question of their equivalency with either the Rochester shale or with some member of the Clinton group. Though the few fossils so far determined are hardly sufficient to solve this problem, it is deemed advisable to show in tabular form their local occurrence and their distribution in the Rochester shale and Clinton group.[1]

	Brewerton	Phoenix	Two and one-half miles northeast of Three River Point	Rochester shale	Clinton group
Rusophycus bilobatus (*Vanuxem*)	X	.....	......	.....	X
Retepora angulata *Hall*	.....	X	......	.....	X
Pholidops squamiformis (*Hall*)	X	.....	......	X	.....
Leptaena rhomboidalis *Wilckens*	.....	X	X	X	.....
Plectambonites transversalis (*Dalman*)	.....	X	......	X	.....
Atrypa reticularis *Linné*	X	X	X	X	X
Spirifer radiatus *Sowerby*	.....	X	......	X	X
S. niagarensis (*Conrad*)	.....	.....	X	X	.....
Avicula emacerata *Conrad*	X	X	X	X	X
Orthonota curta *Hall*	X	.....	......	?	X
Bellerophon (species undetermined)	.....	.....	X	.....	.....
Conularia (species undetermined)	X	.....	......	.....	.....
Orthoceras cancellatum *Hall*	.....	X	......	X	.....
O. annulatum *Sowerby*	.....	X	......	X	?
O. (species undetermined)	X	X	......	.....	.....
Lichas boltoni (*Bigsby*)	X	.....	......	X	.....
Calymmene (species undetermined)	X	X	......	.....	.....
Dalmanites limulurus (*Green*)	.....	X	......	X	X
Beyrichia symmetrica (?) *Hall*	X	.....	......	X	.....

Besides the Niagaran forms listed above, a few fossils have been obtained from a dolomite believed to be the eastern extension of the Lockport. Fragmentary brachiopod shells have been found in blocks of this material which were removed from the bed of the Oneida river at Oak Orchard. About 4 miles away at a quarry just south of Three River Point (Baldwinsville quadrangle) a similar rock, in addition to obscure fragments, carries a Leperditia-like ostracod and a Spirifer apparently of the crispus type.

THE SPARSE FAUNA OF THE SALINA BEDS

Of the lithologic units included under this heading, only one, the Camillus, has furnished fossils in the Syracuse area. The eurypterid-bearing Pittsford shale, which constitutes the base of the group in western New York, has here remained unrecognized while the over-

[1] For the horizons and localities of Clinton group and Rochester (Niagara) shale species, see Hall, Palaeontology of New York, v. 2. For a list of the common Rochester shale species, see Hartnagel, N. Y. State Mus. Bul. 114, p. 19.

lying red Vernon shale is unfossiliferous. In the succeeding Camillus formation gypseous shales and the casts of halite crystals indicate a body of water cut off from the sea and rendered so saline by excessive evaporation that life within its confines was all but impossible.

In a limestone (Fiddler's Green) lying near the top of the Camillus series, a poorly preserved Leperditia is encountered in great numbers. This horizon is both overlaid and underlaid by gypsum beds and points to a slight freshening of the water which permitted this hardy form to swarm into the area.

Above the gypseous shales and limestones of the Camillus comes the Bertie waterlime, regarded as the final stage of the Salina group. Though noted in western New York and in Herkimer county for its beautifully preserved eurypterids, the Bertie is here lacking in organic remains.

The entire Salina group of strata, beginning with the Pittsford and ending with the Bertie, represents a nonmarine series. During its deposition any communication with the sea was, at best, inadequate and transitory and was never sufficient to allow the invasion of a marine fauna.

THE FAUNAS OF THE UPPER CAYUGAN GROUP

This group of strata is ordinarily made to comprise the Cobleskill dolomite, Rondout dolomite and Manlius limestone.

Cobleskill dolomite. In central New York this oldest member of the group is difficult of discrimination on a paleontologic basis. As a rule the rock is unfossiliferous, but Hartnagel[1] has reported Spirifer crispus var. corallinensis Grabau, Whitfieldella nucleolata Hall, Chonetes jerseyensis Weller and Stropheodonta bipartita Hall from the town of Dewitt. The rich and decidedly late Siluric fauna listed by the same author[2] from Schoharie county has not been detected in the local outcrops.

Rondout dolomite. The Rondout is a very sparingly fossiliferous formation, generally regarded as representing a partial return to Salinalike conditions. Eurypterids occur at this horizon near Union Springs, Cayuga county, and at Seneca Falls,[3] but in the Syracuse area the only fossil so far observed is a small Spirifer apparently identical with S. vanuxemi Hall. This species,

[1] N. Y. State Mus. Bul. 69, p. 1161.
[2] *Ibid*, p. 1126–28.
[3] N. Y. State Mus. Bul. 69, p. 1157.

Cyathophyllum hydraulicum Simpson and Leperditia alta are reported by Clarke and Luther[1] from the Rondout of the Tully quadrangle immediately south of Syracuse.

Manlius limestone. The Manlius limestone or uppermost member of the group carries a marine fauna which is remarkable for the abundance of its individuals and the fewness of its species. Crinoids, a Stromatopora and the brachiopods Spirifer vanuxemi Hall and Stropheodonta varistriata (Conrad) are mingled with other, possibly pelagic, forms such as Tentaculites gyracanthus Eaton, Leperditia alta (Conrad) and a species of Beyrichia.

This assemblage has been regarded as a "dwarf" fauna by Shimer[2] who says, "The occurrence of these dwarf faunas between the periods of small exceedingly dense seas or lakes, depositing salt and gypsum, and the normal marine conditions of the Helderbergian is an additional proof of the greater-than-normal density of the water at that time." The mud-crack zones of the Manlius clearly indicate that the material accumulated at no great depth and it is not unlikely that the environment of a shallow fluctuating sea may account, in part at least, for the peculiarly restricted life. Whatever the explanation, it is obvious that the physical conditions were unfavorable for the growth and development of a rich and diversified marine fauna.

The intercalations of drab waterlime which occur near the top of the Manlius and which make so striking a color contrast with the blue limestone, are generally believed to indicate a return of the conditions which prevailed during Rondout and Salina time. This view is strongly supported by Mr Luther's find of eurypterids in the Manlius waterlime of Split Rock.[3]

REPRESENTATIVES OF THE HELDERBERGIAN FAUNAS

In most sections of the limestone escarpment south of Syracuse there intervene between the terminal waterlime bed of the Manlius and the Devonic Oriskany sandstone, a varying number of feet of limestone which carry a mixture of indigenous forms persisting from the Manlius, and of exotic types strongly suggestive of the Helderbergian faunas, which attain their highest expression in the eastern portion of the State. These invaders are, however, apparently

1 N. Y. State Mus. Bul. 82, p. 38.
2 American Naturalist, 42:481.
3 N. Y. State Mus. Bul. 69, p. 1163.

always inferior in number of individuals to the forms of Manlius origin. The massive beds of Stromatopora are the conspicuous feature of the strata, while the Helderbergian brachiopods, gastropods, crinoids and corals are observed only after a closer inspection of the rock.

At Manlius, just beyond the eastern boundary of the quadrangle, the Helderbergian element is more pronounced, but even here it is not uncommon to find a Helderbergian Favosites completely overgrown and overwhelmed by the native Stromatopora. The percentage of Helderbergian forms seems to increase on going eastward in the Syracuse quadrangle, but all the evidence points to the conclusion that though they invaded the area these immigrants were unable thoroughly to accommodate themselves to the environment which had been so suitable to the peculiar life of the Manlius waters.

Near the village of Manlius, Hartnagel[1] has collected the following representatives of the Helderbergian faunas:

Leptaena rhomboidalis *Wilckens*
Orbiculoidea cf. discus *Hall*
Spirifer cyclopterus *Hall*
Stropheodonta becki *Hall*
Trematospira formosa *Hall*
Meristella cf. laevis *(Vanuxem)*
Conocardium sp. undet.
Pterinea communis *Hall*
Tentaculites elongatus *Hall*
Leperditia sp. undet.

FOSSILS OF THE ORISKANY SANDSTONE

The Oriskany lies, throughout the quadrangle, with a slight unconformity on all older formations. It is a deposit formed in a transgressing sea, not far from land, and in comparatively shallow water. As might be expected, the sand often contains fragments of preexisting formations and not infrequently fossils derived from these formations. It likewise carries marine fossils which undoubtedly represent the remains of animals which actually *lived* in the Oriskany sea. Phosphatic nodules scattered through the formation may possibly be assignable to a coprolitic origin. They occasionally include bone fragments and spines (Machaeracanthus)— the oldest fish remains in the quadrangle.

The most abundant Oriskany invertebrates are the brachiopods Spirifer arenosus (Conrad), Spirifer arrectus

[1] N. Y. State Mus. Bul. 69, p. 1164.

Hall, Hipparionyx proximus Vanuxem, Rensselaeria ovoides (Eaton) and the gastropod Platyostoma ventricosa Conrad.

As an example of a derived fossil we may cite Stromatopora, and it is not unlikely that the cosmopolitan Leptaena rhomboidalis owes its presence here to the same causes. The absence of the Helderbergian strata at certain localities in the quadrangle renders it highly probable that these two fossils were derived from beds of this age which were planed away by the advancing Oriskanian sea.

THE FAUNA OF THE ONONDAGA LIMESTONE

Lying above the thin sands of the Oriskany comes the massive Onondaga limestone. In the numerical abundance of its individuals and in its diversified nature, as well as in the beauty of many of its species, the Onondaga is the most noteworthy fauna to be found in the local Paleozoic series. At certain places and at certain horizons the rock may, it is true, be quite barren of fossils: sometimes secondary crystallization has obliterated or at least obscured the traces of life; but, on the whole, it is a highly fossiliferous formation.

At the famous collecting ground in the Split Rock quarries, the sea must have literally teemed with life. Crinoidal fragments and corals (many probably in the position of growth) are the most abundant fossils, but bryozoa, brachiopods, gastropods and trilobites are well represented.

This assemblage gives a picture of the rich life of a favorable Paleozoic marine environment, and, if one is permitted to judge it in the light of what is going on today, he is justified in assuming a warm sea of moderate depth, vigorous currents, and an abundant food supply of minute organisms.

In addition to the corals of difficult specific determination, but referable to the genera Zaphrentis, Heliophyllum and Favosites, it is practicable to list here only a few of the most common fossils of the local exposures, as:

Atrypa reticularis *Linn.*
Meristella nasuta *(Conrad)*
Dalmanella lentiformis *(Hall)*
Leptaena rhomboidalis *Wilckens*
Platyostoma turbinata *Hall*
Strophostylus varians *Hall*
Platyceras (numerous species)
Phacops cristata *Hall*
Dalmanites (Odontocephalus) selenurus *(Eaton)*

Among the rarer but highly interesting specimens which occasionally reward the collector we may mention spinelike pieces of bone apparently referable to the fish Machaeracanthus and fragments of the giant trilobite Dalmanites (Coronura) myrmecophorus (Green).

THE MARCELLUS FAUNAS

The series of about one hundred feet of strata which have been assigned to the Marcellus formation, exhibit two somewhat diverse faunal elements. These are the Black shale fauna and the fauna of the Agoniatites limestone intercalation which occurs in the lower fifteen feet of the series.

Though certain species are common to these two lithologic phases of the Marcellus, the limestone is to be distinguished by the presence of large types of cephalopods which are found at no other horizon within the quadrangle. Almost every exposure of this limestone will yield specimens of Goniatites vanuxemi Hall (=Agoniatites expansus (Van.)) and Orthoceras marcellensis Hall.

The black shales are prevailingly unfossiliferous, yet thin bands or concretionary masses may present the brachiopod Liorhynchus limitaris (Vanuxem) and the pteropod Styliolina fissurella (Hall) in countless numbers. Besides these diminutive invertebrates the shales occasionally furnish fragmentary remains of good sized fishes which can be provisionally assigned to the genera Dinichthys and Onychodus.

This peculiar association of small bottom-living invertebrates with mobile and planktonic types appears to be a normal one for black shales generally and, taken in connection with the characters of the shales themselves, has been interpreted as signifying an environment similar to that of the present Black sea.[1]

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[1] Clarke, John M. N. Y. State Mus. Mem. 6, p. 200. 1903. Schuchert, Charles. Geol. Soc. Am. Bul. 20, p. 446. 1910.

A REVIEW OF THE MAMMALIAN REMAINS FROM THE SUPERFICIAL DEPOSITS IN THE VICINITY OF ONONDAGA LAKE, NEW YORK

BY BURNETT SMITH

Onondaga lake presents along its margins and in its low-lying tributary valleys, a series of clay, marl and peat deposits which are clearly of later date than the latest glaciation of the region. It can not be stated, at present, whether they were laid down in connection with a once larger and higher lake or in and about separate but more or less contemporaneous water bodies which were left behind in the shrinking of such a lake. The highest altitude at which materials of this series have been observed is slightly over 400 feet, that is, approximately 35 or 40 feet above Onondaga lake. They therefore lie below the youngest glacial water level and though their oldest portions may go back to the time immediately following the abandonment of the Mohawk glacial drainage outlet at Rome[1] (now about 460 feet in altitude), their youngest layers fall within historic time and are even accumulating in connection with Onondaga lake today.

On account of the almost complete absence of natural exposures one is obliged to depend upon excavations for a knowledge of the structure and stratigraphy. From the same cause the few mammalian fossils from this series have been obtained at irregular intervals and from scattered localities. The specimens which are available for study have been deposited at Syracuse University by different collectors through a period of about thirty years and comprise the remains of black bear, Virginia deer, American bison and an elephant referable to the northern mammoth.

In the cases of some of the specimens a few measurements have been published but little attention has been paid to their geological environment. In any attempt at correlation ordinary stratigraphic methods can not, it is true, be employed; but for that very reason all obtainable information concerning exact locality and horizon becomes of greater value. Also on account of the fact that some of the specimens are liable to the vicissitudes of privately owned material, it is believed that photographic reproductions of the more important finds should be published.

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[1] H. L. Fairchild. Glacial Waters in Central New York. N. Y. State Mus. Bul. 127, p. 55, 59.

The present divide is below 440 feet (see U. S. G. S. topographic sheets of the Oriskany and Chittenango quadrangles).

Ursus americanus Pallas

Black bear

Plate 1

Locality. Will and Baumer factory, north side of Ley creek on the east shore of Onondaga lake, New York (see U. S. G. S. topographic sheet of the Syracuse quadrangle).

These remains were briefly described by Smallwood[1] in 1903. They comprise two skulls, three mandibles, two left mandibular rami, three left humeri, two right humeri, one left tibia, one right tibia, and one right fibula.

The smaller skull is, on the whole, not so well preserved as the larger skull. Many measurements which were made in the larger were not attempted in the case of the smaller skull.

This collection of bones indicates five or more individuals. Comparisons with recent specimens of the black bear from New York and Pennsylvania disclose no differences which can be regarded as specific. Professor Smallwood in his original description suggests that we are dealing with animals which were killed by man. Certain holes in the larger skull do have more or less resemblance to those made by bullets but while admitting freely (as one must admit in dealing with any Quaternary fossil) that man may have been the cause of death, the author considers that these remains exhibit no indubitable evidence of such a cause. Mr Edward Baumer of Syracuse states that all the bones were secured during excavations which reached from the surface through the peaty layers into marl below. The specimens were found immediately above the marl at a depth of about 10 feet. Even allowing for the sinking of heavy carcasses through soft material, one is justified in assuming a considerable antiquity for remains found in such deposits at that depth. Though the inclosing material was accumulated not far from a still extant water body which is subject to considerable fluctuation in level, the author feels at liberty to express the opinion that these specimens are older and perhaps very much older than the white settlement of the region.

Odocoileus americanus (Erxleben)

Virginia deer or White-tailed deer

Locality. Will and Baumer factory, north side of Ley creek on the east shore of Onondaga lake, New York (see U. S. G. S. topographic sheet of the Syracuse quadrangle).

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[1] W. M. Smallwood. The Remains of Bear and Deer on the Shores of Onondaga Lake. Science, n.s., v. 18, no. 444, p. 26, 27. July 3, 1903.

These remains were briefly described by Smallwood[1] in 1903. They comprise two large humeri each accompanied by its corresponding radius and ulna, two small humeri, one metacarpus, six ribs, one lumbar vertebra, one thoracic vertebra and one atlas.

The two larger humeri lack the proximal epiphyses and have such similar proportions, state of preservation and color that it is scarcely probable that they belonged to two different individuals. Each articulates perfectly with a corresponding radius and ulna.

The two smaller humeri, like the larger specimens, lack the proximal epiphyses. The longer and more slender of these bones (a right) measures in its fragmentary condition, 157 mm in length and 34 mm transversely across the anterior face of the trochlea. Similar measurements on the shorter and more robust humerus (a left) are 145 mm and 35 mm respectively.

The metacarpus (a left) presents the following measurements: length 226 mm, transverse diameter of the inferior epiphysis 32 mm, transverse diameter of the proximal articular surface 28 mm.

The collection of bones from this locality indicates the remains of three or more individuals. Comparisons with recent specimens of the Virginia deer disclose no differences which can be regarded as specific. The specimens came from the same excavation, in which the bear remains (described above) were found. The larger limb bones present a much fresher appearance and better state of preservation than any of the other specimens from this locality. The two smaller humeri show adherent particles of shell fragments and were evidently collected from the marl. The other bones, with one exception,[2] are apparently from the peaty layers above the marl or from the contact of the two deposits. The superior preservation of the larger deer bones may, in the absence of contrary evidence, be urged as an argument in favor of their recent introduction by sinking through soft material. Condition of preservation is, however, an uncertain guide to age and it is believed that in this case the association of remains points to approximate contemporaneity for the different individuals.

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[1] W. M. Smallwood. The Remains of Bear and Deer on the Shores of Onondaga Lake. Science, n.s., v. 18, no. 444, p. 26, 27. July 3, 1903.

[2] The antler fragment mentioned by Professor Smallwood was supposed to have been collected with the other deer remains. Adherent grains of quartz sand indicate, however, that the specimen came from a different level or more probably from a different locality. It has clearly been cut or sawed but the artificial surfaces, though weathered, show no adherent particles of quartz sand or other material.

Locality. Harbor brook near Avery avenue (city line on west), Syracuse, New York (see U. S. G. S. topographic sheet of the Syracuse quadrangle in the valley south and east of "Burnett Park").

During the summer and autumn of 1912 a sewer excavation in the Harbor Brook valley cut down through the swamp deposits to a depth of from 10 to 15 feet. The layers of different materials exhibited a variable and irregular structure but in general the normal sequence of such deposits could be observed. That is, a bluish clay occurred below, followed by marly bands which in turn were overlaid by peaty layers. Locally where the trench crossed Avery avenue a firm calcareous tufa capped the peat.

From the material thrown out of this excavation the writer has obtained one left metacarpus, one right metacarpus and several antler fragments which are all referable to the Virginia deer. On account of their color and adherent particles of marl, it is probably safe to say that the specimens came from below the superficial layer of peat.

The locality is about 2 miles from the present Onondaga lake and its altitude is slightly below the 400 foot contour or about 30 feet above the lake. It is not unlikely that the deposits formed at this point were laid down in and about an arm of a once greater Onondaga lake. If this view is correct, the Harbor brook specimens are much older than those from Ley creek. If, on the other hand, the materials owe their origin to a remnant contemporary pond, it is hardly possible to arrive at any conclusion on the relative ages of the two finds.

Bison bison (Linn.)

American bison

Plate 2

Locality. North side of Croton street (now East Raynor avenue) and 210 feet west of Renwick avenue, Syracuse, New York (see U. S. G. S. topographic sheet of the Syracuse quadrangle near the bend in the 400 foot contour line just above the northern boundary of "Oakwood cemetery").

This skull was briefly described by Underwood[1] in 1890. The teeth are either lost or broken away but the nasals, premaxillaries and horns are preserved.

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[1] Lucien M. Underwood. A Bison at Syracuse, New York. The American Naturalist, 24:953. October 1890.

Comparisons of the photographs of this specimen with the skulls of recent individuals of the American bison fail to reveal any differences which can be regarded as specific. Underwood in his original description states: "The formation was of black swamp muck underlaid by clay; the skull being found at the junction of the two deposits." Its depth below the surface is stated to have been "about 10 feet."

Mr John Cunningham of Syracuse, the owner of the specimen, places the depth at 17 feet and the position as below the "muck." The unstained condition of the skull and the presence of shell fragments between the horns and the horn cores strongly support this latter statement.

In spite of these very natural discrepancies of a few feet in the observation of its geological horizon, this specimen can be regarded as unquestionably of considerable age. If the stratum in which it occurred was laid down in a greater Onondaga lake, then the Syracuse bison is much older than the bear and deer remains from Ley creek. Until, however, more is known of the stratigraphy of these layers this conclusion must remain unverified. The altitude of this locality is about 400 feet, or approximately 36 feet above Onondaga lake.

Elephas primigenius Blumenbach

Northern mammoth

Locality. East side of Limestone creek near Manlius Station (now Minoa) on the West Shore Railroad (see U. S. G. S. topographic sheets of the Syracuse and Chittenango quadrangles).

The specimens assignable to Elephas primigenius were unearthed during the construction of the West Shore Railroad and probably in the year 1883. They comprise one cheek tooth and portions of a tusk or tusks. The best preserved tusk fragment and the molar were secured for Syracuse University through the enterprise of Mr John Cunningham.

The molar is of interest on account of its approach to that of the southern mammoth (Elephas columbi Falconer). In the number and character of its enamel ridges it undoubtedly presents some resemblance to the teeth of E. columbi but it is nevertheless probably referable to the northern form.[1] The tusk

[1] Dr O. P. Hay and Dr W. K. Gregory have both examined photographs of this specimen and have very generously given the author the benefit of their opinions on its specific position.

possesses a diameter of about 180 mm near the base, while the molar which is from the left side of the lower jaw, measures 250 mm on a grinding surface which is incomplete through breakage.

The specimens indicate a large individual and it is indeed unfortunate that we have only meager records of its horizon and of the material in which it was found. Mr Cunningham has assured the writer that the position of these remains was quite superficial. An inspection of the locality leads to the belief that the specimens could not have been unearthed much, if at all, above the 400 foot contour. A few fragments of vegetable matter are still adherent on the tusk but the unstained condition of all the specimens makes it unlikely that true peat was the inclosing deposit.

Both tusk and molar are now in a very friable condition but this, by itself, can hardly be advanced as a certain sign of great antiquity. We are dealing with an extinct animal, it is true, yet no evidence has so far appeared to prove indubitably its reference to any system of deposits differing materially in age from those which included the other mammalian remains considered in this paper.

HISTORICAL EVIDENCE OF THE ABUNDANCE OF MAMMALS IN THE VICINITY OF ONONDAGA LAKE

The superficial deposits in the vicinity of Onondaga lake are now yielding and have in the historic past always furnished many saline springs. For this reason the abundance a century ago of the mammals which still exist in the more unsettled portions of the State is in no way surprising. The presence in large numbers of the American bison or buffalo at about the same date is, however, not generally admitted. The occurrence of a fossil specimen at Syracuse and of the bear and deer remains near Onondaga lake throws an interesting light upon the following curious account published by Thomas Ashe[1] in 1808:

> The native animals of the country too, as the buffalo, elk, deer etc. are well known to pay periodical visits to the saline springs and lakes, bathing and washing in them, and drinking the water till they are hardly able to remove from their vicinity. The best roads to the Onondargo from all parts, are the buffalo tracks; so called from having been observed to be made by the buffaloes in their annual visitations to the lake from their pasture grounds; and though this is a distance of above two hundred miles, the best

[1] Travels in America, Performed in 1806, etc. London 1808. p. 47.

surveyor could not have chosen a more direct course, or firmer or better ground. I have often travelled these tracks with safety and admiration. I perceived them chosen as if by the nicest judgment; and when at times I was perplexed to find them revert on themselves nearly in parallel lines, I soon found it occasioned by swamps, ponds, or precipices, which the animals knew how to avoid: but that object being effected, the road again swept into its due course, and bore towards its destination as if under the direction of a compass.

An old man, one of the first settlers in this country, built his log house on the immediate borders of a salt spring. He informed me that for the first several seasons, the buffaloes paid him their visits with the utmost regularity; they travelled in single files, always following each other at equal distances; forming droves, on their arrival, of about three hundred each. The first and second years, so unacquainted were these poor brutes with the use of this man's house or with his nature, that in a few hours they *rubbed* the house completely down; taking delight in turning the logs off with their horns, while he had some difficulty to escape from being trampled under their feet, or crushed to death in his own ruins. At that period he supposed there could not have been less than ten thousand in the neighborhood of the spring. They sought for no manner of food; but only bathed and drank three or four times a day, and rolled in the earth; or reposed, with their flanks distended, in the adjacent shades; and on the fifth and sixth days separated into distinct droves, bathed, drank, and departed in single files, according to the exact order of their arrival. They all rolled successively in the same hole; and each thus carried away a coat of mud, to preserve the moisture on their skin; and which, when hardened and baked by the sun, would resist the stings of millions of insects that otherwise would persecute these peaceful travellers to madness or even death.

In the first and second years this old man with some companions killed from six to seven hundred of these noble creatures, merely for the sake of the skins, which to them were worth only two shillings each; and after this "work of death," they were obliged to leave the place till the following season; or till the wolves, bears, panthers, eagles, rooks, ravens etc. had devoured the carcasses, and abandoned the place for other prey. In the two following years, the same persons killed great numbers out of the first droves that arrived, skinned them, and left the bodies exposed to the sun and air; but they soon had reason to repent of this; for the remaining droves, as they came up in succession, stopped, gazed on the mangled and putrid bodies, sorrowfully moaned or furiously lowed aloud, and returned instantly to the wilderness in an unusual run, without tasting their favorite spring, or licking the impregnated earth, which was also once their most agreeable occupation; nor did they, or any of their race, ever revisit the neighborhood.

The simple history of this spring, is that of every other in the settled parts of the western world; the carnage of beasts was everywhere the same. I met with a man who had killed two thousand buffaloes with his own hand; and others, no doubt, have done the same. In consequence of such proceedings, not one buffalo is at this time to be found east of the Mississippi; except a few domesticated by the curious, or carried through the country as a public shew. . . .

The salt lakes and springs are also frequented by all the other kinds of beasts, and even by birds; and from the most minute inquiries, I am justified in asserting that their visitations were periodical; except doves, which appear to delight in the neighborhood of impregnated springs, and to make them their constant abode. In such situations they are seen in immense numbers, as tame as domestic pigeons, but rendered more interesting by their solitary notes and plaintive melody.

CORRELATION AND SUMMARY

It has already been pointed out that ordinary stratigraphic methods can not be employed with the series of deposits whose mammalian remains have formed the subject of this paper. The series lies stratigraphically above glacial deposits, but beyond that, our most valuable criterion — geological superposition — fails us. It is therefore necessary to fall back upon geographic methods, correlating by contours and their relation to existing water bodies.

The highest altitude at which excavations in these deposits have yielded fossils is a little over 400 feet. This lies well below the present altitude of the Mohawk glacial drainage outlet at Rome. This outlet is believed to have been that of an ice-dammed lake whose level was controlled by a glacial lobe in the St Lawrence valley and which is generally regarded as the last of the succession of water surfaces to be maintained by the retreating margin of the Labradorian ice sheet.[1]

The deposits inclosing the mammalian remains under discussion lie therefore below the last ice-controlled water level and were consequently laid down in and about water bodies which were in no way affected, even remotely, by a glacial dam. On this account these accumulations must be regarded as strictly postglacial. It should also be noted in this connection that the layers yielding fossils are superficial, being, as far as ascertained, less than 20 feet below the present land surface.

Onondaga and Oneida, as well as several other lakes in the lowlands of central New York, probably represent all that is left of

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[1] See N. Y. State Mus. Bul. 127, pl. 42, page 10.

a once greater postglacial lake. If the deposits under consideration were laid down in connection with one uniformly shrinking and lowering water body, it is reasonable to assume that (depth below the present land surface being constant) those remains which are found far from existing lakes are older than the remains occurring in close proximity to the present lakes. On the other hand if the deposits represent those of separate and more or less contemporary ponds, no statement can be made except that they are all postglacial in age.

Though a final conclusion upon this particular phase of the problem must await future investigation, the writer feels at liberty to express the opinion that all the remains here considered are those of animals which lived at a time or at different times approaching the present much more closely than the date of the last glacial water level. The strongest evidence in support of this view is the superficial position of all the specimens.

A careful survey of the associated molluscan and plant life has not yet been made, but no facts have so far appeared to warrant the belief that the series of deposits under discussion contain more than one biological association. If we accept the classification of Osborn[1] we are apparently dealing with his Fourth Quaternary, *Cervus*, or Holocene fauna. With the exception of *Elephas*, all the forms here considered are those of which we have historic records for America. In the individual case of the Manlius Station (or Minoa) elephant it might be stated that the author has, so far, failed to obtain the slightest evidence which might justify its reference to any system of deposits materially older than those which furnished the bear, deer and bison remains described in this paper.

Acknowledgments. In the preparation of these notes comparisons were made with material belonging to the United States Biological Survey, the United States National Museum, the American Museum of Natural History, and the Academy of Natural Sciences of Philadelphia. To the officers of these institutions, to Dr O. P. Hay of the Carnegie Institution, to Prof. Amos P. Brown of the University of Pennsylvania, to Professors W. M. Smallwood and T. C. Hopkins of Syracuse University, to Messrs John Cunningham, Philip F. Schneider and Edward Baumer of Syracuse, to Mr DeCost Smith of New York City, and to Mrs Ethel Ostrander Smith, the author wishes to express his thanks.

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[1] H. F. Osborn. The Age of Mammals, p. 372, 440.

EXPLANATIONS OF PLATES

Plate 1

Ursus americanus Pallas

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Fig. 1 Skull, lateral aspect.
2 Skull, superior aspect.
3 Skull, inferior aspect.
Locality: Quaternary, Ley creek, Onondaga lake, N. Y.

Plate I

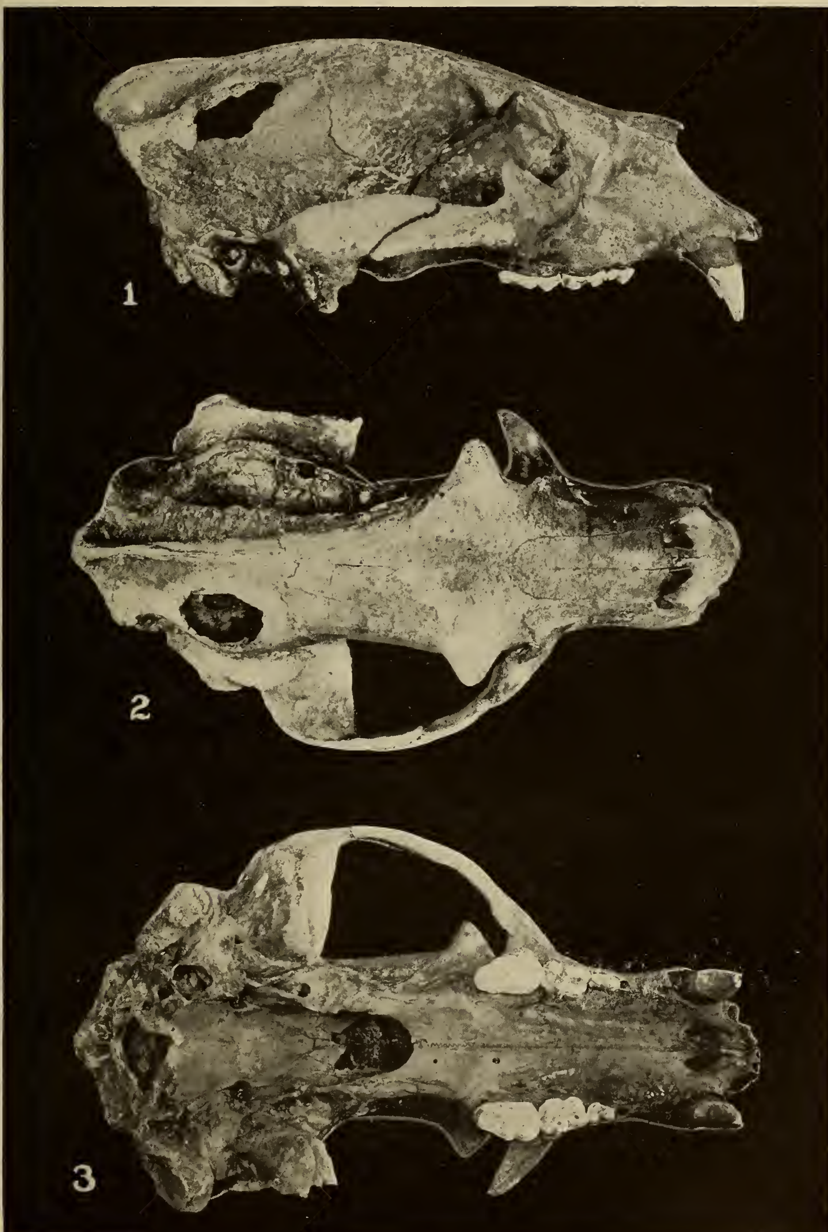

Plate 2

Bison bison (Linn.)

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Fig. 1 Skull, superior aspect.
2 Same, with horns removed from horn cores.
3 Skull, posterior aspect.
4 Same as figure 3, with horns removed from horn cores.
5 Skull, lateral aspect.
6 Same as figure 5, with horns removed from horn cores.
Locality: Quaternary, Syracuse, N. Y.

Plate 2

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New York State Museum

John M. Clarke, Director

Museum Bulletin 172

GEOLOGY OF THE ATTICA-DEPEW QUADRANGLES

BY

D. D. LUTHER

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Description of formation	7	Bibliography	30
Siluric	7	Index	31

New York State Education Department

Science Division, March 7, 1913

Hon. Andrew S. Draper LL.D.

Commissioner of Education

SIR: I have the honor to submit herewith a manuscript report, with maps, on the *Geology of the Attica and Depew Quadrangles,* and to recommend the publication of this report as a bulletin of the State Museum.

Very respectfully

JOHN M. CLARKE

Director

STATE OF NEW YORK

EDUCATION DEPARTMENT

COMMISSIONER'S ROOM

Approved for publication this the 17th day of March 1913

Commissioner of Education

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Museum Bulletin 172

GEOLOGY OF THE ATTICA AND DEPEW QUADRANGLES

BY D. D. LUTHER

The area embraced within these quadrangles lies between the lines of 42° 45′ and 43° north latitude, and 78° 15′ and 78° 45′ west longitude and contains 455 square miles.

It is situated just where the sloping front of the great Allegany plateau begins to bend from a generally east and west line to a direction nearly southwest and parallel to the southern shore of Lake Erie.

The point of lowest altitude is in the northwest corner of the Depew quadrangle where it is 585 feet above sea level, or 338 feet above Lake Ontario and 12 feet higher than Lake Erie, while the crest of the ridge west of Varysburg reaches, on the southern boundary line of the Attica quadrangle, the height of 1780 feet, showing a difference in elevation of 1195 feet.

The rock strata of this region have an average southward dip or declination estimated to be about 33 feet a mile, or 577 feet on a north and south line across the quadrangles. Adding this thickness which is lost from the difference in elevation, the total thickness of the rock section or surface rocks shown on the maps is approximately 1772 feet.

The basal strata of this rock section to the thickness of about 100 feet belong to the Ontaric or Siluric system, and lie at the foot and to the north of the rocky declivity known as the Helderberg escarpment that extends from Albany county to the Niagara river, and crosses the Depew quadrangle near its northern boundary. The Siluric strata and their contact with the overlying basal formation of the Devonic system are finely exposed in several quarries along the front of the escarpment.

The rocks exposed in the upper part of the escarpment and the surface rocks south of it on these quadrangles belong to the

Devonic system, all the subdivisions comprising this system in western New York being found within the area covered by the map, though the highest, the Chemung sandstones and shales, is represented by only a fraction of its thickness and over a small area.

The drift sheet or soil mantle on these areas is usually quite thin and rock outcrops are frequent except in the flat region in the northern part of the Attica quadrangle where it is much thicker and rock exposures very rare.

The Mesodevonic Marcellus and lower Hamilton beds are quite well displayed on the Depew quadrangle in the vicinity of Lancaster, along Cayuga creek and other small streams.

The gorges and gullies through which the Tonawanda, Ellicott, Cayuga and Cazenovia creeks and their numerous branches flow, show the stratigraphic details of the upper Hamilton, the Genesee and Portage beds in a manner and to an extent perhaps nowhere else found so conveniently accessible for examination and the collection of their finely preserved and abundant fossils.

The geologic formations of which the surface rocks of these quadrangles are composed and which are represented by the various colors on the map, consist of the following, in descending order:

ERA OR SYSTEM	PERIOD OR GROUP	STAGE OR AGE
	Chautauquan..	Chemung sandstones and shales
		Wiscoy shale
		Nunda sandstone
		Gardeau flags and shales
		Hatch shales and flags
	Senecan.......	Rhinestreet black shale
		Cashaqua shale
		Middlesex black shale
		West River shale
		Genundewa limestone
		Genesee black shale
Devonic.............		Pyrite in Tully horizon
		Moscow shale
		Tichenor limestone
		Ludlowville shale
	Erian.........	Skaneateles shale
		Cardiff shale
		Stafford limestone
		Marcellus black shale
	Ulsterian......	Onondaga limestone
	Oriskanian....	Oriskany sandstone horizon
		Cobleskill limestone
Siluric.............	Cayugan.......	Bertie waterlime
		Camillus shale

DESCRIPTION OF FORMATIONS IN ASCENDING ORDER FROM NORTH TO SOUTH

SILURIC

CAMILLUS SHALE

The lowest in the series of rock formations shown on the map is the Camillus member of the Cayugan group, 250 to 300 feet thick, composed mainly of soft, light gray marlytes or gypseous shales with frequent thin layers of hard dolomite or magnesian limestone.

The great deposit of rock salt that underlies all southern-central and western New York is at or near the bottom of this formation and the gypsum beds of equal commercial importance, so extensively quarried in Onondaga county and westward to Genesee county, are found in the upper part. It is said that the first discovery of gypsum in the United States was made in 1792 in these beds at Camillus, Onondaga county, when the principal gypsum layer and a large part of the formation were abundantly exposed. The name of the formation is derived from this locality.

The Camillus beds are generally barren of fossils though one or more of the thin dolomites in the upper part contain at some localities the crustacean *Leperditia scalaris*? Jones, and one or two other obscure forms.

No exposures of this formation occur on these quadrangles but the gypsum is mined at Oakfield and Alabama, and the upper part of the formation outcrops in the banks of Tonawanda creek below Indian Falls, on the quadrangles next north of these.

BERTIE WATERLIME

In the upper part of the Camillus beds there is an alternation of shales and limestones in which the shales lose much of their gypsum and the limestones become more compact and heavier and also, by the increased proportion of magnesia carbonate, highly dolomitic. These passage beds are succeeded by about 50 feet of waterlime, dark colored when fresh but weathering to a light gray, in layers from a few inches to 3 or 4 feet thick, separated by thin seams of black carbonaceous matter. The rock in some of the layers is quite compact and the lines of deposition are barely discernible, while other layers have a laminated structure or, in small proportion to the entire mass, are more or less shaly.

The proportion of calcareous and argillaceous matter varies considerably in different layers, the composition of some of them being such as to make true hydraulic limestone or natural cement rock. A bed of this character at the top of the formation and about 6 feet thick has been quarried extensively at Buffalo, Williamsville and Akron for the production of natural cement, and other layers were formerly utilized for this purpose in the central part of the State.

This formation receives its name from its favorable exposure in the township of Bertie, Ontario. It may be seen to excellent advantage at the falls of Ellicott creek in the village of Williamsville and there are frequent small exposures of the upper beds all along the lower part of the escarpment to Clarence and the large quarry two and one-half miles farther east.

Fossils are rare in the Bertie limestone here except the ostracod, Leperditia scalaris Jones, and the small brachiopod Whitfieldella laevis (Whitfield): these two occurring in considerable numbers in several thin layers and occasionally in the more compact and thicker layers. The stratum of cement rock at the top of the formation contains the remains of a peculiarly interesting arachnid or eurypterid fauna, which has recently been fully discussed and illustrated by Clarke and Ruedemann (N. Y. State Mus. Mem. 14, 1912). The wealth of this formation in these fossils has made it widely known and of great interest to paleontologists.

COBLESKILL WATERLIME

West of the Genesee river the Bertie waterline is succeeded by a few feet, not more than 6 to 8 on the Depew quadrangle, or dark subcrystalline dolomitic limestone in uneven layers, usually not more than a few inches thick, separated by thin seams of black carbonaceous matter. After exposure this rock sometimes has a brecciated appearance and is usually more or less porous owing to the removal by dissolution of crystals of calcite and of a small coral, Cyathophyllum hydraulicum Simpson, which occurs quite abundantly here and in the Buffalo quadrangle, but is very rare or absent from the Cobleskill in the central part of the State. The rock resembles the Bertie in being very dark when freshly quarried but weathering to a light gray or buff color. It is known to quarrymen as the "bull head" or "pumpkin head," and is of considerable economic value, being used largely in Buffalo for foundation walls and similar purposes.

Beside the coral mentioned the following fossils occur in the Cobleskill waterlimes in western New York:

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

The Cobleskill waterlime is well exposed at Williamsville in the old quarries; in the village of Clarence, and at the larger quarry two and one half miles east of Clarence on the DeWitt quadrangle, and in the Buffalo cement quarry at Buffalo, at Akron, Fallkirk, Indian Falls and Morganville, North LeRoy, East Victor and Union Springs. It received its name on account of its fine exposure at Cobleskill in Schoharie county, and it may be seen in many other localities in eastern New York.

The Cobleskill waterlime is the highest formation belonging to the Siluric system in the rock section of New York west of Seneca lake, the Rondout waterlime and the Manlius limestone that succeed the Cobleskill in the central and eastern part of the State thinning out and disappearing east of that point.

In the large cement quarries at Buffalo and at nearly all exposures where the surface or cross sections of the contact with the succeeding formation can be observed, there are evidences of considerable erosion, the Paleodevonic strata resting more or less unconformably upon the Cobleskill.

DEVONIC

ORISKANY SANDSTONE HORIZON

Four Devonic formations, the Coeymans limestone, New Scotland beds, Becraft limestone and Port Ewen limestone, constituting the Helderbergian group in the eastern New York counties are absent in the western, the Oriskany sandstone being the lowest of the Devonic subdivisions known here.

This rock in its typical condition is composed of coarse white or pinkish quartz sand, loosely cemented by calcareous matter. It is not a continuous stratum on the line of its outcrops in central and western New York, but appears in cross sections of broad lentils the largest of which are east of Cayuga lake and attain a thickness of 20 to 30 feet, and sometimes are quite fossiliferous.

There are exposures of thin lentils at Phelps, Honeoye Falls and Morganville and a vertical crevice in the Cobleskill waterlime in the cement quarry at Buffalo was filled with the characteristic gray sand of this formation, and at some localities where it is absent as a distinct stratum the basal tier of the succeeding limestone contains a considerable proportion of the same material.

At most exposures where the sand is not present this horizon is marked by a thin, uneven seam of black shaly matter, in which small pebbles of waterlime or black sand are imbedded forming a coarse conglomerate a few inches thick. The sandstone is absent and the horizon is but slightly marked on this quadrangle.

ONONDAGA LIMESTONE

This formation is composed of dark bluish gray limestone, bedded in layers from 3 inches to 2½ feet thick in which there is usually a quarter or less proportion of chert or hornstone in nodules or nodular layers. It was formerly known as the "Corniferous" limestone, and included in the "Upper Helderberg Group," a few layers at the base in which chert is absent being distinguished as the Onondaga limestone. The terms "Corniferous," and "Seneca" limestone were at one time used interchangeably. The term Onondaga limestone is now adopted to cover all the strata in central and western New York, which lie between the Oriskany horizon and the Marcellus black shale, here aggregating in thickness about 125 feet.

The limestone contains considerable black, carbonaceous matter that appears in the shaly partings and on the surface of the tiers. It is removed by slow decomposition on exposure and the rock weathers to a light bluish gray color.

The chert is usually very dark and but slightly translucent, but is sometimes much lighter colored and chalcedonic. It is very unevenly distributed in the beds predominating in some parts and frequently occurs in nodular layers that are continuous for long distances and the separate nodules from 1 to 3 inches in diameter occupy much of the remaining space.

Weathered outcrops and loose blocks from the cherty beds have a peculiarly ragged and scraggy appearance owing to the superior resistance to decomposition of the chert over the limestone. This chert, commonly called flnt, was of the greatest value to our Indian predecessors as it is the material from which their spears, arrows and other implements were formed, but until recently its presence has been regarded as seriously lessening the value of the limestone. Now, however, this rock is recognized as of great economic importance as constituting the best material, when crushed, for concrete work and road-building to be found in western New York and it is being extensively utilized for such purposes. At some outcrops one or more of the layers may be somewhat shaly, but all the remainder is compact and durable and is the source from which have been derived enormous quantities of dimension and building stone of the best quality as well as the purest quicklime.

At the base of the formation there occurs here 6 to 8 feet of limestone entirely free from chert. This condition is found at nearly all exposures of this horizon, the thickness in a few instances increasing to 25 or more feet. The rock is usually crowded with corals and crinoid stems, and is specially valued for ornamental building stone; it is also valuable as a flux in the manufacture of steel and is extensively quarried for such use. In the succeeding 40 or 50 feet the percentage of silicon is very high, reaching 50 per cent in some localities, while in some of the upper beds it is not more than 10 to 12 per cent.

This formation is rich in fossils. A list of the various species that occur in it may be seen in New York State Museum Bulletin 63, in which there are 3 of fishes, 39 of crustaceans, mostly trilobites, 13 of cephalopods, 3 pteropods, 38 gastropods, 15 lamellibranchs and 48 brachiopods. It also contains many species of corals and crinoids.

A few of the more common and distinguishing forms are:

Odontocephalus selenurus *Eaton*
Phacops cristata *var.* pipa *Hall and Clarke*
Gyroceras undulatum (*Vanuxem*)
Gyroceras trivolve (*Conrad*)

and the brachiopods

Atrypa reticularis *Linné*
Leptaena rhomboidalis *Wilckens*
Stropheodonta concava *Hall*
S. inequistriata (*Conrad*)
Spirifer acuminatus (*Conrad*)
Sp. divaricatus *Hall*

Exposures. The Onondaga limestone is covered by drift in most of the area in the northern part of the Attica quadrangle, where it is the surface rock. The largest outcrop is in the vicinity of an old quarry 2 miles north of Crittenden near the road to Murray where 12 to 15 feet of the upper layers are well displayed.

The lower beds are well exposed along the escarpment from the large quarry 2 miles northeast of Clarence to Williamsville and specially in both of those villages. The middle beds may be seen along Ellicott creek at Bowmansville and in some field outcrops and small quarries 2 miles north of Mill Grove, and the upper strata in the bed of Ellicott creek for a mile or two west of Mill Grove. At Bellevue what appear to be the uppermost layers of the Onondaga limestone are exposed in the bed of Cayuga creek north of the electric car line for 50 to 60 rods. The rock has been quarried here and the exposure includes about 10 feet. There is also a small outcrop of these strata in the south bank of the stream a mile northeast.

MARCELLUS BLACK SHALE

This term has been generally applied to a series of black and dark shales that immediately succeed the Onondaga and at the top pass gradually into the lighter colored Hamilton shales. At Marcellus, Onondaga county, from which locality the name is derived, only the lower beds are well exposed and recent 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.

Westward from Ontario county the Marcellus shale is clearly delimited on the top by the Stafford limestone, the shale above which, though very dark, is more calcareous and weathers to a light gray, while the rock between the Onondaga and the Stafford is a densely black and bituminous slaty shale with a few thin calcareous layers and, at some localities, a row of spherical concretions usually one to two feet in diameter.

On these quadrangles the Marcellus is 20 to 25 feet thick.

Fossils are common in the Marcellus shale at the base and for 3 or 4 feet at the top. Where this formation is more calcareous and lighter colored they are fairly abundant. A list numbering 20 species of those occurring in these beds at Lancaster may be found in New York State Museum Bulletin 49.

The following are the more abundant forms:

Ambocoelia nana *Grabau*
Chonetes mucronatus *Hall*
Isochilina? fabacea *Jones*
Liorhynchus limitare (*Vanuxem*)
Pterochaenia fragilis (*Hall*)
Nuculites triqueter *Conrad*
Orthoceras subulatum *Hall*
Strophalosia truncata (*Hall*)
Styliolina fissurella *Hall*

Exposures. A few inches of Marcellus black shale appear beneath the ledge of the Stafford limestone in the bed of Ellicott creek at Wende, south of the Lehigh Valley Railroad bridge. About 2 feet of black shale are exposed in Cayuga creek at Lancaster, just above the lower bridge, and also under the limestone below the Lake Como dam and similarly situated, in the bed of Plumb Bottom creek east of Foundry street. No other outcrops of the Marcellus shale occur on these quadrangles.

STAFFORD LIMESTONE

In western New York the Marcellus black shale is overlaid by a bluish gray compact limestone, that at its most eastern exposure on Flint creek in the town of Phelps, Ontario county, is but 4 inches thick but increases to 3 feet at Stafford, 8 feet 4 inches at Lancaster and, according to a well record, to 15 feet on Smoke creek in West Seneca. In the Seneca Lake valley this horizon is marked by a band of gray calcareous shale in which are imbedded spheric concretions containing fossils of the same species as those found in the limestone on these quadrangles. The largest exposure of this formation and the one most favorably situated for examination is in the beds of Cayuga and Plumb Bottom creeks in the village of Lancaster, where all the strata may be seen. It is here composed of 6 to 8 layers of limestone varying but slightly in lithologic character and quite fossiliferous throughout.

The Stafford limestone at Lancaster and its fauna have been fully described in New York State Museum Bulletin 49, with a complete list of the fossils and descriptions of species, of which there are 72. The more common forms are:

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

Exposures. Besides those mentioned as occurring at Lancaster, a small outcrop in the bed of Ellicott south of the Lehigh Valley Railroad bridge, and a very small one in an old pit 2 miles north of Alden, there is no exposure of Stafford limestone on these quadrangles. There is a quite extensive field exposure at Stafford, from which village the name is taken, and the limestone appears in the cliff below Main street bridge in LeRoy, and also below the mill at Ashantee, near Avon.

CARDIFF SHALE

The upper beds usually included in the old term Marcellus and designated by Vanuxem the "Upper shales of Marcellus," are abundantly exposed near Cardiff, Onondaga county, and have been named from that locality (New York State Museum Bulletin 63, page 16).

The Cardiff shales decrease in thickness from the type locality westward to about 50 feet here, and also become much darker and more bituminous. On these quadrangles they vary but little in character from the shales below the Stafford limestone, though on the whole a little more calcareous and, after exposure, lighter colored. At the top there is a stratum of impure limestone 12 to 15 inches thick, quite hard but somewhat shaly in old exposures. The shales at the base and the limestone near the top of the formation are moderately fossiliferous, but the intervening beds are usually not rich in fossils.

The following forms have been reported from the calcareous lower shales overlying the Stafford limestone at Lancaster:

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 in these beds in Livingston and Ontario counties but are very rare here.

The only exposures of the Cardiff beds on these quadrangles are on Cayuga and Plumb Bottom creeks in Lancaster, where 2 or 3 feet of the lower shale succeeds the Stafford limestone, and at the junction of Cayuga and Little Buffalo creeks one-half mile east of Lancaster, where the hard layer mentioned (which here contains fine specimens of Phacops rana) is exposed under the highway bridge. The shale next above this hard layer for 10 to 12 feet belongs to this formation.

HAMILTON BEDS

SKANEATELES SHALE

The term "Skaneateles shale" was applied by Vanuxem to the beds overlying the Marcellus (Cardiff) shale and exposed on both sides of the north end of Skaneateles lake. It subsequently fell into disuse, but when the State Survey found itself compelled to adopt a more exact and refined classification of the strata than that hitherto in use, the term Skaneateles shale was re-applied in its original meaning and scope. It is the lowest division of the Hamilton beds, and on these quadrangles has an estimated thickness of 40 to 50 feet.

The passage from the Cardiff shale is a gradual one, there being but slight difference between the upper beds of that formation and the lower Skaneateles shales. They become lighter colored and more argillaceous in the upper part but the formation as a whole is much darker on these quadrangles than in the type locality.

The Skaneateles shale is delimited at the top by a calcareous band known as the Centerfield limestones. Fossils are common in the lower and more calcareous portion of the formation, but rare in the upper beds at most localities.

The following species have been reported as occurring in these beds on the Buffalo quadrangle:

Phacops rana *Green*
Cryphaeus boothi *Green*
Primitiopsis punctuliferus *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.

Exposures. There are a few feet of Skaneateles shales uncovered below the limestones in the bed of Murder creek opposite the Losee schoolhouse one and one-fourth miles north of Darien, and also in the bed and banks of Crooked creek a mile west of the schoolhouse. The middle beds are exposed along Cayuga and Little Buffalo creeks 1 to 2 miles south and east of East Lancaster and also along Buffalo creek west of Blossom. The upper beds and the contact with the succeeding formation are displayed below the dam at Blossom.

LUDLOWVILLE SHALE

This formation embraces about 100 feet of soft, light colored shales in which there are interbedded many calcareous concretions and concretionary layers, and, near the base, a continuous band of thin limestones. It is capped by a stratum of encrinal limestone that is continuous from Madison county to Lake Erie.

The term Ludowville shale was adopted by Hall on account of the exposure of these beds at Ludlowville, on Cayuga lake. The calcareous band near the base was described in New York State Museum Bulletin 63 and designated the Centerfield limestone from its favorable exposure in the bed of Shaffer creek at Centerfield in Ontario county. It appears at all exposures of its horizon from that locality westward to Lake Erie varying but little in character except as to the relative thickness of the thin layers of hard limestone of which the band is composed. It is usually succeeded by a soft shale containing a great abundance of corals. At Centerfield and in the Delaware, Lackawanna & Western Railroad cuts 2 miles west of East Bethany, the exposures indicate coral reefs of considerable extent. This limestone resembles somewhat the Tichenor limestone that succeeds the Ludlowville shale and at isolated exposures has been mistaken for it. It is not represented in the coloring on the map but its position is shown by the north line of the Ludlowville area.

The beds in the middle part of the Ludlowville are not usually very fossiliferous, but the upper shales are richer and the concretionary layers contain many finely preserved specimens. The lower limestone at Centerfield afforded 92 species and Doctor Grabau's list of Ludlowville fossils from Eighteen Mile creek and vicinity names 120 species, embracing 6 crustaceans, 4 cephalopods, 4 pteropods, 29 lamellibranchs, 50 brachiopods, 1 crinoid, 8 bryozoans and 7 anthozoans. The common forms are:

Phacops rana *Green*
Cryphaeus boothi *Green*
Proetus rowi *Green*
Platyceras auriculatum *Hall*
P. thetis *Hall*
Nautilus magister *Hall*
Orthoceras nuntium *Hall*
Styliolina fissurella *Hall*
Diaphorostoma lineatum *Hall*
Pterinea flabellum *Conrad*
Actinopteria decussata *Hall*
Modiomorpha subalata *Conrad*
Palaeoneilo tenuistriata *Hall*
Stropheodonta demissa (*Conrad*)
Leptostrophia perplana (*Conrad*)
Rhipdomella vanuxemi *Hall*
Orthothetes arctostriatus *Hall*
Chonetes lepidus *Hall*
C. scitulus *Hall*
Spirifer mucronatus (*Cônrad*)
Sp. granulosus (*Conrad*)
Sp. fimbriatus *Hall*
Sp. subumbona *Hall*
Ambocoelia umbonata (*Conrad*)
Athyris spiriferoides (*Eaton*)
Atrypa spinosa *Hall*
Camarotoechia dotis *Hall*
Tropidoleptus carinatus (*Conrad*)
Liorhynchus multicostum *Hall*
Pleurodictyum stylopora (*Eaton*)
Streptelasma rectum *Hall*

Exposures. There are many fine exposures of the Ludlowville shales on these quadrangles. The upper beds outcrop along Bowen brook and the entire section or nearly all of it along Murder creek north of Darien; along Ellicott creek one and three-fourths miles west of Darien Center, and along Spring creek and the Erie Railroad east of Alden. The middle beds are displayed in the bed of Cayuga creek a mile south and southeast from Marilla Station. At the fall in Buffalo creek at the Bullis bridge, 2 miles west of Marilla, the exposure of the upper beds and the contact with the Tichenor limestone is exceptionally large and favorable for the collection of fossils, and the middle and lower shales are displayed along the bed and banks of the stream to Elma and Blossom. The upper beds with the overlying limestone are well exposed in the bed of Cazenovia creek below the bridge at Spring Brook.

TICHENOR LIMESTONE

The stratum of limestone that succeeds the Ludlowville shale has been commonly known as the "Encrinal limestone," a name applied to it by Hall in 1839 on account of the great abundance of fragments of crinoid stems contained in it.

Since this term has been applied by others to limestone layers of similar character occurring at distinctively different horizons and specially to the limestones in the lower Ludlowville beds, thereby causing confusion in the identification of horizons, a more distinctive appellation for this stratum was required. It has therefore been designated Tichenor limestone from its typical exposure in the ravine at Tichenor point on Canandaigua lake and along the shore toward the south. It usually consists of a single compact layer of bluish gray limestone, hard and durable, with a thickness varying from 12 to 18 inches and continuous, with many outcrops, from Onondaga county to Lake Erie, disappearing at the mouth of Pike creek.

This stratum in central New York is usually overlaid by calcareous shales, but on these quadrangles where the formation attains its greatest development on the line of outcrop it is followed by one or more layers of limestone that make the total thickness of the formation about 3 feet. The Tichenor limestone carries an abundant fauna. Doctor Grabau's list contains the names of 60 species occurring in it in this region, of which the following are the more abundant and striking forms:

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

Exposures. The Tichenor limestone is exposed in the lower part of most of the principal ravines in the southern part of this quadrangle, and by reason of its superior resistance to the erosive power of the stream, cascades have been produced with the limestone at the crests and long exposures in the banks farther down the stream. The larger and more accessible of these exposures are: on Bowen creek 2 miles northwest of Alexander; on Murder creek 30 rods below the bridge at Darien; on Ellicott creek one and three-fourths miles west of Darien Center; at west end of Erie Railroad cut 2 miles east of Alden; in the bed of Durkee creek at 900 A.T. and in the bed of a small stream flowing into Cayuga creek 2 miles south of West Alden. At the Bullis bridge over Buffalo creek the Tichenor limestone is the crest of the fall, and is bare to the extent of half an acre above. It is displayed in the cliffs below the fall for one-quarter of a mile and the bed of the stream is strewn with large blocks from it. The Ludlowville and Moscow shales are also finely exposed, making this an exceedingly interesting as well as picturesque locality.

The limestone is well exposed in the bed of Cazenovia creek below the bridge at Spring Brook and also at the crest of a cascade in a small branch of Cazenovia creek, near the west line of the quadrangle 2 miles north of Webster Corners.

MOSCOW SHALE

This formation rests on the Tichenor limestone and consists in these quadrangles of about 50 feet of soft, light bluish gray shales that are usually somewhat calcareous and embrace several courses of flat concretions. The latter become at some exposures continuous concretionary layers crowded with fossils. Eastward from Ontario to Chenango counties the light colored Moscow is separated from the black Genesee shale by the Tully limestone, but west of Canandaigua lake and on these quadrangles this limestone and the Moscow beds are directly followed by thin lentils of iron pyrite or black shale.

Like most of the Devonic formations, the Moscow diminishes in thickness toward the west. At Moscow in the Genesee River valley, the locality from which the term Moscow shale is derived, the beds are 130 feet thick and on the south side of the mouth of Eighteen Mile creek at North Evans they measure but 17 feet.

Moscow shale is 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 shale. Doctor Grabau reported 51 species from the Moscow beds in the Eighteen Mile creek region, the following being the more common forms:

Phacops rana *Green*
Tentaculites gracilistriatus *Hall*
Palaeoneilo tenuistriata *Hall*
Pholidops hamiltoniae *Hall*
Spirifer tullius *Hall*
Sp. consobrinus *d'Orbigny*
Chontes deflectus *Hall*
C. mucronatus *Hall*
Leptostrophia perplana (*Conrad*)
Ambocoelia umbonata (*Conrad*)
Atrypa reticularis *Linné*
A. spinosa *Hall*
Streptelasma rectum *Hall*
Cystiphyllum conifollis *Hall*

Exposures. The Moscow beds are advantageously exposed along Bowen brook 2 miles northwest of Alexander; along Murder creek between Griswold and Darien; in the bed of Ellicott creek from the fall one and three-fourths miles west of Darien Center to a low cascade 35 rods below the Erie Railroad bridge; in the Erie Railroad cut 2 miles east of Alden; in a ravine 2 miles southeast of West Alden; 6 feet of upper beds on Little Buffalo creek half a mile below Marilla; and especially fine and conveniently accesssible exposures are in the Buffalo Creek gorge above the falls at the Bullis bridge 2 miles west of Marilla; in the Cazenovia Creek gorge at Spring Brook and in a small ravine 2 miles north of Websters Corners.

TULLY HORIZON — PYRITE LENSES

The Tully limestone that succeeds the Moscow shale in central New York and is 30 feet thick in Onondaga county, thins out toward the west to Ontario county and is not known west of Canandaigua lake. In its place there appear at frequent intervals along the line of outcrop of this horizon, thin lenticular masses or lentils composed almost entirely of iron pyrites. These lentils in a few instances attain a thickness of 4 to 5 inches, but are usually less than 2, and they vary greatly in breadth, ranging from a few feet to the entire length of exposure many rods long.

Fossils are quite common in the pyrite and are mostly of species common in the Moscow or Genesee shales, but greatly reduced in size. A list prepared by Dr F. B. Loomis, published in New York State Museum Bulletin 69, contains the names of 48 species collected from the pyrite in this horizon in Ontario and Livingston counties. Most of these are pigmy forms of well-known species reduced to about one-fifteenth of their normal size. The more abundant forms are:

Spirifer mucronatus *mut.* hecate *Clarke*
" fimbriatus *mut.* pygmaeus *Loomis*
" granulosus *mut.* pluto *Clarke*
Ambocoelia umbonata *mut.* pygmaeus *Loomis*
Paracyclas lirata *mut.* pygmaeus *Loomis*
Tornoceras uniangulare *Conrad*
Orthoceras subulatum *mut.* pygmaea *Loomis*
Pleurotomaria, 3 species
Crinoid stems

Exposures. A thin lentil occurs in a small ravine half a mile west of Alexander and a similar one in the east bank of Murder creek 40 rods north of the railroad station at Griswold. A 1 inch lentil appears in the east bank of Ellicott creek one and one-half miles west of Darien Center, and at the iron bridge over Cayuga creek one and one-half miles below Cowlesville, a lentil of more than ordinary thickness and breadth is finely exposed. Another 2 inches thick, is in the banks of Little Buffalo creek half a mile below Marilla. There are traces of lentils in the long exposure of this horizon in the banks of Cazenovia creek south of Spring Brook, but they are all very thin.

GENESEE BLACK SHALE

The heavy beds of black and dark slaty shale that succeed the light colored Moscow shale in Ontario and Livingston counties were, in Hall's original classification, all included under the term Genesee shale, from their exposure in the Genesee river valley. Subsequent investigations disclosed such differences in the character of these beds as to require, in the interest of clearness and accuracy of description, a division into four distinct members or formations, the lowest of which in the type locality is 90 feet thick and capped by a bed of light gray limestone. The shale composing this member is nearly all densely black and slaty answering to the original description of the Genesee slate, and the use of that term is now restricted to these beds. It thins out from the type locality rapidly toward the west to about 20 feet on the east line of these quadrangles and to less than 2 feet on the western boundary.

Fossils are not usually abundant in the Genesee, but Chonetes setigera occurs in great numbers in the upper part at the exposure in Ellicott creek west of Darien Center and at the iron bridge north of Cowlesville. Styliolina fissurella is also common, and Pterochaenia fragilis and small cephalopods occur occasionally.

Exposures. This black shale is exposed in the ravine west of Alexander; above and below the railroad bridge at Griswold; below the railroad bridge a mile west of the station at Darien Center, and at a 5 foot fall in Durkee creek, 3 miles southeast from Alden, where the entire section with an interbedded row of spherical concretions and the overlying limestone are displayed. It is 8 feet 6 inches thick at the fine exposure under the Iron bridge northwest of Cowlesville; 7 feet in the bed of Buffalo creek below Marilla, 3 feet 6 inches in a long exposure in the gorge of Cazenovia creek south of Spring Brook.

GENUNDEWA LIMESTONE

From Canandaigua lake westward to Lake Erie the black Genesee shale is succeeded by a limestone formation consisting at Genundewa point on Canandaigua lake, of several thin layers of limestone and calcareous shale. The layers of limestone decrease in number toward the west, but as the remaining ones retain their peculiar characteristics the formation is easily recognized and is a convenient stratigraphic bench mark. On these quadrangles it consists of a concretionary layer 8 to 10 inches thick overlaid by 3 to 6 inches of limestone, slightly shaly and composed, in large proportion, of the minute shells of a pteropod, Styliolina fissurella. This characteristic is persistent, and the formation has been sometimes referred to as the "Styliola limestone" for this reason. Most of the exposures of the Genundewa limestone are in the bottom of ravines where, by its superior hardness over the shales beneath and above, small falls or cascades are produced. It is exposed in both branches of the ravine half a mile west of Alexander; in the bed of Murder creek on the south side of the Erie Railroad bridge at Griswold; in the bed of Ellicott creek 1 mile west of Darien Center; above the falls in Durkee creek southwest of Alden; under the iron bridge northwest of Cowlesville, and in a small ravine half a mile north of the bridge; finely in the bed of Buffalo creek at Marilla; in the banks of the Buffalo Creek gorge south of the Bullis bridge and in the Cazenovia Creek gorge south of Spring Brook. It dips beneath the water level of Lake Erie a mile southwest of Pike creek. The fauna of the Genundewa limestone in Ontario and Livingston counties comprised 44 species and is of peculiar interest in that the brachiopods and corals so abundant in the Ludlowville and Moscow calcareous layers and shales are absent here, and the fossils are mostly species of cephalopods, gastropods and lamellibranchs that make their earliest appearance in this limestone.

The fauna includes the following species:

Manticoceras pattersoni *Hall*
Gephyroceras genundewa *Clarke*
Tornoceras uniangulare (*Conrad*)
Orthoceras atreus *Hall*
Styliolina fissurella *Hall*
Pleurotomaria genundewa *Clarke*
Bellerophon koeneni *Clarke*
Phragmostoma natator *Hall*
Loxonema noe *Clarke*
Pterochaenia fragilis (*Hall*)
Honeoyea styliophila *Clarke*
Ontaria suborbicularis *Hall*
Buchiolia retrostriata (*von Buch*)
Paracardium doris *Hall*
Melocrinus clarkei *Williams*
Plant remains and fish remains also occur.

WEST RIVER SHALE

The beds of dark shale that succeed the Genundewa limestone in the Genesee valley to the thickness of about 100 feet were until recently known as the upper Genesee shales. In that locality about 65 feet next above the limestone were dark bluish gray shales with thin layers of black shale interbedded at intervals of 3 to 8 feet. The term West River shale is now used to designate these beds on account of their abundant exposure in the West River valley in the western part of Yates county, the remaining 35 feet of the Upper Genesee beds receiving the name Middlesex black shale.

The thickness of the West River shale is decreased to 30 feet on the east line of these quadrangles and to 15 feet on the west boundary, but the character of the rock is not altered, spherical concretions and occasionally a thin calcareous sandstone flag appearing in the shales at nearly all exposures.

Fossils. The fauna of the West River shale embraces the following species, nearly all from the lighter colored shales:

Bactrites aciculum *Hall*
Gephyroceras *sp.*
Pleurotomaria rugulata *Hall*
Buchiola retrostriata (*von Buch*)
Panenka *sp.*
Pterochaenia fragilis *Hall*
Lunulicardium curtum *Hall*
Lingula spatulata *Vanuxem*
Orbiculoidea
Melocrinus clarkei *Williams*

Exposures. The West River shale outcrops in the banks of the ravines west of Alexander, and along Tannery creek at Attica to the little falls below the second highway bridge; at Griswold 25 rods south of the Erie Railroad in the west bank of Murder creek; along Ellicott creek below the railroad west of Darien Center; at the falls in Durkee creek southeast of Alden; in the west bank of Cayuga creek at the Iron bridge and in the small ravine half a mile north; also along Little Buffalo creek below Marilla; in the banks of the Buffalo Creek gorge one-half mile south of the Bullis bridge, and in the gorge of Cazenovia creek one and one-half miles south of Spring Brook.

MIDDLESEX BLACK SHALE

A band of black slaty shales about 20 feet in thickness succeeds the West River beds and is followed by argillaceous shales of a much lighter color. This band was formerly considered as a part of the upper Genesee shales, but differs from the beds below it not only in respect to its lithologic character, but also in its fauna, the characteristic fossils of the West River beds being absent from these.

In United States Geological Survey Bulletin 16, 1885, Clarke separated this black shale from the Genesee, and considered it under the term "Lower Blank Band of the Portage Group." In New York State Museum Bulletin 63 it received the designation Middlesex black shale on account of its abundant exposure in the Middlesex valley in Yates county, from which locality it is continuous westward without change of character, though diminishing gradually in thickness to about 6 feet at the point where it dips under the water of Lake Erie, in the town of Evans in Erie county. It is nearly barren of fossils except lignites. A small lingula, *L. ligea*, occurs in this horizon near the mouth of Pike creek.

Exposures. At the cascade on Tannery brook one-half mile northwest of Attica; on Murder creek 30 rods south of the railroad bridge at Griswold; near the Erie Railroad bridge over Ellicott creek; along Durkee creek; Little Buffalo creek at Marilla; Buffalo creek one mile below East Elma and along Cazenovia creek one and one-half miles south of Spring Brook.

CASHAQUA SHALE

This formation is composed of light bluish or olive clayey shales having an aggregate thickness on the east line of these quadrangles of about 80 feet, decreasing to 50 feet on the west line. Calcareous concretions are common in the shale and blocky calcareous layers 2 to 5 inches thick occur at intervals of from 1 to 5 feet and a few thin flags also appear at some outcrops. The passage from dark to light shale at the bottom and from light to dark at the top is in both cases gradual through several alternations in 5 to 10 feet, but the formation presents an aspect so different from the beds above and below as to make recognition easy.

It was described and considered as the lowest member of the Portage group by Prof. James Hall in the Report on the Geology of the Fourth District, 1840, and by him designated the Cashaqua shale on account of its specially fine exposure along Cashaqua creek in Livingston county. The Cashaqua beds are 165 feet thick in the Genesee River gorge and but 32 feet in the cliffs on the shore of Lake Erie.

Fossils are not found in great abundance in these beds, but are fairly common in some of the upper shales, and some of the large flat concretions in the upper part of the formation contain finely preserved goniatites and orthoceratites.

The following are the more common and characteristic species of the Cashaqua shale:

Manticoceras pattersoni *Hall*
Probeloceras lutheri *Clarke*
Tornoceras uniangulare (*Conrad*)
Bactrites aciculum *Hall*
Orthoceras pacator *Hall*
O. ontario *Clarke*
O. filosum *Clarke*
Phragmostoma natator *Hall*
Lunulicardium (Pinnopsis) acutirostrum *Hall*
L. (Pinnopsis) ornatum *Hall*
Pterochaenia fragilis *Hall*
P. cashaqua *Clarke*
Honeoyea major *Clarke*
Ontaria suborbicularis *Hall*
O. accincta *Clarke*
Buchiola retrostriata (*von Buch*)
Paracardium doris *Hall*
Paleoneilo petila *Clarke*
Lingula ligea *Hall*
Aulopora annectens *Clarke*
Melocrinus clarkei *Williams*

Exposures. There are good exposures of the Cashaqua beds in both branches of Tannery brook a mile west of Attica. In the Murder Creek ravine at Griswold the entire section may be seen to excellent advantage. The upper beds are well shown below the milldam at Cowlesville, and below the bridge over Buffalo creek at East Elma, and the entire section in the bed and sides of Cazenovia creek for more than a mile. There are also many outcrops in small ravines and roadside gutters.

RHINESTREET BLACK SHALE

This formation, consisting of a heavy mass of black shale succeeding the light colored Cashaqua beds, is 90 to 100 feet thick on the east line of these quadrangles and 150 feet on the west. With one exception, the Dunkirk black shale, higher in the series, it is the only Devonic formation that decreases in thickness toward the east. It extends as far as the Keuka Lake valley on the east, where outcrops show but 6 to 10 feet of the black shale, and to the shore of Lake Erie in the town of Evans, where it is 185 feet thick. On these quadrangles it includes a few thin bands of dark bluish gray shale usually from 3 to 5 feet thick that contain large symmetric concretions and septaria, some of which attain a diameter of 3 to 6 feet.

The black shales are quite barren of fossils, except plant remains, fish remains and conodont teeth, all of which are very rare. In the lighter shales obscure forms like those found in the Cashaqua shales occur but are also rare.

Exposures. Rhinestreet shale is the surface rock over a large area and is exposed in numerous ravines, frequently at and above cascades produced by its greater resistance to the erosive power of the streams than the more argillaceous Cashaqua shale. The larger exposures are along Tonawanda creek at Sierks; in the Tannery Brook ravines; in the upper part of Murder Creek ravine, along Cayuga creek at Folsomdale, Buffalo creek at Porterville and along Cazenovia creek at Jewettville and the banks of the gorge for 3 miles below.

HATCH SHALES AND FLAGS

In the Genesee River Gorge section the Rhinestreet shale is succeeded by about 150 feet of dark ferruginous and light blue shales with frequent layers of thin sandstone and overlaid by a well-defined sandstone. The black Rhinestreet shale and these beds were included by Professor Hall in the Report on the Geology of the Fourth District, 1842, in the formation designated "Gardeau flags and shales," but for reasons set forth in New York State Museum Bulletins 63 and 118 they were separated and considered as units in the Portage series and designated "Hatch flags and shales" from their exposure at the base of Hatch hill at the head of the

Canandaigua Lake valley. In Ontario and Livingston counties they are succeeded by a band of compact sandstone designated the Grimes sandstone.

The beds become softer toward the west and lighter colored, though black bands are frequent. Large flat concretions are common in the lower part and there are a few flags. Iron pyrite in nodules and small nodular masses is quite common in both shales and sandstones at some localities. Fossils are somewhat rare in this member of the series, but occur quite frequently in the lower beds and become more common toward the west.

The larger concretions mentioned contain very fine goniatites and other species along the Lake Erie shore. The fauna includes:

Manticoceras rhynchostoma *Clarke*
M. oxy *Clarke*
M. sororium *Clarke*
M. pattersoni *Hall*
Tornoceras uniangulare (*Conrad*)
Bactrites aciculum *Hall*
Ontaria suborbicularis *Hall*
Buchiola retrostriata (*von Buch*)
Paracardium doris *Hall*
Pterochaenia fragilis (*Hall*)
Cladochonus *sp.*
Lignites and fucoids also occur.

Exposures. Along Crow creek above the reservoir 2½ miles southeast of Attica; in Tannery brook below Danley Corners; in the ravine of the Right branch of Cayuga creek below Bennington, and along Hunters creek a mile southwest of Wales Center, and along the road leading west from Jewettville.

GARDEAU FLAGS AND SHALES

As set forth in New York State Museum Bulletin 118, this term is now used to designate the strata resting upon the Grimes sandstone in Livingston and Ontario counties and succeeded by the Nunda sandstones. The Grimes sandstones thin out westwardly and have not been traced to these quadrangles with certainty, but an arenaceous band consisting of two or three sandstones 12 to 18 inches thick that appears to be at or near the Grimes horizon marks a change in the sedimentation and is here considered the base of the Gardeau beds.

This formation is composed of sandstones, thin flags, hard sandy shales, soft clayey shales and in the lower part a considerable proportion of dark to black shale that increases toward the west and large calcareous concretions occur in all parts. A bed of black shale near the base, much heavier on the shore of Lake Erie, has been designated the "Dunkirk black shale." The aggregate thickness of the Gardeau beds on these quadrangles is approximately 300 feet.

Fossils are very rare in most of the strata, except some of the light colored soft shales, where they are fairly common. The fauna is composed of the following species:

Manticoceras rhynchostoma *Clarke*
M. pattersoni *Hall*
M. oxy *Clarke*
Tornoceras uniangulare *Conrad*
Orthoceras pacator *Hall*
Bactrites aciculum *Hall*
Styliolina fissurella *Hall*
Phragmostoma natator *Hall*
Loxonema multiplicatum *Clarke*
Palaeotrochus praecursor *Clarke*
Lunulicardium bickense *Holzapfel*
Honeoyea erinacea *Clarke*
H. major *Clarke*
H. desmata *Clarke*
Posidonia attica *Williams*
Ontaria suborbicularis *Hall*
O. clarkei (*Beushausen*)
Euthydesma subtextile *Hall*
Buchiola retrostriata *von Buch*
B. lupina *Clarke*
Paracardium doris *Hall*
Pterochaenia fragilis *Hall*
Hydnoceras nodosum *Hall*
Cladochonus *sp.*
Lignites.

Exposures. Exposures of the Gardeau flags and shales are in all the ravines on the west side of the Tonawanda Creek valley, and specially good ones are in the large ravine above the railroad west of Varysburg, and in the large Stony Brook ravine east of that village. The flags and heavier sandstones crop out in many of the small gullies in the towns of Bennington and Sheldon and those in the southern part of Attica.

NUNDA SANDSTONES

Toward the west from the Genesee River gorge at Portageville where this formation is a nearly homogeneous mass of compact light bluish gray sandstone nearly 200 feet thick, it gradually becomes softer and more shaly. This tendency appears to be stronger in the lower portion, reducing the thickness of the strata retaining the characteristics of the sandstones at the type locality to 125 to 150 feet on these quadrangles and of these some are less compact.

Fossils (except lignites) are rarely found in the sandstones and there are very few in the shaly partings. The following forms, collected at Portageville, constitute the fauna of the Nunda sandstones in this region:

Manticoceras oxy *Clarke*
M. rhynchostoma *Clarke*
Orbiculoidea *sp.*
Cladochonus *sp.*
Crinoid stems
Fucoids

Exposures. The Nunda beds are well exposed in but two localities on these quadrangles. The entire section may be seen in the bed and sides of the upper part of a ravine in the hillside west of Varysburg, and at the highway bridge over the Stony Brook gorge 2 miles east of Varysburg. There are small outcrops near South Attica, also on Poland hill and west of Persons Corners.

WISCOY SHALES

This formation, named from its exposure at the falls of West Coy creek at Wiscoy in the Genesee River valley, is composed at the type locality of a band of black shale 20 feet thick at the base, succeeded by 150 to 170 feet of light soft shale resembling the Cashaqua beds, with thin bands of black shale and a few thin layers of hard and soft sandstones. Calcareous concretions are common at some horizons.

The formation is capped by a band of hard, calcareous sandstones, containing brachiopods, that produces in the bed of the Genesee river a small cascade known as Long Beards riffs. These beds were formerly considered as belonging to the Chemung group. but their close resemblance lithologically and in the character of their fossils, to the Cashaqua beds, and the entire absence of the brachiopods that distinguish the Chemung rocks, have been deemed sufficient grounds for their description as a separate formation.

Fossils. The following species occur at Wiscoy:

Manticoceras oxy *Clarke*
Orthoceras *sp.*
Pleurotomaria *sp.*
Hyolithes neapolis *Clarke*
Buchiola retrostriata (*von Buch*)

Lunulicardium (Pinnopsis) wiscoyense *Clarke*
Paracardium doris *Hall*
Lingula ligea *Hall*
Zaphrentis *sp.*

Exposures. The basal black band, 15 feet thick, is exposed in the upper part of the ravine west of Varysburg with a few feet of the lighter nodular shales above.

CHEMUNG SANDSTONE AND SHALES

Sandstones and shales of this division are the surface rocks over a small area on the hill west of Varysburg, but are not exposed on these quadrangles.

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Appendix 2

Economic geology

Museum Bulletin 174

174 Mining and Quarry Industry of New York State 1913

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JOHN M. CLARKE, Director

Museum Bulletin 174

THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1913

BY

D. H. NEWLAND

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The University of the State of New York

Department of Science, July 21, 1914

Dr Augustus S. Downing

Acting Commissioner of Education

SIR: I beg to communicate herewith for publication as a bulletin of the State Museum, the annual report on the Mining and Quarry Industry of New York State, which covers the operations and production during the year 1913.

Very respectfully

JOHN M. CLARKE

Director

THE UNIVERSITY OF THE
STATE OF NEW YORK

Approved for publication this 24th day of July 1914

Augustus S. Downing

Acting Commissioner of Education

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THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1913

BY

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INTRODUCTION

The year 1913 was marked by general activity among the leading branches of the mining and quarry industry of the State. Productive operations were stimulated by a strong demand, especially during the first six months; in the latter part of the year, however, a reactionary tendency became manifest and conditions were rather unsettled toward the close. On the whole it was a period of large output, but of rather moderate prices.

The value of the ores and mineral materials, in their crude or first prepared forms, aggregated the sum of $41,598,399. This was larger than the total returned for any preceding year by several millions of dollars, and represented a gain of about 14 per cent over the corresponding figures for 1912, which were $36,648,382. In view of the average ruling prices for the different materials, which were by no means as high as they had been in the earlier years, the record was exceedingly favorable and showed a real expansion in the productive capacity of the enterprises.

A further index of the year's activity may be had from the tonnage of ores and minerals hoisted from underground workings.

Iron ores, pyrite, rock salt, gypsum, graphite and talc are wholly or mainly produced by mining operations in the strict sense, as contrasted with open-cast methods; the total quantity of these materials raised in 1913 was 3,156,643 tons against 2,722,648 tons in 1912.

The products on which the valuations above mentioned are based number over thirty in all and with few exceptions represent the materials as they come from the mines and quarries without elaboration or manufacture, except so much as is necessary to put them in marketable form. They do not include secondary products like iron and steel, sulphuric acid, aluminum, carborundum, calcium carbide, alkali products, etc., the manufacture of which constitutes a very large industry with an annual output that has a much greater value than that returned by the industries covered in this report.

Among the metallic minerals found in the State, iron ore is the most important from an industrial standpoint. The gross output of this ore last year was 1,606,196 long tons. After allowance for concentration, which is practised by the Adirondack mines, there remained a total of 1,217,899 long tons of shipping ore which had a value of $3,870,841, as compared with 1,057,702 long tons valued at $3,349,095 for the year 1912. Both the mines in the Clinton belt in the middle of the State and those in the Adirondacks increased their output, but the latter to a greater extent. Exploration of the iron ore continued to receive attention and further advances in this field may be looked for in the future.

The clay-working industries generally did not have a very prosperous season, as the demand for structural materials was rather quiet. The aggregate output of all classes of clay materials was valued at $12,077,872, about the same figure as in 1912, but there was actually a falling off in clay-building materials like brick and terra cotta. The decline in these branches, however, found compensation in the gains reported in the paving brick and pottery branches. A very large development of the paving brick industry is to be expected in the next few years, as a result of the increasing demand for use of the more permanent materials in highway construction.

The cement industry, especially the portland branch, showed a marked advance. The output of portland cement exceeded 5,000,000 barrels for the first time since the establishment of plants in the State, the actual quantity being 5,146,782 barrels with a value of $4,873,807. The natural cement trade on the other hand was on a decreasing scale and the production amounts to but 193,975 barrels valued at $95,565, a mere fraction of the former output.

The stone products, inclusive of granite, limestone, marble, sandstone and trap, were valued at $6,763,054, a gain of about 11 per cent in the total for the year. There was a decline in the value of the building stone quarried, and also of the monumental material, but a gain in the production of crushed stone, paving blocks and other materials used in street work. More than one-half of the total was contributed by the limestone quarries.

One of the historic industries of the State is that based on the salt deposits which were the object of enterprise in colonial times and have contributed steadily for more than a century. Complete records of the production are available from the year 1797 to date. In 1913 the output amounted to 10,819,521 barrels with a value of $2,856,664, which was in excess of the quantity reported in any previous year.

An output of 532,884 tons of gypsum set a new figure also for that material which has been of steadily increasing importance in the local mining field. The product is mainly employed for the manufacture of stucco and wall plasters, but has application also in agriculture and cement manufacture. The value of the output was $1,306,143.

Natural gas showed one of the largest gains recorded for the year; the quantity produced was 9,155,429,000 cubic feet valued at $2,549,227, or a gain of nearly 40 per cent which may be considered remarkable in view of the long-continued development of the local field. Petroleum, the only other mineral fuel that occurs in workable quantity in New York State, was produced in Allegany and Cattaraugus counties to the extent of 916,873 barrels with a value of $2,255,508. In respect to prices, the year was a notable one, as the prices for crude oil averaged nearly $2.50 a barrel for the whole twelve months, but the quantity was below the usual figure.

Among the other branches of the mineral industry that shared in the year's returns were those of talc, graphite, garnet, pyrite, slate, mineral paints, mineral waters, emery, feldspar, molding and building sand, sand-lime brick, diatomaceous earth, marl, apatite, and mica. Talc ranks as one of the more important of these, with an output of 63,000 short tons valued at $551,250, mostly from mines in St Lawrence county. Garnet for abrasive uses comes from Essex and Warren counties and the product last year amounted to 4665 short tons with a value of $145,445. Pyrite for acid manufacture is mined in St Lawrence county; graphite of the finest crystalline grade is obtained in Essex county; and feldspar for pottery and other uses in Westchester and Essex counties. The only material added to the list of the preceding year was mica, of which a small quantity was obtained in Essex county.

Mineral production of New York in 1912

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	4 495 842	$3 488 931
Natural-rock cement	Barrels	287 693	142 165
Building brick	Thousands	1 205 704	6 776 602
Pottery	....	....	2 876 762
Other clay products	....	....	2 389 731
Crude clay	Short tons	8 583	18 980
Emery	Short tons	589	6 479
Feldspar and quartz	Short tons	28 584	115 419
Garnet	Short tons	4 112	117 325
Graphite	Pounds	2 628 000	142 665
Gypsum	Short tons	506 274	1 186 845
Iron ore	Long tons	1 057 702	3 349 095
Millstones	....	....	15 358
Metallic paint	Short tons	8 012	72 176
Slate pigment	Short tons	1 750	12 800
Mineral waters	Gallons	9 682 447	760 847
Natural gas	1000 cubic feet	6 564 659	1 882 297
Petroleum	Barrels	782 661	1 338 350
Pyrite	Long tons	58 137	286 577
Salt	Barrels	10 502 214	2 597 260
Sand and gravel	....	....	2 549 729
Sand-lime brick	Thousands	21 231	133 736
Roofing slate	Squares	9 738	83 222
Slate manufactures	....	....	Nil
Granite	....	....	202 096
Limestone	....	....	3 510 445
Marble	....	....	241 847
Sandstone	....	....	1 280 743
Trap	....	....	483 863
Talc	Short tons	61 619	511 437
Other materials [1]	....	....	74 600
Total value	....	....	$36 648 382

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

Mineral production of New York in 1913

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	5 146 782	$4 873 807
Natural cement	Barrels	193 975	95 565
Building brick	Thousands	1 099 861	6 038 658
Pottery	....	....	3 367 187
Other clay products	....	....	2 672 027
Crude clay	Short tons	6 291	17 411
Emery	Short tons	611	7 332
Feldspar and quartz	Short tons	25 680	113 765
Garnet	Short tons	4 665	145 445
Graphite	Pounds	2 250 000	112 500
Gypsum	Short tons	532 884	1 306 143
Iron ore	Long tons	1 217 899	3 870 841
Millstones	....	....	13 130
Metallic paint	Short tons	7 950	78 200
Slate pigment	Short tons	2 200	15 026
Mineral waters	Gallons	9 448 348	806 298
Natural gas	1000 cubic feet	9 155 429	2 549 227
Petroleum	Barrels	916 873	2 255 508
Pyrite	Long tons	54 903	242 065
Salt	Barrels	10 819 521	2 856 664
Sand and gravel	....	....	2 584 266
Sand-lime brick	Thousands	22 225	143 345
Roofing slate	Squares	6 109	53 074
Slate manufactures	....	....	Nil
Granite	....	....	335 642
Limestone	....	....	3 852 678
Marble	....	....	252 292
Sandstone	....	....	1 321 272
Trap	....	....	1 001 170
Talc	Short tons	63 000	551 250
Othe materials [1]	....	....	66 611
Total value	....	....	$41 598 399

[1] Includes apatite, diatomaceous earth, marl and mica.

CEMENT

The cement industry greatly improved its position last year when it experienced the first really sustained prosperity that it has had in a long time. There was a strong demand, sufficient to keep all the mills busy at full capacity. The higher level of prices, which was firmly held throughout the year, afforded a fair margin of profit to manufacturers, most of whom had operated at a minimum profit if not with actual loss in the three preceding years. The recent period of price-cutting and unrestrained competition for markets found some plants in a weak position financially or technically; these either succumbed to the pressure or were reorganized on a better basis, so that as a whole the industry is now in a healthier state than ever before.

The New York portland cement plants, with one or two exceptions, successfully withstood the critical test. No doubt they fared somewhat better than most mills by reason of the exceptionally good home market that enabled them to dispose of much of their product without going into other territory, as there has been a very large amount of construction work in progress in the State by reason of the highway and canal improvements. The Hudson river district also has a natural outlet in the western section of New England which no other manufacturing center reaches on an equal basis. In consequence of these relative advantages the local industry has been able not only to hold its own in the trade, but has actually increased its output steadily from year to year.

The present favorable situation of the cement industry may be said to be the outcome of a market change which began in the season of 1912. In the early part of the year conditions were almost on the point of demoralization so far as prices are concerned, with quotations on the basis of 60 cents a barrel in bulk at the mill. Such prices furnished an incentive to buying, so that the surplus held by the manufacturers diminished rapidly and helped to strengthen the market from month to month. Prices were raised in the spring and again in the summer and with other advances later on raised the basis to 90@95 cents mill quotation which obtained in the month of December. The actual sales for the year, however, did not average so high as the market prices would indicate, owing to the fact that a considerable portion of the output is sold on contract. Within the year 1913 the market held steadily around the high mark reached in the preceding season. The New York City basis was $1.58 a barrel inclusive of package for standard brands, or $1.18 in bulk. The State plants received somewhat higher prices in their local markets. The average for the whole output was 95 cents. In 1912 the average was 78 cents a barrel.

At the close of the past season stocks were lower than at the beginning, the plants being practically denuded of any marketable surplus. There was good prospect of a continued steady demand for the early part of the current season. The removal of the former tariff of 32 cents a barrel probably will serve to prevent any material increase in prices over the present level since that would encourage importations from Germany, Belgium and England. With prices under $1 a barrel there seems to be no danger of a general invasion by foreign brands, although in periods of depression those countries may sell more or less in the seaboard markets.

In the natural cement trade conditions have not been so favorable and the few plants now engaged in that branch reported a somewhat smaller output than in 1912. The decline of the industry has meant a great loss to many communities, although its effects generally have been counterbalanced by the gain of portland cement manufacture. The natural cement product for a long time averaged around 4,000,000 barrels a year, and the industry continued in a flourishing condition down to about the year 1900 when the cheapening of the cost of portland cement brought on competition that caused the closing down of most plants.

The output of cement in the State last year reached record figures; the total as compiled from the individual reports amounted to 5,340,757 barrels. In the preceding year, the combined production of portland and natural cement was 4,783,535 barrels and in 1911 it was 3,691,373 barrels. The value of the output was also larger than that of any previous year.

As shown in the accompanying tables, the portland industry accounted last year for a total of 5,146,782 barrels, as compared with 4,495,842 barrels in 1912, or a gain of 650,940 barrels. The value of the output was $4,873,807 against $3,488,931 in 1912. The average value for the product, based on the mill prices for the year, was 95 cents a barrel against 77.6 cents a barrel. There were eight mills in operation during the year, one more than in 1912.

The output of natural cement amounted to 193,975 barrels valued at $95,565, the greater part having been made by a single plant in the Rosendale district of Ulster county. The total for 1912 was 287,693 barrels with a value of $142,165. The average price received was thus about 50 cents a barrel in 1913, the same as in 1912. Aside from Ulster county the only other county which was represented in the industry was Onondaga with three small producers.

Production of cement in New York

YEAR	PORTLAND CEMENT		NATURAL CEMENT	
	Barrels	Value	Barrels	Value
1893	137 096	$287 725	3 597 758	$2 805 387
1894	117 275	205 231	3 446 330	1 974 463
1895	159 320	278 810	3 939 727	2 285 094
1896	260 787	443 175	4 181 918	2 423 891
1897	394 398	690 179	4 259 186	2 123 771
1898	554 358	970 126	4 157 917	2 065 658
1899	472 386	708 579	4 689 167	2 813 500
1900	465 832	582 290	3 409 085	2 045 451
1901	617 228	617 228	2 234 131	1 117 066
1902	1 156 807	1 521 553	3 577 340	2 135 036
1903	1 602 946	2 031 310	2 417 137	1 510 529
1904	1 377 302	1 245 778	1 881 630	1 207 883
1905	2 117 822	2 046 864	2 257 698	1 590 689
1906	2 423 374	2 766 488	1 691 565	1 184 211
1907	2 108 450	2 214 090	1 137 279	757 730
1908	1 988 874	1 813 622	623 588	441 136
1909	2 061 019	1 761 297	549 364	361 605
1910	3 364 255	2 939 818	292 760	147 202
1911	3 416 400	2 930 434	274 973	134 900
1912	4 495 842	3 488 931	287 693	142 165
1913	5 146 782	4 873 807	193 975	95 565

A further gain in the production of portland cement may be anticipated for the immediate future. The plant of the Millen Portland Cement Co at Jamesville, Onondaga county, ran only a part of the past season, having been placed in operation for the first time in the spring. The cement is made from limestone quarried by the Solvay Process Co., nearby, who thus dispose of the smaller sizes of stone unsuitable for use in their alkali plant. The limestone, with the shale which is obtained from a local bank, is fed directly into ball mills without any preliminary crushing. From there it passes to tube mills and to the kiln. The plant was designed for a capacity of 700 barrels a day, but will probably exceed that figure when under full headway.

The portland cement mills in the State now use hard limestone exclusively as the basis of the cement mixture. The use of marl has been discontinued, and the last marl plant, which was operated by the Marengo Portland Cement Co., at Caledonia, was sold last year and dismantled.

CLAY

BY ROBERT W. JONES

The clay-working industries experienced a rather poor season in 1913. In the structural branches conditions fluctuated very markedly; at times the demand for building brick was fairly good, but such periods were followed by sudden slumps which left the market overstocked and brought prices down to a lower basis. The consequence was that the output of clay structural materials was smaller than in the preceding year and conditions at the close of the season were not auspicious for any great revival of activity in the immediate future.

The decline of output in the structural branches, however, was counterbalanced by a gain in the paving brick and pottery industries so that the year's total was somewhat larger that the output recorded in 1912. The combined value of all the products made in the State was $12,077,872, as compared with $12,043,095 in 1912.

The following table presents the figures of production for the different clay-working industries as they have been reported by the individual plants. The classification is somewhat different than that followed heretofore, necessitating some changes in the figures for the years 1911 and 1912.

Production of clay materials

MATERIAL	1911	1912	1913
Common brick	$5 310 511	$6 666 945	$5 938 922
Front brick	132 792	109 657	99 736
Vitrified paving	388 479	382 984	576 970
Hollow brick	82 217	42 575	44 265
Fireproofing	229 627	230 833	276 053
Terra cotta	718 700	1 139 291	1 113 322
Fire brick and stove lining	413 500	380 005	371 408
Drain tile	202 292	122 571	134 199
Sewer pipe	138 258	77 644	154 646
Pottery	2 196 054	2 876 762	3 367 187
Miscellaneous	20 179	13 828	1 164
Total	$9 832 609	$12 043 095	$12 077 872

There were two hundred four companies and individuals active in the clay-working industries last year. Of this number, one hundred fifty-nine were engaged in the production of common building brick, of which the number made was 1,090,506,000, valued at $5,938,922, against 1,190,374,000 in 1912 valued at $6,666,945. Front brick also showed a decline, with a value of $99,736 against $109,657; fire brick and stove lining fell off, $371,408 against $380,-005; and terra cotta showed a decline, $1,113,322 against $1,139,291 in the preceding year. The product of paving brick, on the other hand, increased over 50 per cent, the output having a value of $576,970, as compared with $382,984 in 1912; and pottery also showed a notable increase.

The production was distributed among 36 counties of the State. Onondaga county had the largest clay-working industry and reported an output valued at $1,613,395, a gain of $245,050 for the year. Ulster county occupied second place with a production of $1,077,655, all common building brick. Erie county with a production of $1,000,055 displaced Rockland county from third place. The production from Rockland county amounted to $820,475. Cattaraugus, Chautauqua and Greene counties made considerable increases due principally to the greater activity in the paving brick industry. Other counties reporting a gain over 1912 were Albany, Cayuga, Livingston, Monroe, Niagara, Ontario, Queens and Schenectady.

The basis of New York's clay-working industry is the widespread occurrence of common clays that are adapted to the manufacture of building brick, drain tile and materials of that class. These clays are found at the surface, being of glacial derivation and are usually of blue color, weathering to yellow on exposure. They burn readily and yield a product of reddish color. In addition there are extensive beds of shales, especially in the Devonic formations, which are valuable for the manufacture of paving brick and pressed building brick. The deposits of white-burning clays are quite restricted and occur only in certain localities on Long Island and Staten Island.

Production of clay materials by counties

COUNTY	1911	1912	1913
Albany	$470 503	$457 694	$473 325
Allegany	9 000	*a*	....
Broome	....	....	*a*
Cattaraugus	171 013	231 156	275 763
Cayuga	15 724	3 740	5 800
Chautauqua	166 322	113 315	147 451
Chemung	76 169	79 510	*a*
Clinton	....	....	*a*
Columbia	284 475	381 888	307 571
Dutchess	648 151	665 082	634 043
Erie	755 602	810 516	1 000 055
Greene	139 578	202 306	290 116
Jefferson	*a*	3 630	....
Kings	602 756	574 805	539 002
Livingston	70 295	125 642	200 248
Monroe	325 849	246 264	278 145
Montgomery	*a*	14 400	*a*
Nassau	105 740	119 708	109 051
New York	*a*	56 884	*a*
Niagara	25 426	22 357	55 469
Oneida	95 605	85 897	84 714
Onondaga	912 982	1 368 345	1 613 395
Ontario	255 298	341 617	470 638
Orange	565 152	615 155	472 465
Queens	402 398	613 605	651 328
Rensselaer	173 564	169 179	151 202
Richmond	470 591	723 875	588 534
Rockland	747 040	994 967	820 475
St Lawrence	....	....	*a*
Saratoga	393 490	516 632	460 223
Schenectady	486 327	539 928	579 158
Steuben	149 649	181 663	*a*
Suffolk	73 750	92 150	81 000
Ulster	829 035	1 296 779	1 077 655
Warren	*a*	17 875	*a*
Washington	10 350	19 620	14 625
Wayne	*a*	*a*	*a*
Westchester	297 997	344 798	290 256
Other counties *b*	102 778	12 113	406 165
Total	$9 832 609	$12 043 095	$12 077 872

a Included under other counties.
b In 1911, aside from counties marked *a*, are included Clinton, Genesee, St Lawrence, Tompkins and Wayne counties. In 1912, aside from counties marked *a*, are included Clinton, St Lawrence, Tompkins and Wayne counties. In 1913 are included all counties marked *a*.

COMMON BUILDING BRICK

A larger proportion of the common brick is made by the soft mud process which in spite of its defects seems destined to remain the chief method of manufacture in New York State for many years to come. The deposits of soft plastic clays in the Hudson valley will continue to afford the main basis of the industry, since many of the clay banks are not suited to any other process. New York and its environs may be expected to supply the largest outlet for material of this class as it has in the past.

Besides the brick made by the soft mud process, the term "common brick" also includes the ungraded red brick manufactured in stiff mud machines and a small product of vitrified shale brick, the latter made by the paving brick operators. Statistics covering the production of common brick for the last two years are shown in the accompanying table.

Production of common building brick by counties

COUNTY	1912		1913	
	Number	Value	Number	Value
Albany	69 100 000	$381 694	66 700 000	$370 425
Broome	....	....	*a*	*a*
Cattaraugus	770 000	5 506	800 000	8 000
Cayuga	....	....	800 000	4 800
Chautauqua	3 040 000	20 483	5 352 000	35 962
Chemung	12 300 000	79 510	*a*	*a*
Clinton	....	....	*a*	*a*
Columbia	69 434 000	381 888	58 585 000	307 571
Dutchess	122 085 000	665 082	120 770 000	634 043
Erie	43 184 000	277 696	56 899 000	380 153
Gree e	36 573 000	199 360	26 976 000	143 466
Livingston	....	....	*a*	*a*
Monroe	26 083 000	171 266	19 747 000	99 064
Montgomery	3 200 000	14 400	*a*	*a*
Nassau	15 399 000	105 048	15 997 000	102 531
Niagara	3 114 000	22 357	8 067 000	55 469
Oneida	12 525 000	79 575	11 860 000	78 088
Onondaga	16 985 000	119 134	19 800 000	139 150
Ontario	2 500 000	16 250	2 000 000	16 000
Orange	113 363 000	615 155	96 493 000	472 465
Rensselaer	13 800 000	76 452	12 600 000	75 550
Richmond	33 297 000	175 358	29 507 000	147 540
Rockland	184 595 000	994 967	156 281 000	820 475
St Lawrence	....	....	*a*	*a*
Saratoga	103 210 000	516 632	91 745 000	458 723
Steuben	....	....	*a*	*a*
Suffolk	15 200 000	92 150	13 500 000	81 000
Ulster	231 550 000	1 296 779	197 801 000	1 077 655
Warren	3 575 000	17 875	*a*	*a*
Washington	....	....	*a*	*a*
Westchester	53 582 000	327 698	52 525 000	275 756
Other counties *b*	1 910 000	14 630	25 701 000	158 036
Total	1 190 374 000	$6 666 945	1 090 506 000	$5 938 922

a Included under other counties.
b Includes in 1912 Cayuga, Clinton, Jefferson, Livingston, St Lawrence, Tompkins and Washington counties. In 1913 includes all counties marked *a*.

Hudson river region. The brickyards of the Hudson river section operated during the last season under rather adverse conditions. The stock of brick on hand at the end of 1912 was comparatively high, amounting to 312,004,000 as compared with 250,000,000 for 1911. The mild winter and spring, however, permitted considerable activity in building operations so that the stock of unsold brick was rapidly reduced and the active brick-making season of the Hudson valley opened with a comparatively small amount of brick in storage. The continuation of the mild weather favored manufacturing operations and the yards opened to their full working capacity. Many plants that had been idle for several seasons were again placed in operation. By the middle of the summer there was a noticeable slackening of building operations in response to the general business situation and the demand for brick from that time began to decline, becoming more restricted as the season advanced. Thus the New York market was soon overstocked and the operators were carrying large quantities of burned and unburned brick. Many of the smaller manufacturers closed their yards and the others generally reduced operations. It is estimated that the sales of Hudson river common brick in the New York market during the year were 642,950,000, as compared with 758,800,000 in 1912. The average wholesale price was $6.125 against $6.75 in the preceding year.

The statistics of production for the nine counties that send the greater part of their output to the New York City market are as follows:

Output of common brick in the Hudson river region in 1912

COUNTY	NUMBER OF OPERATORS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	69 100 000	$414 600	$6 00
Columbia	5	69 434 000	381 888	5 50
Dutchess	17	122 085 000	665 082	5 45
Greene	6	36 573 000	199 360	5 45
Orange	8	113 363 000	615 155	5 43
Rensselaer	4	13 800 000	82 800	6 00
Rockland	23	191 595 000	1 063 352	5 55
Ulster	21	231 550 000	1 296 779	5 60
Westchester	6	52 844 000	318 422	6 03
Total	102	900 344 000	$5 037 438	$5 60

Output of common brick in the Hudson river region in 1913

COUNTY	NUMBER OF OPERATORS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	66 700 000	$370 425	$5 55
Columbia	5	58 585 000	307 571	5 25
Dutchess	18	120 770 000	634 043	5 25
Greene	7	26 976 000	143 466	5 32
Orange	8	96 493 000	472 465	5 00
Rensselaer	4	12 600 000	74 550	5 97
Rockland	21	156 281 000	820 475	5 25
Ulster	24	197 801 000	1 077 655	5 50
Westchester	7	52 525 000	275 756	5 24
Total	106	788 731 000	$4 176 406	$5 37

The Hudson valley yards that ship by water have a total machine capacity of about 11,000,000 brick a day. This is the output of 500 soft mud machines. The principal districts include Haverstraw, Kingston and Dutchess Junction, but there are one or more plants at a number of other places.

In the Haverstraw district last year twenty-one companies were active and reported a total of 156,281,000 brick valued at $820,475. This comprised the entire output of Rockland county. The plants are situated along the Hudson river from the southern limits of Haverstraw north through Grassy Point and North Haverstraw, a distance of about 3 miles. Most of the yards are operated under lease; consequently there are many changes in management from year to year, though there has been no increase in the number of yards or machines during late years. At the present time there are twenty-six different yards. The total available machine capacity of the yards is 2,948,000 daily which gives this district the greatest available capacity of any in the Hudson valley. Coal is used almost exclusively for fuel. One yard uses crude oil for the preliminary heating of the kiln, followed by bituminous coal and forced draft. Sixteen yards dry by the open method, five use pallets exclusively, one is equipped with pallets and an extension steam tunnel, two are equipped with covered yards, and two have a combination of covered and pallet yard. Four yards use clay dredged from the river bottom while the rest have pits and banks west of the yards. In a few cases, the pit and molding sands come from the same local sources.

The Kingston district occupies the river front for a distance of about 12 miles and includes the yards at Port Ewen, Kingston, East Kingston, Glasco, Saugerties and Malden, with a total of twenty-one operating companies. The production, during the season, from the twenty-five yards controlled by these companies, amounted to 196,301,000 having a value of $1,068,655. The total production from Ulster county during 1913 amounted to 197,801,000 with a value of $1,077,655. The methods of manufacture are somewhat different from those used in the other sections of the Hudson valley, especially in regard to mining and tempering the clay. One yard operates with clay dredged from the river bottom. The circular tempering pit, which has been discarded by many Hudson river producers on account of the higher labor cost, is in use at many of the Kingston yards. The open yard seems to be the favorite method of drying, as it is in exclusive use in eighteen yards. Two yards combine this method with steam drying, and five are equipped with pallets. There are no covered yards now in use. Anthracite coal is the only fuel used in burning. Transportation is entirely by water and the output is disposed of in New York City with the exception of a few yards which ship entirely to Jersey City and Hoboken. The available machine capacity of this district is 2,904,000 daily.

The district which includes Dutchess Junction, in Dutchess county, produced during 1913 a total of 112,723,000 brick with a value of $591,796. The total production of Dutchess county during the same period was 120,770,000 with a value of $634,043. With a few exceptions, the crude material is the ordinary soft, sandy blue clay similar to that found at Verplanck Point and Haverstraw. The total available machine capacity of this district is 1,936,000 a day from an equivalent of eighty-eight machines. Circular tempering pits are not used; all the material at the sixteen plants is prepared in rectangular soak pits.

Six producers of common brick in Westchester county reported a total production of 52,525,000, with a value of $275,756. This includes also a small amount of ornamental soft mud brick. The entire production was made in ten yards. The district which extends along the river front from Croton Point north through Georges island to Verplanck point has a total available daily machine capacity of 1,122,000 equivalent to the production from fifty-one machines producing at the rate of 22,000 each. The clay is a grayish blue, sandy material requiring very little water in tempering. Five yards use the open method of drying, three are equipped with pallets and two with covered yards. Circular tempering pits are in use on two yards, the others using the rectangular pit exclusively. The total available kiln capacity is approximately 2000 arches, or about 70,000,000 brick. Coal is used for fuel in six yards.

Long Island and Staten Island. The common brick industry in the Long Island and Staten Island section depends upon the use of glacial clays found along the coast. The soft mud process is usually employed. On account of the low elevation most of the clay is mined from pits and the working face is usually not over 10 or 12 feet. Gravel and boulders are intermixed with the clay to an extent that sorting and crushing are necessary before the material is put in the soak pits. The sandy Cretaceous clays that occur here are employed to some extent for common brick; they require very little preparation and in some cases are used without any addition of sand. Four of the operators have pallet yards, one employs a combination pallet and open yard, one has a steam tunnel, and one a direct-heat tunnel. The fuel is chiefly wood. The production in 1913 was 59,004,000 brick valued at $331,071. The total available machine capacity is about 387,000 a day. The product is marketed locally and in the New England States.

Erie county. The district around Buffalo made an output of 56,899,000 common brick in 1913, considerably more than in 1912. The soft mud process was used for more than half of the product. The clays are found in shallow beds and the methods of treatment are similar to those employed in the Hudson valley. The market is entirely local.

FRONT BRICK

Front brick include four grades and are made by two different processes. The ordinary red front brick are simply a graded common brick, made by the stiff mud process under practically the same conditions as those obtaining in the manufacture of the common variety. Greater care, however, is exercised in burning, and the product is carefully sorted as to color. The crude materials should be of uniform composition. Buff front brick are made in the same way from clays that burn white or bluff. Richmond county affords the only output of such brick. Rough-faced, tapestry or corduroy brick are made by the producers of paving brick and are burned to vitrification along with the latter materials. This grade occupies from two to six courses at the bottom of the kiln where the temperature does not rise high enough for the thorough vitrification required in paving brick. They are never repressed and the roughened surface is secured by means of a wire placed near the die of the machine so that it drags over the surface of the clay ribbon as this comes from the machine. The dry-pressed front brick constitute the fourth class. All varieties are burned in circular or rectangular down-draft kilns. The total production of front brick in 1913 was 9,355,000 valued at $99,736, a slightly smaller number than was reported for 1912.

COMMON HOLLOW BRICK

The common hollow brick were made by nine producers last year who reported an output of 7,631,000 valued at $44,265. The methods of manufacture are practically the same as those used for hollow building blocks. Clays or shales are employed in a stiff mud machine, the brick being end cut. At one place the bricks are formed with a tile press. There are two forms — headers and stretchers. They are used chiefly for the construction of an inside veneer over common building brick or fireproofing. The demand comes mostly from the larger cities and is supplied in most cases by local plants.

FIREPROOFING

Fireproofing, which has come into such favor among architects and builders during late years, has had in the State of New York a fairly constant growth since 1907. As reported to this office, the product is known under the various names of terra cotta lumber, fireproofing, hollow tile and hollow building block. It includes many different shapes and sizes that are used in the construction of side walls, floors, arches and partitions, but not common hollow brick. This last article is used mostly as a veneer and not in the main construction. The shapes and sizes of the blocks vary, though it is the usual case to make one face with an area of one square foot. The product is sold mainly by the ton, but in small construction work the prices may be quoted by the square foot. The number of air spaces varies from one to nine.

On account of fire protection, comparative great strength, low repair costs, low first cost as compared with the present prices of lumber, and its control of sudden changes in outside temperature, the product has lately been used to a great extent as a material in the construction of private dwellings. Faced with cement, stucco or a veneer of front brick, a building of this material is practically indestructible by fire. For inside purposes, whenever it is necessary to nail woodwork, the blocks are made porous by the addition of sawdust during the process of manufacture. This is the variety usually reported as terra cotta lumber. For foundation work a special block is made with a salt glaze, rock finish face.

The product as manufactured in this State is made by the stiff mud process. Both clays and shales are used, either separately or mixed, depending upon local conditions. While the clays of the Hudson valley are not usually suitable for the manufacture of stiff mud products, there are local beds, especially among the delta deposits, that can be employed for this purpose. Such deposits occur near the mouth of the Mohawk river and are utilized for the manufacture of both fireproofing and common hollow brick. The calcareous clays of the western section of the State are also used, and the shales of the extreme western section are especially adapted. The soft plastic clays are prepared for manufacture by first passing through a disintegrator, which is practically a pug mill, without the addition of water. Coal screenings, sand and grog of crushed burned brick may be added at this point. The mixture then goes to a set of rolls, then to the pug mill, and finally to the machine. The shales are usually pulverized in a dry pan, water is added and the material then passed through a wet pan as a substitute for the pug mill. While the horizontal auger machine is usually used in the manufacture, the tile press is also employed. Drying is carried on in steam, waste heat, or direct heat tunnels and also in a covered pallet yard. The product is burned in round down-draft kilns using bituminous coal. Burning requires about five days. The finished product goes mostly to outside markets and generally on contract. There were seven firms actively engaged in the manufacture of fireproofing during 1913 in this State. The production of fireproofing, exclusive of common hollow brick, in the last four years has been as follows: 1910, $256,820; 1911, $229,627; 1912, $230,833; 1913, $276,053.

TERRA COTTA

Terra cotta is manufactured in this State to a large extent, although all the materials except some of the clays used in the glazes are brought in from outside sources. At one time the Staten Island clays were employed in a local plant. The value of the yearly outturn has recently exceeded $1,000,000, having been $1,113,322 in 1913 and $1,139,291 in 1912.

DRAIN TILE

The production of drain tile in New York State is carried on by thirteen firms who operate on a small scale. The output barely suffices to supply local markets. It is made mostly from soft plastic clays by a stiff mud process under the same conditions as those described for hollow brick and fireproofing. The output in 1913 has a value of $134,199.

POTTERY

Pottery stands second in the list of clay products in importance, and the industry has shown a steady growth. The crude materials for the finer grades are mainly imported from abroad or from other States, although the red earthenware products contain local clays. The following table gives the values of the different pottery materials as reported by the individual producers. The value assigned in the porcelain electric supplies includes also the value of the metal fixtures which amounts in the average to about 30 per cent of the whole.

Value of production of pottery

WARE	1911	1912	1913
Stoneware	$39 095	$46 024	$37 077
Red earthenware	32 495	29 697	35 790
Porcelain and semiporcelain	1 048 872	1 038 428	1 143 835
Electric and sanitary supplies	1 026 517	1 727 553	2 100 985
Miscellaneous	49 075	35 060	49 500
Total	$2 196 054	$2 876 762	$3 367 187

THE MANUFACTURE OF PAVING BRICK IN NEW YORK STATE

With the activity in State, county and municipal road construction, there has developed an insistent demand for a paving material that will stand the hard usage of modern traffic. Various methods of construction have been tried on the highways, and it may be said that the test of experience is favorable to the use of vitrified paving brick whenever the traffic is sufficient to warrant the high first cost of the material. When properly laid, paving brick give good satisfaction as to durability, appearance and low repair cost. Their use in this country does not date back much further than 30 or 40 years, but they have steadily gained in popularity and no doubt are destined to play a much more important part in future road construction than in the past.

The manufacture of paving brick requires first of all a clay that can be vitrified without difficulty and when so treated possess great hardness and toughness. Experimentation has demonstrated that the consolidated clays known as shales yield the best results in these respects, and consequently such clays are almost universally employed, although in certain cases the admixture of other clays may be needed to impart all the desired qualities to the product.

In its shale formations New York State has an inexhaustible and widely distributed resource which may be made the basis of an industry large enough to supply all the local requirements in paving material of the best quality. The value of the resource has been recognized by private enterprise, and for the last twenty-six years paving brick has been manufactured on an increasingly large scale, with a production last year of 35,666,000 having a value of $576,-970. The local product comes in competition with that made in Pennsylvania, Ohio, Michigan and other states, and the test of experience generally appears to justify the opinion that the brick made in the New York plants compare favorably with the best in the market.

Practically the whole of the southern half of the State, between the meridian of Buffalo and Albany and the Pennsylvania state line, is underlain by formations that include shale among the more important members. Not all of these, however, are adapted to paving brick manufacture, since the requirements in this case are much more restricted than in most branches of the clay-working industry. It may be said that the shales best suited for this purpose are found in the higher or more southerly formations which are generally recognized under the names of the Hamilton, Portage and Chemung groups. All these are distributed in belts that extend east and west across the central and lower tiers of counties. There are a great number of sites where the shales outcrop in force and appear to be adaptable to the purpose in view, but it would require detailed investigations in the field and some experimentation to determine just what localities offer the best advantages. The chemical analyses of clays and shales give comparatively little information as to their working qualities in the manufacture of paving brick. The following table of analyses is given, however, in an attempt to show something of the composition of the various clays and shales that have been used, are used, or may have some future application in the manufacture of vitrified ware.

Analyses of New York State shales and clays

	1	2	3	4	5	6	7	8
SiO_2	58.44	64.30	44.74	67.29	52.30	68.00	52.70	56.00
Al_2O_3	27.45	33.60	18.70	15.85	18.85	15.00	21.48	22.50
Fe_2O_3			4.25	6.16	6.55	12.00	7.02	6.70
CaO	1.16	1.46	11.25	.95	3.36	.....	3.49	1.20
MgO	2.23	1.30	1.29	.19	4.49	.....	.44	1.40
Na_2O, K_2O	.....	.....	1.20	8.71	6.00	.....	2.27	3.70
SO_3	.....	.....	2.78	.....	.....	.....	.....	.....
CO_2	.....	.....	.....	.....	.....	.....	3.20	.....
H_2O	.....	.....	9.25	.....	.....	.....	7.46	.....

1 Hamilton shale, Portland Point. From U. S. G. S. Bul. 522.
2 Hudson shale; analysis quoted from same report.
3 Clay, Warners. From N. Y. State Mus. Bul. 35.
4 Shale, Hornell. Same reference.
5 Shale, Warners. Same reference.
6 Shale, Cairo. Same reference.
7 Clay, Catskill. From Percival Golden & Son, Catskill.
8 Average of 50 clays and shales used in paving brick, quoted from "Vitrified Paving Brick," 1895.

Success in brick manufacture commercially depends to a great extent upon shipping facilities and the ability to reach the important markets at a low cost. This becomes evident when the bulk of the material is considered in connection with its value. It is also highly essential that the plant be placed near a cheap fuel supply, which in this State means soft coal. For that reason the western counties which are traversed by the railroads leading to the Pennsylvania bituminous fields have certain advantages. The cost of fuel ranks next to the item of labor in the expense of manufacture. Of the total costs, labor probably constitutes from 50 to 60 per cent. Detailed figures are almost impossible to secure in the manufacture of paving brick. The actual cost in the local plants is very close to $10 or $11 a thousand. The selling prices of paving brick, for a number of years past, have averaged around $16 a thousand at the plant.

The distribution of plants now active, or recently active, in the industry affords an idea as to the widespread extent of the natural resources. There are ten of these plants, situated at the following localities: one at Binghamton, Broome county; one at Catskill, Greene county; one at Elmira, Chemung county; one at Corning, Steuben county; two at Olean, Cattaraugus county; one at Hornell, Steuben county; one at Jamestown, Chautauqua county; one at

Newfield, Tompkins county; and one at Syracuse, Onondaga county. The first attempt to use the shales of this State was in 1888 when the Elmira Shale Brick Co., at Elmira, began the manufacture of brick. Some of the undeveloped but still promising sites are found in the central section of the State, such as along the shores of Cayuga lake, north of Ithaca, and in the vicinity of some of the other Finger lakes, where the shales are so situated that they can be readily investigated and cheaply worked, and also in Erie county, a section that is well supplied with cheap fuel, has both water and rail transportation and is close to the important markets.

Methods of manufacture. There are three kinds of material used in the manufacture of paving brick: fire clays, soft plastic clays, and shales. The fire clays generally give a product of light brown or yellow color, the plastic clays and shales a dark brown or red color. The industry in this State makes use only of the soft plastic clays and shales.

The crude materials are mined chiefly with the pick and shovel, though several companies are using steam shovels for loading. In most cases the plant has been placed fairly close to the open cut so that the material can be sent to the crushers by gravity without the necessity of a long haul. In two plants, however, there are hauls respectively of one and ten miles by rail. Hand sorting has to be resorted to at several localities in order to remove the thin layers of coarse-grained sandstone and limestone.

In nearly all cases the material receives a preliminary crushing in jaw or gyratory crushers before it is sent to the dry pan. It is reduced in the dry pan to a size that will pass a 3-16 inch mesh, then screened and the oversize returned to the pan for further grinding. The pulverized material then goes to the storage bins. The dry pan consists of a revolving slotted or perforated iron plate having a rim about one foot in height around the side. Two heavy iron mullers resting on edge, revolving by friction against the bottom plate, crush the material.

From the storage bins the pulverized material goes to the pug mill where the necessary water is added to form a stiff mud. The pug mill consists of a semicylindrical, horizontal trough of metal through the center of which revolves a shaft, furnished with steel arms, so set as to mix thoroughly the dry material and water and to feed it continually forward to the brick machine.

The brick machine, generally known as the auger machine, consists of a heavy tapering steel barrel set directly under the pug mill or combined with the pug mill on a single base. The material from the pug mill is forced by the auger under great pressure through this tapering barrel and issues from a die at the end in a solid column, the size depending upon the method to be used in cutting. With side-cut bricks the column has a cross-section of about 4½ by 10 inches, and with end-cut bricks 4 by 4½ inches. The column of stiff mud is forced along over a cutting table where it is cut by means of piano wire into bricks of such dimensions that, allowing for repressing, drying and burning, will produce a finished product of a standard size. Twelve bricks are usually made at one cut. From the cutting table the product is taken by a continuous belt either to the represses or direct to the double-deck cars preparatory to drying. Lugs are a necessity on paving bricks and are either formed by the process of repressing or at the time of cutting.

The product now goes to the drying tunnels where a temperature sufficient to dry the bricks in about 24 hours is secured either by the use of steam, waste heat from the kilns, or by direct heat. The bricks lose in moisture about 20 per cent of their original weight in the process of drying. The cars have a capacity of from 450 to 500 bricks and traverse a distance of about 100 feet between the time of entering and leaving the drying tunnels.

Burning, which is probably the most important branch of the industry, is carried on in down-draft or in continuous kilns, using bituminous or anthracite coal with or without a forced draft. Kilns and methods of burning vary. The kiln in most common use, known as the rectangular down-draft kiln, has inside dimensions of about 80 feet in length by 18 feet in width and 12½ feet in height with ten or more fireplaces on each side. The fireplaces are built in such a manner that the heat reaches the top of the kiln first, passes down through the green brick, then through the floor and by a system of flues to the stack. The proper burn is recognized almost entirely by the settle of the brick. Kilns are set about 27 bricks high, the bricks separated from each other by a thin layer of sea sand, and burned from 10 to 12 days until the material settles from 12 to 15 inches. On account of the difference in kiln temperature between the top and bottom it is the usual custom to set the first two to six layers with either common, side-walk, or rough-faced front brick that do not require so high a temperature to burn as do the paving brick.

A circular down-draft kiln is also used in the burning of paving brick. The kiln, in this case, has an inside diameter of from 20 to 30 feet and a height of about 14 feet, and is usually furnished with eight fireplaces having individual stacks or all drawing to one stack.

It would seem from experience that the circular down-draft kiln has some advantages in temperature regulation. The continuous kiln in use for the burning of paving brick, in this State at present, is of the Haight type. This consists in form of two rectangular kilns placed in parallel position and connected at both ends by a semicircular extension of the same cross-section. The kiln is divided into fifty-five chambers and after the original fire is started it is a continuous operation of setting, burning, cooling, and emptying. This kiln is top fired, using bituminous coal, the fire being controlled and regulated by dampers. The waste heat, in cooling, is carried over to a forward chamber and assists in drying. As soon as a compartment is burned, the fire is transferred ahead to the next and the first begins to cool. In this manner, the fire is carried completely around the kiln.

With one exception, railroad transportation is the only method available for the shipment of the finished product to the markets. The local brick are sold in New York, New England and the Southern States.

The figures in the following table show the annual production of vitrified brick in New York State from 1897 to date. The figures for 1897 and 1898 are taken from the "Mineral Industry," those for 1899 to 1903 inclusive from the "Mineral Resources of the United States," and those from 1904 to date from the publications of the New York State Museum.

YEAR	QUANTITY	VALUE	VALUE PER M	NUMBER OF PLANTS
1897	19 849 000	$209 124	$10 53	....
1898	18 233 000	177 968	9 75	....
1899	32 233 000	342 845	10 60	....
1900	29 943 000	347 671	11 61	....
1901	29 950 000	342 342	11 46	....
1902	27 009 000	322 250	11 93	....
1903	16 797 000	220 296	13 11	....
1904	16 351 000	210 707	12 88	8
1905	13 984 000	180 004	12 87	6
1906	11 472 000	178 011	15 51	5
1907	12 296 000	184 306	14 98	4
1908	14 570 000	211 289	14 50	5
1909	12 278 000	207 970	16 27	3
1910	19 762 000	333 511	16 88	4
1911	23 993 000	388 479	16 19	4
1912	18 249 000	382 984	15 78	5
1913	35 666 000	576 970	16 17	6

Foster Paving Block Co., Binghamton. This plant began to operate in May 1913, under the name of the Binghamton Paving Block Co. The plant, which is situated about 2 miles north of Binghamton, on the line of the Delaware & Hudson railroad is of the most modern construction. The shale in use is the blue and brown variety from the Chemung formation, which alternates with thin beds of blue sandstone. There is a little surface clay which is taken as it comes with the shale, no attempt being made to separate the two materials. The equipment consists of two dry pans, one high-speed machine, waste heat dryer and six rectangular down-draft kilns. It is the intention of the company to increase the number of kilns to twelve. The products consist of wire-cut lug paving block, common vitrified brick and rough-faced brick. When completed, the plant will have an estimated daily output of 75,000 brick.

Tidewater Paving Brick Co., Catskill. This plant, situated so as to have only water transportation, secures its supply of red Chemung shale at Cairo, a distance of 10 miles from the village of Catskill. Transportation is by means of a narrow gauge steam road. The supply of soft plastic clay, which is a necessary addition to this shale, is brought from a distance of about a mile. The product consists of repressed paving brick, common vitrified and rough-faced brick. The shale is pulverized in dry pans and stored in bins until ready for the machine. Two machines are in use, one for paving brick and the other for common and rough-faced brick. Steam tunnels are used in drying and the product is burned in rectangular down-draft kilns. The Haight type continuous kiln, formerly in use, has been dismantled as the haul from the machine was too long for the economical production of paving brick. Anthracite coal, pea size, is used with a steam forced draft in burning.

Elmira Shale Brick Co., Elmira. This plant is not operating and has been dismantled of machinery used in the manufacture of paving brick.

Brick, Terra Cotta and Tile Co., Corning. This company is engaged in the manufacture of terra cotta, paving brick and common vitrified brick. The shale, which is of a bluish color, is obtained about a mile from the plant. Clay is not mixed with the shale. The material is pulverized in dry pans and the green bricks are dried with steam heat or hot air. Burning is accomplished in circular down-draft kilns with bituminous coal. Railroad transportation is the only method available for the finished product.

Sterling Brick Co., Olean. This property, situated in East

Olean, produces a patent lug, wire-cut paving brick. No common or rough-faced brick are made. The shale is transported from the bank to the mill in side dump cars, a distance of about 1500 feet. The entire face of shale, including the small amount of surface clay, is used. From the storage bins the crude material goes to two dry pans, is then screened and the oversize returned for further grinding. The pulverized material is elevated to bins and then goes to the pug mill and machine, of which there is one. The plant is equipped with fourteen tunnels for drying. Soft coal is used for fuel. Two types of kilns are being used, of which six are rectangular and five circular down-draft. The kilns are set twenty-seven high with green brick and settle 12 inches in burning. The daily production from the plant is about 30,000 hard brick.

Allegany Valley Brick Co., Olean. This plant, also situated at East Olean, is so arranged that the crude material goes through the mill to the machine by gravity. Shale is used entirely, except for a small amount of surface clay. Natural gas is used for power. From the pug mill the material goes to two machines, one used for paving brick and the other for common brick. The lower two layers of each kiln are set with common brick. Drying requires about 24 hours, using waste heat. The drying equipment consists of sixteen tunnels holding twenty-eight cars each. There are six rectangular down-draft kilns, using soft coal. The green brick are set twenty-six high and settle 12½ inches with a twelve days' burn. The daily output is about 22,000 repressed paving brick.

Preston Brick, Hornell. This property, which was destroyed by fire several years ago, has not been rebuilt. Shale was used entirely. Dry pans were used for crushing and wet pans for tempering. The plant was equipped for the manufacture of a repressed brick. Drying was accomplished by the use of waste heat and the product was burned in circular down-draft kilns, of which there were six.

Jamestown Shale Brick & Paving Co., Jamestown. This property has been in successful operation for many years and was one of the first to make paving brick in the State on a commercial scale. The brown and green Devonic shale is secured from a large open cut near the plant. A steam shovel is used in loading the material onto cars. The shale is first crushed in a gyratory crusher and then transferred by means of a belt conveyor and elevator to storage bins. From here it goes to four dry pans, then is elevated to bins and thence to the pug mill. The plant is equipped with one high speed machine making both paving brick and common brick. The paving brick are all repressed. Drying is accomplished in steam tunnels having a combined capacity of 400 cars. There are five rectangular down-draft kilns, each having a capacity of 190,000, and one Haight continuous kiln of fifty-five chambers, each chamber having a capacity of 15,000 paving and common brick. Bituminous coal is used as fuel. The green bricks are set twenty-two high with paving and six lower layers in common brick. They settle about 15 inches with a ten or eleven days' burn. The daily output is about 66,000.

F. C. Campbell, Newfield. This plant was situated about a mile north of the village, along the line of the Lehigh Valley R. R. The mixture of clay and shale was ground in dry pans, then screened and formed in an auger machine. All paving bricks were side cut and repressed either by hand or power. Tunnel dryers were used and the material was burned in down-draft and continuous kilns, using coal. The plant has not been in operation for many years.

New York Paving Brick Co., Syracuse. This plant, situated at Geddes, was the only one in this State to make a paving brick entirely from clay. The material was brought from Three River Point on the Oswego. The product was formed in a soft mud machine and a stiff mud plunger machine. In the latter case the material was repressed. The green bricks were dried in tunnels using waste heat and burned in rectangular and circular down-draft kilns. The product was sold mostly in the local markets. At present no paving bricks are being made by this company.

New York State Plant, Elmira. The construction of a paving brick plant to be operated by prison labor is contemplated in an enactment by the last Legislature. A site for the plant has been selected in the vicinity of the State Reformatory at Elmira. The local shales are said to have given satisfactory results when manufactured and burned under working conditions. It is proposed to use the product in the southern tier of counties which are almost devoid of other materials for highway construction of permanent character.

EMERY

The emery business, which is confined to a few small operations near Peekskill, has not been very active in the last year or two. The shipments during 1913 as reported by the companies to whom they were made, amounted to 611 short tons, valued at $7332. In 1912 the shipments were reported as 589 short tons valued at $6749, and in the earlier years were still larger, reaching as high as 1500 tons at one time.

The Peekskill emery is a hard, dense rock of rather variable composition and dark gray to black color. It occurs in small lenses, bands and irregular masses in the area of basic igneous rocks that outcrops south and east of Peekskill. The emery bodies are found mainly in the northern section of the area and apparently near the contact of the igneous, or Cortland, series with the sedimentary schists. They represent without much doubt segregations within the intrusive mass similar to the titaniferous magnetites that occur within the gabbros and anorthosites of the Adirondacks. The surrounding sediments may have been absorbed more or less into the igneous mass on its way to the surface, thereby contributing some of the aluminum which has crystallized out in the form of corundum and spinel. The intrusion took place after the deposition of the Hudson River strata which are made up largely of argillaceous materials.

The emery is a mixture of corundum, spinel and magnetite, with more or less of the silicate minerals that are found in the wall rocks. The proportion of the oxids varies greatly. In some places magnetite constitutes nearly the whole mass and such bodies have been worked in the past for their iron, though not with much success. Spinel (hercynite) is intimately associated with the magnetite, though its presence is seldom to be established without microscopic examination, being in finely divided particles scarcely distinguishable from the latter in the hand specimens. Its occurrence may account for the high aluminum percentages shown in analyses of the magnetites, even in the absence of corundum. The latter is a fluctuating constituent, constituting as much as 50 per cent of the emery in places, but usually considerably less. It appears in the form of thin prismatic crystals which are set off by reason of their light color and their relatively large size from the magnetite and spinel. The mines consist of open cuts on the outcrop of the bodies, occasionally supplemented by a single underground level reached through an adit. They have little permanent equipment, being too small to warrant any considerable outlay for machinery; consequently there is a lack of stability and system to the operations.

The present source of supply is mainly from one or two properties on the northern border of the Cortland area. The Keystone Emery Mills and the Blue Corundum Mining Co. have been the principal shippers of recent years. There are a number of mines in the section north of Dickinson hill and south of the east-west highway leading out of Peekskill, but most have been closed either on account of exhaustion or the unsuitable character of the material. Some of the more extensive workings are on the farms of John Buckbee and Oscar Dalton.

FELDSPAR

The commercial production of feldspar is based on the occurrences of pegmatite that are found within the crystalline formations of the Adirondacks and southeastern New York. Pegmatite is a coarsely textured variety of granite in which the individual minerals — feldspar, quartz and mica — form crystals and masses many times larger than in ordinary granite. It occurs in dikes and bosses intrusive in the country rocks and usually associated with large bodies of granite, of which the dikes are offshoots. Such dikes range from a foot or less to 100 feet thick and are often traceable for long distances along the strike. The bosses appear as rounded or lenticular bodies with diameters of several hundred feet in some instances; most of the workable bodies have the form of bosses rather than the elongated tabular shape characteristic of dikes.

The feldspar found in pegmatites may be one of the potash varieties, that is, either orthoclase or microcline, or one of the soda-lime species such as albite, oligoclase and andesine. Very commonly both potash and soda-lime feldspar are found in the same occurrence. Microcline is by far the most frequent variety of the potash feldspars in the New York localities. It is distinguished from orthoclase by its striated appearance, but does not differ chemically from the latter. The potash varieties are the ones commonly used in pottery, but albite is preferred for some purposes as in glazing of tiles and terra cotta on account of its lower temperature of fusion.

For pottery purposes it is an advantage to have the feldspar in well-segregated crystals so that it can be readily freed from the accompanying minerals. The separation has to be effected by hand-sorting and cobbing. In the pegmatites which are quarried for pottery spar, the crystals range up to 3 or 4 feet in diameter. The pegmatites of finer texture and those in which the minerals are intimately intergrown have application principally for roofing materials.

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

The other constituents of pegmatite include biotite and muscovite, one or both of which are nearly always present, and also hornblende, pyroxene, garnet, tourmaline, magnetite, pyrite, epidote, titanite and beryl. Black tourmaline is almost invariably in evidence in the Adirondack pegmatites. These constituents may be of determinative importance with reference to the commercial uses of pegmatite, since if disseminated through the body they preclude the extraction of high-grade material.

The feldspar quarries in present operation are situated in Essex and Westchester counties. In the latter county are included the quarries near Bedford which are the principal producers of ground spar for pottery, enamel and glass manufacture. They are operated by P. H. Kinkel & Son and the Bedford Feldspar Co. The former company produces also a large amount of quartz which is shipped to Bridgeport for manufacture into wood filler.

The quarries in Essex county which are situated at Ticonderoga and Crown Point produce unsorted pegmatite which is used for roofing material. The Barrett Manufacturing Co. and the Crown Point Spar Co. are the operators.

The output of feldspar of late years has ranged from 10,000 to 15,000 tons annually, but in the last two years has shown a considerable advance through the increased shipments of ground spar. In 1912 the product amounted to 24,584 short tons valued at $106,419, by far the largest that had been recorded in the State. In 1913 the production fell off about 25 per cent and amounted to 19,680 tons with a value of $99,765. The prices recorded for the product depend upon the quality of the material and the state of preparation. The best selected crude spar brings from $4.50 to $5 a ton. Ground spar for enamel and glass manufacture is worth $6 to $8 and ground pottery material $8 to $10 a ton. The unsorted crushed pegmatite sells for about $3 a ton.

GARNET

The production of garnet for abrasive uses represents a specialized and rather limited branch of the mining industry. Garnet has certain physical qualities which make it an ideal abrasive for some classes of work, notably in leather manufacture, and there is little likelihood that it will be displaced in the trade by other abrasive materials. But the market is not capable of absorbing more than a few thousand tons a year, at least on the present basis of prices. The production in New York State for many years has ranged between 4000 and 5000 short tons, the largest recent output having been in 1907 when it amounted to 5709 short tons, and the average selling prices have remained steady at around $30 to $32 a ton for the standard grades of crystallized garnet.

The important qualities of abrasive garnet seem to be those of hardness, toughness and cleavage. In hardness, the different garnet species vary considerably, and most of the garnet that is mined for abrasive uses is almandite (iron-alumina garnet) which has a hardness of 7—7.5 on the mineral scale, or between that of quartz and topaz. Well-crystallized material which is relatively free of impurities has greater strength and stands up better under conditions of service than the finely granular mineral or that containing inclusions of other minerals. The common impurities of garnet are chlorite, mica, hornblende and pyroxene. It is an advantage, also, if the garnet possesses a parting or imperfect cleavage so that it breaks with one or more plane surfaces. Much of the Adirondack garnet shows a well-developed parting, and the faces often present a sharp chisel-edge that is not usual in any other natural abrasive. Color, of course, is not a criterion of value, but abrasive manufacturers express a preference for the darker shades which in the crushed product appear almost a ruby red. The garnet crystals should also be sufficiently large so that when they are freed from their matrix by crushing or other means, they will afford a desirable assortment of sizes. The normal result of milling operations is to produce an excess of the finer sizes.

Notwithstanding the wide distribution of garnet as a common component of the metamorphic rocks, especially the gneisses and schists, there appear to be few localities where the material has the essential qualities and occurs in sufficient quantity to be commercially valuable. In this country the most productive deposits are found in the Adirondacks. North Carolina and New Hampshire have supplied small quantities in recent years, and there are mines, now inactive, in Maine, Massachusetts, Connecticut and Pennsylvania. A description of the local deposits and the methods employed in their exploitation will be found in earlier issues of this report.

For the last four or five years the domestic supply of the mineral has been supplemented by imports amounting to a few hundred tons annually of Spanish garnet. This garnet is said to be of placer origin and is obtained by washing the sands of certain streams in the province of Almeria. According to the American counsel at Madrid (Daily Consular and Trade Reports, March 13, 1914) there were three producers of such garnet in 1911, and their output amounted to 600 tons. As nearly all the output comes to the United States, it is evident that the application of garnet for abrasive uses is not generally recognized in the European countries and, so far as known, no other garnet-mining industry has been established. The Spanish garnet is too fine in size to be a rival of the American product. The present value of the product is stated to be $7.75 a ton at the mines and the expense of shipment to the seaboard $6.65 a ton, so that it can be laid down in this country at $20 a ton.

The output of garnet in 1913 was of the usual proportions. The Adirondack mines contributed the greater part as heretofore, their production having been 4665 short tons with a value of $145,445. There were three active mines, including those of the North River Garnet Co., H. H. Barton & Sons Co., and the Warren County Garnet Mills, all situated in the vicinity of North Creek, Warren county.

Reports from the collector of customs at Boston, New York and New Orleans show that a total of 547 short tons of abrasive garnet with a value of $8078 was imported in 1913. The imports for 1912 were 548 tons valued at $9271. The exports from Almeria are stated by the consular agent to have been 1239 tons, which seems to indicate that the garnet is now finding a market elsewhere than in the United States.

GYPSUM

There was a further advance in the gypsum production last year, thus continuing the record of almost uninterrupted growth which has marked the recent course of the industry. The main developments of late have been in the western section of the gypsum district where the output is used largely by local plants for the manufacture of plaster of paris and various products of which that is the basis. The use of gypsum plasters has grown tremendously in the last decade or so and seems likely to continue to expand in the future with the increasing application of improved methods of building construction.

The tabulation of statistics of the industry is attended with some difficulty, owing to the various stages of preparation which the gypsum undergoes before entering the market. Some companies sell the lump rock just as it comes from the mines, in which case the material is crushed, ground or further treated by other companies before it is consumed. The mines or quarries in Onondaga county supply lump rock which is ground for agricultural plaster in local mills, or which is shipped to other points for manufacture. One quarry in that county furnishes rock for a local portland cement plant. In the western district some of the rock is shipped in crushed condition to portland cement manufacturers, but the larger portion is calcined at the mines and either sold as stucco or is further manufactured into various materials like wall plaster, finishing plaster, plaster board and hollow partition blocks.

The statistics for the present report show the production of crude rock and some of the first-hand products. The output of lump gypsum is the fundamental factor, of course, in estimating the mining activity. The first-hand products include lump and crushed gypsum sold by the mines for use in portland cement, or for manufacture into plaster of paris by plants outside the district. The greater part, as given under the second item of the table, represents the gypsum sold to portland cement plants. There is also a small quantity of gypsum sold in finely ground form for use in agriculture and known as land plaster. The third class of products that is reported by the mining companies includes stucco and prepared wall plasters, but it does not embrace any materials of further manufacture like board or blocks.

The conditions in the industry last year were fairly prosperous, considering the general state of business which on the whole was rather quiet. The sales to portland cement plants were slightly larger than in the preceding years, and were made at somewhat higher prices. The prices received for crushed gypsum have ruled very low owing to competition, some of the product having been sold as low as $1.30 a ton at the mines which can hardly yield a fair profit to the companies. An increase in the production of calcined plasters reflected a good demand for the various structural materials of gypsum, although the building trade generally was not very active. An increasing proportion of the product is being used by the producing companies in the manufacture of plaster board and partition blocks.

Production of gypsum

MATERIAL	1912		1913	
	SHORT TONS	VALUE	SHORT TONS	VALUE
Total output, crude..........	506 274	....	532 884	....
Sold crude..................	178 499	$240 784	183 579	$265 879
Ground for land plaster......	8 213	17 779	8 521	17 807
Wall plaster, etc. made.......	267 889	928 282	306 206	1 022 457
Total..................	....	$1 186 845	....	$1 306 143

The production of 532,884 short tons of rock gypsum, reported by the mines and quarries for 1913, was the largest on record. In 1912 the output was 506,274 tons and in 1911, 446,794 tons. Up to the year 1900 the average annual output was less than 50,000 tons, and the output in the entire country previous to that time did not reach the quantity reported by the New York mines for last year.

Few changes occurred in the list of active mining companies in 1913. The number of mines and quarries under operation was nine as compared with ten in the preceding year. In Onondaga county the Fayetteville Gypsum Co., which formerly worked the Severance quarry, discontinued production; the Akron Gypsum Co., of Akron, Erie county, also went out of business. The property of this company has been taken over by the Akron Gypsum Products Corporation of Buffalo, and the mines and mill will probably resume activity during the current season. At Union Springs, Cayuga county, the quarries were operated by the Cayuga Gypsum Co., for the supply of rock to the portland cement trade, and mainly to the plant of the Cayuga Portland Cement Co., at Portland Point, to which the rock is shipped by rail. The mill of the Consolidated Wheatland Plaster Co. near Mumford, was destroyed by fire in the spring of 1913.

No further progress has been made with the construction of the calcining plant at Mumford undertaken by the Delac Gypsum Products Co., as mentioned in the report for 1912. The company had secured options on gypsum lands north of Mumford which it had prospected with the diamond drill.

The search for new deposits has been carried on recently in the section west of Akron. It is reported that a test hole located near the limestone quarries, just southwest of the village, encountered only a thin bed, too small to be workable. A hole put down on the farm of W. K. Flint, 2 miles southwest of Akron and near the crossing of the West Shore and New York Central (Batavia branch) railroads, encountered the following strata:

	Feet	Inche
Soil and earth	25	......
Broken limestone	20	......
Shale, water-soaked	2	6
Broken limestone	14	6
Water seam	1	....
Limestone (flinty)	7	....
Light brown limestone	7	....
Blue shale and gypsum	5	....
Hard " ashes " (shaly gypsum)	4	....
Rock	2	....
Soft " ashes "	....	6
White gypsum	3	6

The results of mining and exploration in the gypsum belt have tended to confirm the view that the deposits are in general lenticular and that the workable bodies are separated into more or less distinct areas.[1] Between such areas in which the gypsum attains a thickness of 4 feet and upward may intervene considerable stretches in which the beds are very thin or else so interleaved with shale that they have no commercial value. In some parts of the belt two or more workable seams occur, separated by shale.

So far the surficial portion of the gypsum belt alone has been explored and that in a very incomplete way. There are still possibilities of uncovering profitable rock in the unexplored sections lying between the developed areas. In the western sections where the gypsum is rarely more than 5 or 6 feet thick it is seldom found exposed at the surface. This is ascribable to the fact that the gypsum weathers very rapidly, much more quickly than the overlying limestones, and it has been largely removed near the surface. As a rule, the full thickness of the gypsum bed does not appear until it is covered by 40 or 50 feet of rock, which with the average rate of inclination means a mile back from the projected line of outcrop. Consequently, the lack of gypsum at the surface is no indication that beds may not be found further south under cover.

Under the conditions the work of prospecting has to be carried on entirely by drilling. A core drill, armed with either diamonds or hardened steel shot, is employed so as to secure accurate records of the rocks penetrated and samples of the gypsum for testing. The results obtained with a churn drill have little value beyond proving the possible presence of gypsum.

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[1] For details of the distribution of the gypsum deposits, see N. Y. State Museum Bul. 143.

IRON ORE

The local iron mines made a good record in 1913. The showing in fact was better than might have been expected from the conditions of the ore markets. The inquiry for ores was not so active as in some of the preceding years and developed a declining tendency with the season's advance. Prices, in comparison with the earlier level, were low.

The actual product of furnace ores was 1,217,899 long tons. This represented a good gain over the total reported for 1912 and has not been exceeded in the recent records. The value of the output was $3,870,841, as compared with $3,349,095 in 1912.

The magnetite mines produced 1,097,208 long tons with a value of $3,635,670 and the hematite mines 120,691 tons with a value of $235,171. The hematite all came from the Clinton belt. There were no shipments from the mines near Antwerp, nor of limonite and carbonate from southeastern New York.

Production of iron ore in New York State

YEAR	MAGNETITE	HEMATITE	LIMONITE	CARBONATE	TOTAL	TOTAL VALUE	VALUE A TON
	Long tons	Long tons	Long tons	Long tons	Long tons		
1893	440 693	15 890	35 592	41 947	534 122	$1 222 934	$2 29
1894	....	......	......	......	242 759	....	.....
1895	260 139	6 769	26 462	13 886	307 256	598 313	1 95
1896	346 015	10 789	12 288	16 385	385 477	780 932	2 03
1897	296 722	7 664	20 059	11 280	335 725	642 838	1 91
1898	155 551	6 400	14 000	4 000	179 951	350 999	1 95
1899	344 159	45 503	31 975	22 153	443 790	1 241 985	2 80
1900	345 714	44 467	44 891	6 413	441 485	1 103 817	2 50
1901	329 467	66 389	23 362	1 000	420 218	1 006 231	2 39
1902	451 570	91 075	12 676	Nil	555 321	1 362 987	2 45
1903	451 481	83 820	5 159	Nil	540 460	1 209 899	2 24
1904	559 575	54 128	5 000	Nil	619 103	1 328 894	2 15
1905	739 736	79 313	8 000	Nil	827 049	2 576 123	3 11
1906	717 365	187 002	1 000	Nil	905 367	3 393 609	3 75
1907	853 579	164 434	Nil	Nil	1 018 013	3 750 493	3 68
1908	663 648	33 825	Nil	Nil	697 473	2 098 247	3 01
1909	934 274	56 734	Nil	Nil	991 008	3 179 358	3 21
1910	1 075 026	79 206	4 835	Nil	1 159 067	3 906 478	3 37
1911	909 359	38 005	5 000	Nil	952 364	3 184 057	3 34
1912	954 320	103 382	Nil	Nil	1 057 702	3 349 095	3 17
1913	1 097 208	120 691	Nil	Nil	1 217 899	3 870 841	3 18

The actual tonnage hoisted at the mines was considerably larger than the quantity of furnace ore reported, since much of the product from the Adirondack magnetite mines undergoes concentration before shipment. A ton of concentrates which has an average tenor of 65 per cent iron represents from a little over one to three tons of crude ore, according to the character of the deposit. The reports for 1913 show that the total quantity of magnetite hoisted was 1,485,501 long tons, or 52 per cent more than the production of furnace ore. The total tonnage of ore of all kinds hoisted was 1,606,196, as compared with 1,430,998 in 1912.

The list of mining companies that were active during the year included for the Adirondack region: Witherbee, Sherman & Co., and Port Henry Iron Ore Co., Mineville; Cheever Iron Ore Co., Port Henry; Chateaugay Ore & Iron Co., Lyon Mountain; Benson Mines Co., Benson Mines. In southeastern New York the producers were Hudson Iron Co., Fort Montgomery, and the Sterling Iron & Railway Co., Lakeville. The output of hematite was made by C. H. Borst, Clinton; Furnaceville Iron Co., Ontario Center; and Ontario Iron Co., Ontario Center.

Mineville. The Mineville properties made a large output, although operations were reduced for a time by labor troubles. The quantity of ore raised by the two companies was 906,399 long tons, nearly the maximum record, but the average grade was somewhat lower than in earlier years, as an increased proportion came from the deposits of concentrating ore. The active mines included the Joker-Bonanza, Harmony, Barton Hill and Smith groups of Witherbee, Sherman & Co., and 21, Clonan and Welch shafts of the Port Henry Iron Ore Co.

The development of the Sherman mine, on the northern end of the ore zone as at present defined, was started by Witherbee, Sherman & Co., during the year. This mine and the Hall mine nearby were discovered many years ago, but have not been actively worked, as they are somewhat remote from the main group. The ore occurrence, however, is very similar to that of the more southerly deposits.

Work in the Joker-Bonanza property has been centered mainly upon the sheetlike deposit underlying the Old Bed proper. The two shafts have been carried down to the lower zone, but the output is mainly hoisted through the Joker. Exploration with the diamond drill has disclosed the existence of magnetite in undeveloped ground on the borders of the main bodies, but its relation to the latter and economic importance are as yet undetermined.

The Barton Hill mines have furnished a large output of concentrating ore, running from 30 to 35 per cent iron. The output is treated in a separate mill which was placed in operation in the fall of 1912. The mill concentrates are of Bessemer grade, carrying about .025 phosphorus with 65 per cent iron. About 1000 tons crude ore are handled each day in this mill alone which is the latest of the Mineville concentrating plants and which marks an advance in arrangement and equipment over its prototypes. A full description of the mill has been given by J. S. Pellett in the Engineering and Mining Journal.[1]

Lake Sanford. A furnace test of the titaniferous magnetites which occur in this part of Essex county is planned for the current season by the MacIntyre Iron Co. The ore for the test will be shipped to the Cedar Point furnace at Port Henry. The trial will be made with regular working charges and continued sufficiently long to demonstrate the behavior of the material under conditions of commercial practice. A small mill has been erected at the mines and about 15,000 tons of ore were taken out last year for treatment. The main difficulty that has confronted the owners in their experimental work is the remote situation of the property which necessitates a long and expensive haulage of all materials to or from the nearest railroad point.

Lyon Mountain. It is probable that the output of the mines at Lyon Mountain will soon be considerably enlarged. The Chateaugay Ore & Iron Co. has decided upon undertaking certain improvements which will lead to the introduction of a new system of underground work and provide an increased hoisting capacity. The principal feature of the new plans is an inclined shaft which it is intended will serve as the main opening for future mining and development and will take the place of the several inclines in use heretofore. The new shaft will be concrete lined and have four compartments, of which three will be for hoisting and one for an air and manway. It will be put down in the footwall 20 feet or more below the vein. From the shaft, access to the ore will be had through cross-cuts and levels established at every 300 feet. Instead of the room and pillar system now used, a method of shrinkage stopping will be employed. The ore will be loaded by gravity into mine cars and electrically hauled to the shaft bins. Reaching the surface in skips, the ore will be first crushed down to 1.5 inches at the shaft by passing through crushers and rolls and then taken

[1] March 14, 1914.

to the mill. The reduction at the shaft house will enable the mill to handle half as much ore again as it now treats. The improvements will provide an ultimate hoisting capacity of over 3000 tons a day, but this can not be fully utilized until additional milling capacity is provided. The ore bodies at Lyon Mountain are among the largest in the State and are notable for their low content in phosphorus and sulphur. They are lean, carrying only 30 to 35 per cent iron, but there has always been an active demand for the concentrates which command prices above those paid for ordinary ores.

Cheever mine. This mine has continued in successful operation, making an average of 500 tons of concentrating ore a day, taken in part from the old slopes, but mainly from new ground developed by the present management.

Croton mine. Construction work was begun in 1912 with a view to reopening the Croton mine and to its operation on a large scale. The plans for the new enterprise, as drawn up by the Croton Magnetic Iron Mines, call for a concentrating plant that will handle 1500 tons crude ore a day, with an outturn, it is expected, of about 500 tons concentrates. The mill is designed for the use of the Gröndal wet process, supplemented by sintering to reduce the sulphur content. Experiments with the ore are reported to have indicated that concentrates averaging 64 per cent iron can be made by crushing to 20 mesh; the sulphur content of the sintered product is .3 per cent and the phosphorus .03 per cent, well within the Bessemer limit. The foundations of the mill were completed within the year. If the original plans are carried out this will be the first plant of its kind in the State, and should afford some interesting material for comparison with the magnetic concentrating plants of the Adirondacks which are all based on dry methods.

The Croton mine is opened on a large body of low-grade magnetite which is a part of an ore zone that extends some 5 miles in a southwest direction from the village of Brewster. The mine is about in the middle of the zone, while the Brewster mine lies at the north and a third mine is near the south end and one-half mile west of Croton Falls. Work has been carried on at different times, the last period of previous activity beginning in 1899 and continuing for a few years. Magnetic concentration was practised in the later operations, but the sulphurous nature of the ore, and particularly the presence of pyrrhotite, presented difficulties that could not then be readily overcome. The magnetite body has been tested for a length of 2500 feet and is opened by a tunnel 1400 feet at an average depth of 135 feet from the surface. The ore is not sharply defined from the wall rock in most places, but shades over into it through a gradual decrease in magnetite having the same nonmetallic constituents. The width to which the workings are carried ranges from 50 or 60 feet to 100 feet or a little more. In its general features the ore body resembles some of the Adirondack deposits, and this resemblance is heightened by the fact that the immediate walls as well as the gangue matter are constituted of syenitic gneiss which has very similar characters to the syenitic ore-bearing gneisses of the Adirondacks.

Forest of Dean. This mine is in the Highlands of Orange county and was active throughout the year except for a temporary shutdown in the fall. Under the present management, that of the Hudson Iron Co., who took over the property in 1905, the operations have been extended and the ore shipments increased until for the last four years they have been at the highest rate in the history of the property. There is no apparent diminution in the size of the ore body as the workings have been deepened, so that the prospects for the future seem as good as at any time in the past. The workings are 3000 feet long on the trend or pitch of the deposit and give an almost complete cross-section throughout the distance; few magnetite bodies are so well exposed for the study of their physical features and underground geology.

The Forest of Dean has had a long history. According to the early records of Orange county, mining on the deposit began about 1756 and it was one of the sources of iron ore supply during the Revolutionary War. It thus ranks with the Sterling mines, also in Orange county, as among the oldest iron ore properties in the county that are still in operation. In the early period of activity production must have been small. Mather in his report on the "Geology of the First Geological District" of 1842 states that excavations had been made over a breadth of about 150 feet, which from the context seems to mean that the body had been worked as an open cut for that distance along the strike. The output up to that time is estimated by Mather to have been not less than 40,000 tons. From 1865 to 1894 the mine was owned and operated by the Forest of Dean Iron Ore Co., and the output in that period was something over 500,000 tons. The production has acquired more importance in the recent period of operations.

In form the deposit is a long shoot, with its principal axis following the northeasterly trend of the country rocks but inclined downward at an angle of 19°. The inclination or pitch holds very uniform throughout the entire distance, although the shaft which generally follows the bottom of the ore has a slightly steeper pitch at the start. In cross-section it is heart-shaped, having two lobes which converge below and are separated above by a horse of granite. On the outcrop the deposit appeared to be a double vein, as shown in a section included in Mather's report already mentioned. The lobes are somewhat unequally developed, the southerly one being the higher. The whole mass has a steep dip toward the southeast conformity with the lamination of the country gneiss. In structure the deposit may be compared to a narrow synclinal fold slightly overturned, the wings of which terminate abruptly a short distance above the arch. That the body has actually been folded, however, is not at all certain from any evidences so far presented; the relation of the ore to the country gneisses is also in doubt.

The gneiss is a laminated biotite-feldspar-quartz rock which shows banding in lighter and darker layers. It belongs to a very common type of the gneissic rocks exposed in the Precambric belt of southeastern New York and northern New Jersey. Its derivation is not known, as in fact the Precambric rocks of this section of the State have been studied only in a preliminary way. The banding which seems at first suggestive of sedimentary affinities, on closer study is seen to be due in part to the injection of lighter granitic material along the planes of lamination. In the vicinity of the ore body the gneiss has been so permeated with granitic material that the latter predominates over the gneiss itself. The horse of granite which apparently follows the ore all the way from the surface is a solid mass of this intrusive of a somewhat coarser type than the average. It is composed of pink and green feldspars and quartz, with magnetite as the only dark mineral of importance. The granite is also seen in places along the two walls and occasional stringers and bodies of it are found within the ore itself. The deposit has been a locus of igneous activity, a feature that has been noted by the writer to be frequent in many of the other deposits of Orange county. Its significance with respect to the origin of the ore body in question can not now be stated, if there is indeed any connection between the intrusive and the formation of the deposit. The possibility that the magnetite has been introduced in its present place as a result of igneous action, however, may be considered as an alternative to the sedimentary theory of origin until more definite knowledge on the subject is obtained.

Some interesting trap dikes occur in the mine. They cut all the rocks including the magnetite and have been described by Professor Kemp as belonging to the camptonite class. A rather curious feature observed in some of these is the presence of calcite distributed through the mass in small rhombohedra; this mineral occurs also in some of the ore. The largest dike is about 6 feet thick and crosses the ore body diagonally.

The ore from the Forest of Dean mine is medium grained, inclining to a shotlike texture, and unlike most of the magnetites in this part of Orange county is quite free of admixture with silicate minerals. It requires only rough sorting to prepare it for the furnace; the waste is nearly all granite. The sorted ore carries 60 per cent or a little more, of iron.

MICA

The production of mica has never attained the basis of a settled industry in this State, although small quantities are extracted from time to time in an experimental way or as a secondary product in the mining of other minerals. The occurrences illustrate the general types of deposits which have commercial importance elsewhere as sources of mica and are distributed over the two great crystalline rock areas of the Adirondacks and the southeastern Highlands, being found in Orange, Putnam and Westchester counties in the Highlands, and in Saratoga, Essex, St Lawrence, Jefferson, Herkimer and other countries in the northern area. It is the purpose of the present article to give some particulars regarding the character and economic features of the deposits which hitherto have received little more than casual attention.

Mica is a general term for a group of minerals, of which three varieties find commercial use. These include muscovite, biotite and phlogopite. Muscovite is often called white mica, in allusion to its transparent quality, but it is not necessarily light or highly transparent, though the best commercial kinds are thus characterized. Some muscovite from the Adirondack pegmatites has a smoky gray color, nearly as dark as some examples of biotite. Chemically it contains potassium and sodium as basic elements, and is therefore an alkali variety. Biotite, as a rule, has a dark brown to nearly black color, but occasionally is sufficiently light to be transparent in thin sheets. Iron is present in considerable amounts and with the dark color renders it unsuitable for many purposes. Phlogopite is a magnesium variety, containing no iron, but less transparent usually than the best muscovite. Its color is amber or yellow, sometimes red or of a greenish tinge. It is employed for the same purposes as muscovite, but seems to be even preferred to the latter in electrical work. The distinction of the different varieties of mica when not apparent from outward appearance requires the use of a polarizing microscope, supplemented possibly by chemical tests to determine the nature of the basic elements.

Muscovite and biotite are allied in their occurrence, both being important ingredients of the crystalline silicate rocks such as granite, and many gneisses and schists. Typical granite contains both varieties. The commercial sources of the two minerals, however, are limited to pegmatites, those modifications of granite in which the minerals are coarsely crystallized and irregularly distributed. Pegmatite is found in rather limited bodies, usually in dikes or lenses, which have intrusive relations with the country formations, more rarely as irregular masses within normal granites. The dikes or lenses range from very small examples, a few inches or a foot or two thick, up to bodies several hundred feet in diameter and of much greater length. They afford feldspar, quartz and other commercial materials in addition to mica.

Phlogopite is seldom if ever found in granite pegmatites, but its occurrence in New York is practically restricted to crystalline limestones where it appears to represent a secondary product of metamorphism, probably in most cases as a result of contact influences exerted by igneous intrusions. It is associated with such other minerals as amphibole, pyroxene, wernerite, tourmaline, fluorite, titanite and apatite. The mineral association varies from place to place and the occurrence of phlogopite is quite irregular or bunchy, or else restricted to a definite part of the contact zone. According to the report of Cirkel [1], the commercial phlogopite deposits of Canada are associated with pyroxene which penetrates country gneisses and limestones in the form of dikes, the pyroxene being regarded as an igneous rock. There is no resemblance to such conditions in the Adirondack occurrences, though pyroxene is a frequent accompaniment of the mica. The minerals rather have resulted from a conversion of the limestones by mineralizing solutions and vapors given off by granite intrusions and they gradually disappear with increas-

[1] "Mica, Its Occurrence and Uses." Mines Branch, Department of the Interior, Ottawa, 1905.

ing distance from the contacts, giving way to normal crystalline limestones. There is little regularity in the shape of such contact zones; in fact a highly irregular form may be said to be the prevailing one. Their nature and mineral content are even more variable than in the case of pegmatites.

The working of mica deposits in this State, as well as in most sections of the country, has been a rather uncertain business. Of necessity, it involves small-scale individual operations. The technical difficulties surrounding the industry are such that they do not admit of the methods employed in other branches of mining and the adoption of labor-saving devices that might tend to reduce costs. Labor conditions, therefore, exercise a great influence upon the course of mining operations. The principal mining activity in this country at present is in North Carolina, where according to the article by Sterrett in *Mineral Resources* for 1912, volume 2, there are probably as many as a hundred separate mines and prospects, many worked by farmers in the off-season of their labors. As the entire output of the country in recent years has been well under $400,000 annually, the average outturn from the individual mines evidently is very small. India contributes most of the mica consumed in the United States, though Canada is an important source of the electrical grades. It has been stated (*Mineral Industry* for 1912) that the cost of labor in the production of mica in India is about one-sixth of the labor cost in the domestic mines.

The quality of mica depends upon a great many factors which can be estimated accurately only by the expert. Of the three varieties, biotite has more limited use than the others and the market does not warrant mining operations for its production alone. It is obtained mainly as a by-product in the working of pegmatites for feldspar. Owing to its iron content it is not much used for electrical insulation which is the prinicpal application for the colored micas. Muscovite, having the greatest transparency, is preferred for glazing and for lamp chimneys, shades and similar purposes. The larger sizes only can thus be used. For electrical insulation in motors and dynamos, phlogopite seems to find the most favor on account of the softer nature of that variety, it is said. Much of the electrical mica is used in the form of " micanite " which consists of small sheets cemented and compressed into boards. The presence of inclusions of iron oxid, usually magnetite, which is quite common in muscovite and phlogopite, is stated by Sterrett to have no injurious effect upon the quality of the electrical mica.

Much of the mica as found in pegmatites and contact zones, even when in large crystals, can not be used in sheet form on account of the numerous fractures and lines that traverse the surfaces. There is great variation in the splitting quality of mica from different places, some examples cleaving readily and cleanly even to very thin sheets and others showing a splintery surface. The average size of sheet that can be obtained largely determines the value of a deposit, since the prices rapidly decrease with the size. The waste in the splitting is sometimes turned into use by converting it into ground mica for which there exists a more or less ready market in the making of lustrous coated papers, lubricants and insulating materials.

FIELD OCCURRENCE

Orange county. Phlogopite of greenish color is found in a pyroxene rock near Lake Mombasha, town of Monroe. The locality is mentioned by Beck in the reports of the First Survey as being on the bank of the stream flowing from " Mount Basha " pond, near the Forshee iron mine. It is a contact deposit in limestone of which there are exposures in the vicinity of the mine mentioned and also farther north around the opening of the O'Neil mine. Amphibole, pyroxene, garnet and probably magnetite bodies themselves are accompanying results of the contact action. The occurrence is mentioned by Whitlock[1] as having been worked in 1903. Sheets have been mined that measured as much as three feet in diameter.

Warwick. According to Whitlock[2] muscovite occurs near Greenwood lake, 8 miles southwest of Warwick, in a pegmatite vein, the plates reaching a foot in diameter. There are numerous other occurrences of muscovite in this vicinity, as pegmatite has a wide distribution in the crystalline areas of the Highlands.

Westchester county. A deposit of mica near Pleasantville was at one time the object of mining operations. The occurrence is in pegmatite and the mica belongs to the muscovite variety. The sheets contain magnetite inclusions.

Muscovite is found in considerable quantity in parts of the Kinkel feldspar quarry at Bedford, but is not of commercial quality, except possibly for ground mica.

Putnam county. The occurrences in this county have not afforded any commercial mica so far as known.

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[1] Minerals Not Commercially Important, 23d Report of the State Geologist Albany, 1904, p. 191.
[2] Op. cit.

Essex county. Mica is found in the pegmatite bodies at Crown Point and Ticonderoga now worked. The chief variety is biotite. Occasional shipments of scrap mica recovered in the milling of feldspar are made by the Crown Point Spar Co. The material is ground and used in paint.

Large crystals of biotite have been taken from various localities in the town of Keene.

Saratoga county. A pegmatite body about 2 miles north of Batchellerville, town of Edinburg, was worked some years since by the Claspka Mining Co. for feldspar. Several tons of muscovite were taken out in the course of the operations, the mineral occurring in the spaces between the larger feldspars, or intergrown with the latter. The crystals measure up to a foot or more in diameter and half that in thickness, many bearing very perfect prismatic boundaries. Inclusions of magnetite arranged in regular lines are frequent. The muscovite has little value for sheet cutting, being much fractured and splintery.

Biotite in sheets up to 2 feet across are also found here.

Warren county. A pegmatite occurrence near Chestertown has been under development at different times and has afforded small quantities of commercial mica, including muscovite and biotite. The locality is mentioned in the *Mining and Quarry Report* for 1911 under the head of Feldspar, which also is present in marketable quality. It is 3 miles south of Chestertown on the ridge to the east of the Warrensburg road. Two openings were made over 15 years ago, and in 1913 further work was carried on by C. A. Williams who informs the writer that he secured some merchantable book mica and plans to continue operations during the current season. The main opening is a pit 15 feet wide extended for 75 or 80 feet along the course of the pegmatite which strikes northeast. The full size of the body could not be ascertained at the time the writer visited the locality as only the easterly wall was exposed. The pegmatite is a coarse aggregate of white microcline, quartz and mica. Biotite seems to be chiefly represented near the outcrop, but Mr Williams states that recent work has uncovered muscovite in larger amount. The books run to a foot or so in diameter and usually show fractures or rulings. Black tourmaline occurs sparingly in the quartz and feldspar, but it would appear that feldspar of pottery grade may be obtained with a little sorting. A smaller pit lies to the north of the other, the result of the earlier operations, and is thought to be on the same pegmatite body, in which case the occurrence must be quite extensive.

Jefferson county. Yellow mica, probably phlogopite, is found in large plates near Henderson. Muscalonge lake, town of Theresa, has afforded fine examples of crystallized phlogopite of brown color, but in small individuals.

St Lawrence county. Some fine examples of phlogopite crystals in the State Museum are recorded as having been collected from Somerville. Perfect six-sided prisms unmarked by fractures or rulings and of brown color have a diameter of 12 inches. The exact locality is not given, but it may be the same mentioned by Beck as 2 miles north of Somerville, with limestone and serpentine as the gangue materials. Judging from the samples, the occurrence is of unusual interest.

Small quantities of mica have been obtained from the town of Fine, 2 miles north of Oswegatchie. Good sheets of reddish phlogopite were shown to the writer as coming from that locality. The last work on the deposit was in 1909.

Muscovite is found in Edwards associated with the fibrous talc. It is not, however, of commercial importance.

St Lawrence county may be regarded as one of the more favorable sections for the occurrence of commercial grades of mica. Granite intrusions of great size have taken place at different times in the Precambric and on their borders may be found dikes and lenses of pegmatite intersecting the older gneisses and schists. Since the intrusion of the pegmatites there has been no great disturbance from regional-metamorphic forces so that the mica is little fractured in most occurrences, whereas the pegmatites in the central Adirondacks often show the effects of severe compression. The pegmatites carry both muscovite and biotite. The numerous contacts of limestone and granite afford favorable conditions for the occurrence of phlogopite, which, as stated, is found here and there in specimens of commercial quality, though the real importance of the deposits has never been adequately tested. The geological relations in this part of the Adirondacks are very similar to those in the mica-mining districts of Canada.

MINERAL WATERS

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

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

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

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

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

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

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

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

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

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

NAME	LOCALITY
Baldwin Mineral Spring	Cayuga, Cayuga county
Coyle & Caywood (Arrowhead Spring)	Weedsport, Cayuga county
Diamond Rock Spring	Cherry Creek, Chautauqua county
M. J. Spicer	Westfield, Chautauqua county
Breesport Oxygenated Spring	Breesport, Chemung county
Breesport Deep Rock Water Co	Breesport, Chemung county

NAME	LOCALITY
Chemung Spring Water Co	Chemung, Chemung county
Keeseville Mineral Spring	Keeseville, Clinton county
Lebanon Mineral Spring	Lebanon, Columbia county
Trespúr Spring	McGraw, Cortland county
Arlington Spring	Arlington, Dutchess county
Mount Beacon Spring	Mount Beacon, Dutchess county
Mount View Spring	Poughkeepsie, Dutchess county
Monarch Spring Water Co	Matteawan, Dutchess county
Elk Spring Water Co	Lancaster, Erie county
Sparkling Spring	Buffalo, Erie county
Red Rock Spring	Fine View, Jefferson county
Garden City Spring	Garden City, Nassau county
Clinton Lithia Springs, Inc	Franklin Springs, Oneida county
Glen Alix Spring	Washington Mills, Oneida county
Lithia Polaris Spring	Boonville, Oneida county
F. H. Suppe (Franklin Lithia Spring)	Franklin Springs, Oneida county
Geneva Lithia Spring	Geneva, Ontario county
Red Cross Lithia Spring	Geneva, Ontario county
Crystal Spring	Oswego, Oswego county
Deep Rock Spring	Oswego, Oswego county
Great Bear Spring	Fulton, Oswego county
White Sulphur Spring	Richfield Springs, Otsego county
Black Rock Spring	Rensselaer, Rensselaer county
Mammoth Spring	North Greenbush, Rensselaer county
Shell Rock Spring	East Greenbush, Rensselaer county
Madrid Indian Spring	Madrid, St Lawrence county
Artesian Lithia Spring	Ballston Spa, Saratoga county
Comstock Mineral Spring	Ballston Spa, Saratoga county
Mohican Spring	Ballston Spa, Saratoga county
Arondack Spring	Saratoga Springs, Saratoga county
Coesa Spring	Saratoga Springs, Saratoga county
Hathorn (Nos. 1 and 2) Springs	Saratoga Springs, Saratoga county
Saratoga Gurn Spring	Saratoga Springs, Saratoga county
Chalybeate Spring	Sharon Springs, Schoharie county
Eye Water Spring	Sharon Springs, Schoharie county
Sulphur-Magnesia Spring	Sharon Springs, Schoharie county
White Sulphur Spring	Sharon Springs, Schoharie county
Red Jacket Spring	Seneca Falls, Seneca county
Setawket Spring	Setawket, Suffolk county
Elixir Spring	Clintondale, Ulster county
Sun Ray Spring	Ellenville, Ulster county
Vita Spring	Fort Edward, Washington county
Briarcliff Lodge Association	Briarcliff Manor, Westchester county
Gramatan Spring Water Co	Bronxville, Westchester county
Orchard Spring	Yorktown Heights, Westchester co.

Production. The trade in spring waters does not lend itself to accurate statistical tabulation. A large part of the sales at present consist of the nonmedicinal or fresh waters which are distributed in the principal cities for office and table use and have a very low value. Such waters may be obtained from a distance, in which case they are sometimes shipped in tank cars, or they may come from some local spring. Their main cost to the consumer is represented in the item of transportation. There are doubtless many springs of this character that fail to make a return each year, since the list is constantly changing. Besides the waters that are sold in bottles, large quantities of mineral waters are consumed at the spring localities by the hotels, sanatoriums etc., for which no accurate statistics are obtainable.

The returns received from the spring water companies for 1913 showed total sales of 9,448,348 gallons with a value of $806,298. This was about the same quantity as was reported for 1912 when the sales amounted to 9,682,447 gallons, with a value of $760,847.

NATURAL GAS

The year 1913 witnessed unusual activity in exploratory work and drilling in the natural gas fields of the State. It does not appear that any very notable discoveries were made in the way of new pools, such as have been reported from time to time in previous years, or that the bounds of the existing fields were materially extended, yet altogether the year's activity resulted in an important increment in the supply, principally owing to intensive exploitation of the known resources.

The growth of production during the last decade has been quite remarkable and seems to evidence the capacity of the fields for still further development. The only district which has been exploited probably to the limit of its possibilities is that in northern Allegany and Cattaraugus counties where the existence of oil has furnished an incentive for exploration that has been under way for nearly half a century.

The gas pools are distributed among sixteen counties which lie mainly in the western part of the State. The counties in the extreme western section are the most productive. The four counties of Erie, Chautauqua, Cattaraugus and Allegany contribute nearly 90 per cent of the total output. They contain a large number of individual pools in different geological horizons. Chautauqua and Erie counties have come into prominence rather recently, but lead all others in regard to output. Genesee county in the last five or six years has assumed importance through the development of the field near Pavilion. The remaining counties, including Niagara, Livingston, Ontario, Schuyler, Seneca, Steuben, Monroe, Wyoming, Yates, Onondaga and Oswego, rank as relatively small producers.

In addition to the counties named there are many others in which gas has been found. Test wells are reported as having shown gas in nearly all the counties that lie between Lake Ontario and the Pennsylvania boundary, as well as in Jefferson, Oneida, Albany and other counties in the northern and eastern sections. The more permanent supplies seem to be confined, however, to the western section.

The geologic features of the gas fields have been described in several reports and papers of the New York State Museum. In particular may be noted the report of Edward Orton (Museum Bulletin 30) which described the field of northern Chautauqua county and the pools near the eastern end of Lake Ontario in considerable detail. Notes on the developments in Erie county are given in Bishop's "Structural and Economic Geology of Erie County" (Museum Report 49, vol. 2) and the oil and gas fields of southwestern New York are covered by the same writer in special papers (Museum Reports 51, vol. 2, and 53, vol. 1). Field notes of more recent date have been included in some of the issues of the mining and quarry bulletin.

Geologically the occurrence of natural gas in the State has a rather wide distribution. Flows have been encountered from as far down the column as the Potsdam sandstone and upward as far as the Portage and Chemung strata at the top of the Devonic system. The more productive horizons are in the Trenton limestone (Oswego county), the Medina sandstone (Genesee, Erie and Chautauqua counties) and the Devonic formations (Allegany, Cattaraugus and Chautauqua counties). The Medina sandstone has been the main source of supply in the more recent explorations in Erie, Chautauqua and Genesee counties.

The business of distributing the gas is in the control of relatively few companies who have pipe lines connecting the fields with the cities and communities which they supply. The Iroquois Natural Gas Co. of Buffalo is the largest single distributor and collects gas from Allegany, Cattaraugus, Chautauqua and Erie counties, with Buffalo as the principal consuming point. The Alden-Batavia Natural Gas Co. and the Pavilion Natural Gas Co. are important distributors in the Genesee-Erie county district. In Chautauqua county are a great number of small producers who supply one or two families, besides these large distributors: The South Shore Natural Gas & Fuel Co., the Silver Creek Gas & Improvement Co. In Allegany and Cattauraugus counties the Empire Gas & Fuel Co. and the producers Gas Co. have pipe lines. A rather productive field has been opened in the towns of East Bloomfield and West Bloomfield, Ontario county, the gas being distributed by the Ontario Gas Co. Among the smaller companies engaged in the business are the Consumers Natural Gas Co. with wells in the town of Dix, Schuyler county, the Baldwinsville Light & Heat Co. of Baldwinsville, Onondaga county, the Pulaski Gas & Oil Co. of Pulaski, Oswego county, and the Sandy Creek Oil & Gas Co. of Sandy Creek in the same county.

Production. The present status of the gas industry is shown by the accompanying table which gives the production for the last four years. In the earlier years it has been possible to distribute the production according to the county or district in which it was made, but with the consolidation of the pipe-line companies which has recently taken place, the output can not be readily segregated, especially in the case of the western fields where some of the companies operate in several counties.

Reports from the individual producers show the value of the gas produced in 1913 to have been $2,549,227, an increase of over 35 per cent as compared with the value reported in the preceding year. The gain was the largest reported in any single year. The actual flow from the wells was 9,155,429,000 cubic feet, against 6,564,659,000 cubic feet in 1912. There were about 1750 productive wells.

The average price received for the gas sold for general consumption was 27.8 cents a thousand, against 28.7 in 1912. The slight decrease is accounted for by the gain in the production of the western fields where the gas brings a relatively lower price than in the outlying districts which about held their own.

Production of natural gas

COUNTY	1910	1911	1912	1913
Allegany-Cattaraugus	$337 427	$402 931	$1 503 274	$2 119 824
Chautauqua	202 754	222 023	263 742	324 939
Erie[1]	717 038	813 279	*a*	*a*
Livingston [2]	60 997	73 357	81 740	70 396
Onondaga	12 733	12 972	14 260	13 488
Oswego	14 783	14 913	16 366	18 027
Wyoming [3]	65 967	7 602	2 915	2 553
	$1 411 699	$1 547 077	$1 882 297	$2 549 227

[1] Includes output of Genesee county for 1911 and part of it for 1910.
[2] Includes also Seneca, Schuyler, Steuben, Ontario and Yates.
[3] Includes Niagara.
a Erie and Genesee counties included under Allegany-Cattaraugus.

The reports received for 1913 showed a total of about 200 individual producers with 1750 wells. More than one-half the producers were in Chautauqua county, but most of them reported as having but one well utilized for a single household. Erie county had by far the largest output of any county in the State, although the actual production can not be definitely stated. The product of Erie and Genesee counties is included under that of Allegany-Cattaraugus in the first item of the table. The four counties together contributed a total of 7,392,718,000 cubic feet, with a value of $2,119,824. This represented a gain of about 2,000,000,000 cubic feet over that of 1912. The Orchard Park pool in Erie county, which was discovered in the spring of 1912, accounted for much of the increase, but the Pavilion field also made a good showing.

Pavilion field. One of the most important natural gas fields in the State of relatively recent discovery is in the vicinity of Pavilion, Genesee county. The first holes were drilled in 1906, and there are now about sixty producing wells which maintain a very steady flow. The following information in regard to the local features and developments has been contributed by W. P. Randall, engineer, of the Pavilion Natural Gas Company.

The Pavilion field lies south of the Roanoke district, in the southeast corner of Genesee county. Its boundaries are defined approximately by a line running from the southern boundary of Genesee county northerly to Bethlehem Center, thence easterly along the Telephone road through Pavilion Center to the east boundary of Genesee county, thence south on said boundary to the corner of Genesee county and thence west to the point of beginning. It comprises an area 3 miles wide north and south and 9 miles long east and west. The gas is distributed by two companies, the New York Central Gas Co. with pipes running to Batavia, Attica, Corfu, and other towns in that vicinity, and the Pavilion Natural Gas Co. which supplies Mumford, Caledonia, Le Roy, Pavilion, Warsaw, Perry, Mount Morris, Moscow and smaller places along the route. New lines are being laid by the latter company to Linwood, York, Greigsville, Retsof, Piffard, Cuylerville, Geneseo and Avon. The trunk lines convey the gas under pressure of from 60 to 125 pounds; reducing stations at the distributing points lower the pressure to the normal required for consumption.

The gas is dry, nearly pure, marsh gas with less than 8 per cent of other ingredients. The pressure in the original wells was 500 pounds a square inch and has shown little diminution. Along the eastern boundary of the field and near Linwood, wells of from five to seven million cubic feet daily capacity have been drilled.

The field lies along the outcrop of the Genesee shale which is at an elevation of about 900 feet above tide. The gas flow is found at intervals in the last 30 feet of the Medina sandstone. The succession of strata explored by the wells conforms to the normal order as given in the reports of the New York State Museum, but in the western boundary of the field and near Lindon the Niagara is upturned so as to make the drilling of straight holes a difficult work. Below such disturbances the Medina gives a very limited flow, and consequently exploration in these places has been discontinued. The Niagara averages about 228 feet thick, and black water (sulphurous water from cavities in the dolomite) occurs at about the middle. Below the Niagara comes the Clinton with a thickness up to 15 feet (Wolcott limestone?) and at this point anchor packers are usually placed. The Medina sandstone is a little over 100 feet thick; on the northern and southern borders of the field it gives a limited flow of gas, the longest wells being on the eastern border and around Linwood.

A typical section in the Pavilion field is here given:

Top of flint	475	feet
Bottom of flint	625	"
Top of salt	1 072	"
Top of Niagara	1 300	"
Black water	1 415	"
Bottom of Niagara	1 500	"
Top of Medina	1 678	"
First gas	1 743	"
Second gas	1 753	"
Third gas	1 774	"
Bottom of Medina	1 775	"
Ho e bottomed	1 875	"

Altitude at mouth of well is about 1000 feet above tide.

PETROLEUM

The record of the local oil industry has been attended with features of much interest during the last year or two. The output for 1912 showed a decline of nearly 25 per cent from the average for the years immediately preceding and reached the lowest figure (782,661 barrels) that has been returned since the New York field was first fully developed. This decline took place in the face of advancing prices for crude oil, so that at first glance it would seem to indicate a permanent impairment of the productive capacity, rather than to reflect temporary conditions which might be expected to change for the better at any time. That there is really no ground for belief that the industry is destined to rapid extinction, however, is indicated by the response which the production showed in the past year as a result of increased field work under the stimulus of the improved market.

The returns of the pipe-line companies and other shippers of crude oil for the year 1913 indicated a total run of 916,873 barrels. Compared with the total already given for 1912 there was a gain of 134,212 barrels or about 17 per cent in the output. This did not quite restore the production to its earlier level, since in 1911 the yield was 955,314 barrels and in 1910 it amounted to 1,073,650 barrels, but it demonstrated that the industry is still capable of expanding its yield in response to favorable conditions. A further gain may be looked for during the current season should the market continue on the present basis.

The quotations for Pennsylvania oil, which apply as well to the output of New York wells, have advanced rapidly since the severe slump of 1910. The upward trend began to be noticeable in the early part of 1912. From the quotation of $1.35 a barrel, which ruled in January of that year, there was a steady advance month by month until by December the prevailing price was $2 a barrel. In January 1913, another advance brought the quotation to $2.05 and numerous rapid increases within a short time raised the price to $2.50, at which figure they remained undisturbed throughout the rest of 1913. It was to be expected that such remunerative figures would encourage new drilling and general activity in the producing industry, as in fact took place.

The record of field work, as compiled monthly by the Oil City Derrick, showed that 512 wells were drilled in the New York field during 1913. This was more than double the number drilled in the preceding year, when the total reported was 246 wells. In 1911 the number was 195, and in 1910 it was 283. The increment of production from the new wells amounted to 810 barrels, as compared with 278 barrels in 1912, 201 barrels in 1911 and 368 barrels in 1910. Of the number of wells completed, 48 were dry, against 66, 59 and 61 respectively in the previous years.

The output of oil in the State during the last two decades is given in the accompanying table. The figures for the years 1894–1903 have been taken from the annual volumes of *The Mineral Resources* and those for the following years compiled from reports rendered by the pipe-line companies and shippers who operate in the State. The list of these companies follows; Columbia Pipe Line Co., Union Pipe Line Co., Fords Brook Pipe Line Co., Buena Vista Oil

Co., and Madison Pipe Line Co., of Wellsville; Vacuum Oil Co., Rochester; New York Transit Co., Olean; Emery Pipe Line Co., Allegany Pipe Line Co., Tide Water Pipe Co., Limited, and Kendall Refining Co., of Bradford, Pa.

Production of petroleum in New York

YEAR	BARRELS	VALUE
1894	942 431	$790 464
1895	912 948	1 240 468
1896	1 205 220	1 420 653
1897	1 279 155	1 005 736
1898	1 205 250	1 098 284
1899	1 320 909	1 708 926
1900	1 300 925	1 759 501
1901	1 206 618	1 460 00
1902	1 119 730	1 530 852
1903	1 162 978	1 849 135
1904	1 036 179	1 709 770
1905	949 511	1 566 931
1906	1 043 088	1 721 095
1907	1 052 324	1 736 335
1908	1 160 128	2 071 533
1909	1 160 402	1 914 663
1910	1 073 650	1 458 194
1911	955 314	1 251 461
1912	782 661	1 338 350
1913	916 873	2 255 508

There have been no notable discoveries of oil pools in many years, and the productive territory remains restricted to the sections of Cattaraugus, Allegany and Steuben counties which were marked out in the early exploratory operations. The first well was drilled in Cattaraugus county in 1865 so that production has been continuous for half a century, a remarkable record for an oil field.

The oil is found in fine-grained sandstones of dark color belonging to the Chemung formation, at the top of the Devonic system. In Cattaraugus county the productive area embraces about 40 square miles, mostly in Olean, Allegany and Carrolton townships. The pools, of which the principal ones are the Ricebrook, Chupmunk, Allegany and Flatstone, occur at several horizons from 600 to 1800 feet below the surface. The oil district of Allegany county extends across the southern townships of Clarksville, Seneca, Wirt, Bolivar, Alma, Scio and Andover and is divided into several pools that are considered to be more or less independent. The Bolivar, Richburg and Wirt pools have been most productive. The oil is found at depths of from 1400 to 1800 feet. The Andover pool lies partly in the town of West Union, Steuben county, and is accountable for the production in that section.

The productive wells in the three counties number about 10,500, of which 7500 are in Allegany county, 200 in Steuben and the remainder in Cattaraugus county. All are pumped, using natural gas derived from some of them for power. The average yield is now less than one-third of a barrel a day.

SALT

The salt-producing industry experienced fairly prosperous conditions during the year 1913, as in the preceding season. Production was at a high rate in response to an active demand, and record figures were reported for the output as a whole, although in one or two branches little or no gain was registered. Along with the increased demand there was some advance in the prices of different grades of evaporated salt, a most welcome feature to the manufacturers who for a long time have had to face a continual slump in the market.

For many years the industry in this State showed the effects of a great overextension of the productive capacity. An active campaign in the exploration and development of the salt deposits was carried on during the last two decades of the last century, and the enterprises that came into existence then had a capacity far in excess of any available outlet for the products. As a consequence, competition became so keen that manufacturers realized scarcely any profits, and many were compelled to shut down their plants. Some of the mines and evaporating plants which went out of business at the time have never resumed operations. In the last decade the stress of conditions found relief through the gradual growth of the markets, so that now productive capacity and demand are more nearly balanced. Few new enterprises have been started within late years, and it would appear that there is no present need of any material addition to the productive facilities.

The history of the industry in New York dates back to colonial days, but the first authentic records of salt production begin with the year 1797, when, by an act of the Legislature the State assumed control of salt manufacture on the Onondaga Reservation. Until 1881 the evaporating works were all centered around Syracuse which derived its early importance from the salt industry. In that year, however, production began on a fairly large scale in the Warsaw district where private enterprise had succeeded in developing beds of rock salt. These afforded much richer brines than the natural brines of the Onondaga district, an advantage that proved very important in the manufacture of the artificially evaporated grades and that led to the later exclusive use of such brines in all but the solar evaporating plants. The production of rock salt by underground mining through vertical shafts began in 1885 on the property now owned by the Retsof Mining Co., situated at Retsof, Livingston county.

The statistical record of the industry shows that the output in 1797, when the first regular operations began, was 25,474 bushels, or 5095 barrels. By the year 1828 the output had reached a million bushels or 200,000 barrels, and in 1849 it had grown to over 1,000,000 barrels. The solar process was introduced in the Syracuse district in 1821, but for many years the process was subordinate to that of artificial evaporation in open kettles. After 1882 the competition of the works in the western part of the State which used brines derived from the rock salt beds began to show itself in a diminished production from the Syracuse plants, and the latter soon lost the preeminent position in the industry which they had so long held. Altogether the output of brine and rock salt in the State in the period 1797–1913 has amounted to the total of 257,622,716 barrels. As indicative of the rapid growth made in the last few decades it may be noted that the production up to 1882, when the exploitation of the rock salt beds began to be active, was 57,890,922 barrels; whereas in the period since elapsed it has amounted to 199,731,794 barrels.

The accompanying tables present the figures of production and value for recent years. The output in 1912 and 1913 is given according to grades, so far as the classification can be made without revealing the individual figures. The grades depend upon the methods of manufacture and purposes for which the salt is used. Rock salt and salt in brine consumed for the manufacture of sodium compounds appear in the last item of the detailed tables, which also include small quantities of evaporated salt not especially classified in the returns. The evaporated salt is chiefly marketed under the grades of common fine, table and dairy, common coarse, coarse solar and packers salt. Table and dairy salt includes the finest grades of artificially evaporated salt which undergo special preparation for the table and for butter and cheese making; it brings the highest market price. Under common salt are listed the other grades of fine artificially evaporated salt that are not so prepared. Common coarse represents the coarser product from artificial evaporation. Coarse solar salt is made by evaporation of brine in shallow pans exposed to the sun's heat. This process can not be closely regulated and results in a very coarsely crystallized salt that serves many of the purposes of rock salt. Packers salt includes the product sold to meat packers and fish salters.

Production of salt by grades in 1912

GRADE	BARRELS	VALUE	VALUE A BARREL
Common fine [1]	1 408 543	$519 844	$0.37
Common coarse	204 136	82 880	.41
Table and dairy	1 353 643	819 103	.61
Coarse solar	296 814	103 886	.35
Packers	72 771	30 564	.42
Other grades [2]	7 166 307	1 040 983	.15
Total	10 502 214	$2 597 260	$.247

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

Production of salt by grades in 1913

GRADE	BARRELS	VALUE	VALUE A BARREL
Common fine [1]	1 490 957	$583 757	$0.39
Common coarse	111 057	45 942	.45
Table and dairy	1 266 864	789 857	.62
Coarse solar	436 800	131 040	.30
Packers	107 293	51 895	.48
Other grades [2]	7 406 550	1 254 173	....
Total	10 819 521	$2 856 664	$.264

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

The output in 1913 of 10,819,521 barrels of 280 pounds, or 1,514,733 short tons, was the largest on record and represents an increase of 317,307 barrels (44,423 tons) over the total reported for the preceding year, which also was a record output. The production was contributed by approximately thirty mines and works distributed over the counties of Livingston, Onondaga, Schuyler, Wyoming, Tompkins and Genesee in the relative order given of their output. Of the plants, all but two were engaged in brine salt operations.

Production of salt in New York since 1887

YEAR	BARRELS	VALUE
1887	2 353 560	$936 894
1888	2 318 483	1 130 409
1889	2 273 007	1 136 503
1890	2 532 036	1 266 018
1891	2 839 544	1 340 036
1892	3 472 073	1 662 816
1893	5 662 074	1 870 084
1894	6 270 588	1 999 146
1895	6 832 331	1 943 398
1896	6 069 040	1 896 681
1897	6 805 854	1 948 759
1898	6 791 798	2 369 323
1899	7 489 105	2 540 426
1900	7 897 071	2 171 418
1901	7 286 320	2 089 834
1902	8 523 389	1 938 539
1903	8 170 648	2 007 807
1904	8 724 768	2 102 748
1905	8 575 649	2 303 067
1906	9 013 993	2 131 650
1907	9 657 543	2 449 178
1908	9 005 311	2 136 736
1909	9 880 618	2 298 652
1910	10 270 273	2 258 292
1911	10 082 656	2 191 485
1912	10 502 214	2 597 260
1913	10 819 521	2 856 664

Occurrence of salt. The productive sources of salt are natural brines and beds of rock salt. Natural brines have been found in a number of places and in various rock formations, but the only occurrence that has had any great commercial importance is in the vicinity of Syracuse on the old Onondaga Salt Springs Reservation, which was sold to the State by the Indians in 1788. The brines are encountered in loose gravels, sands and clays which extend to depths of several hundred feet and apparently lie in a channel or basin hollowed out of the Salina rocks. The original wells were shallow, but it was later found that the strength of the brine could be increased by going deeper and wells were put down to depths of from 200 to 400 feet from which the present supplies are obtained. The borings of the underlying strata in the basin show that they contain no rock salt, and it is thought the brines are derived from leaching of beds that are found to the south of Syracuse under cover of a heavy thickness of shale.

With the exception of the salt made at Syracuse, the rock salt beds constitute the entire source of present production. The beds are found in the Salina formation, a succession of shales, limestones gypsum and rock salt, that has its outcrop along an east-west belt from Albany county to the Niagara river and is represented by a smaller separate area in southeastern New York. Test borings indicate that the salt deposits are restricted to the western section of the main belt beginning in Madison county, and that they occur at intervals from that county to Erie and Cattaraugus counties. The most easterly point where rock salt has been found is at Morrisville, Madison county. On account of its ready solubility it is rarely encountered at depths of less than about 1000 feet where the cover is sufficient to protect the beds from the action of underground waters. Since the Salina beds have a dip uniformly toward the south, the mines and wells are all located on the southern side of the outcrop which lies about the line of the 43d parallel. The dip averages 40 or 50 feet to the mile. The persistence of the salt to the south is indicated by the wells at Ithaca which reach the salt horizon at over 2200 feet depth and by test borings in northern Cattaraugus and Allegany counties which encountered salt at over 3000 feet depth. A boring at Canaseraga, Allegany county, penetrated 75 feet of rock salt beginning at 3050 feet. The western extensions of the beds in Erie county are stated by Bishop to be about on a line between East Aurora, Patchen and Boston Corners and a point 3 miles west of Springville. Brines have been found in wells at Eden valley, Gowanda and other localities to the west of the boundary, but no rock salt. In Cattaraugus county, however, rock salt is reported to have been found in a gas well situated between Cattaraugus and Gowanda.

Rock salt mines. The active rock salt mines are situated at Retsof and Cuylerville, Livingston county. Shafts have been sunk also near Le Roy, Seneca county, and at Livonia and Greigsville, Livingston county, but have not been in use for many years.

The methods of mining the salt at the two active mines are very similar. In both the bed is reached through vertical shafts of a little over a 1000 feet depth. The Sterling Salt Co. at Cuylerville has two shafts, and the Retsof Mining Co. at Retsof three, which are bottomed in a bed of salt from 20 to 25 feet thick. The workings are laid out in panels, with the main galleries running east-west. The headings are driven to the north so as to secure advantage of the dip in tramming the salt to the main haulage ways. Of the 20 feet or more of salt only about 12 feet are actually mined, the remainder being left in the roof and floor. The breast of salt is worked in two benches. The rooms are 30 feet wide, separated by equally wide pillars. There is no timbering, and of course no drainage to provide for in the workings. The salt is drilled by rotary auger drills run by compressed air. The holes are placed with a view to making the greatest proportion of lump salt, and they are charged lightly with low-grade dynamite. Charging and blasting are performed by a separate crew, with one man for each pair of drillers. The broken salt is loaded into three-ton cars which are run down to the main haulage ways and from there hauled to the shaft. At the surface the salt is crushed and the various sizes separated by screening. The coarsest lumps are sold uncrushed, principally as cattle salt. The crushed and screened salt finds use in the curing of hides, refrigeration, in the manufacture of oleomargarine, and in various other industries. An analysis of a sample of the New York salt, as given by Merrill, follows:

$NaCl$	98.701
$MgCl_2$	.055
$CaCl_2$	.018
$CaSO_4$	.484
Moisture	trace
Insoluble	.743

Brine salt. The manufacture of salt from brine is carried on either by the solar process, in which the brine is led into shallow wooden vats and there exposed to evaporation by the sun's heat, or by artificial methods which depend upon evaporation by direct fire or steam of the brine contained in kettles, pans or vats. The open kettle process of artificial evaporation was long used at Syracuse, but has now been superseded by the solar process. The methods of artificial evaporation now in general use are the grainer, open pan and vacuum pan. Some of the plants make use of only one method; others have an equipment that combines the grainers with vacuum pans or grainers with open pans.

The manufacture of solar salt at Syracuse is still an important industry in which a large number of individuals and firms are active. The product varies considerably from year to year, depending on the character of the season. The salt is marketed through the Onondaga Coarse Salt Association. It is sold in seven grades, of which six represent the different sizes of salt crystals separated by screening, as follows: Diamond C, B. C., Standard, Diamond F, B. F., and 6 mesh B. F. The finest size is 8 mesh, which is crushed to pass an eight-mesh screen. The product is used for the same purposes practically as rock salt.

The list of manufacturers of artificially evaporated salt at present includes the following: International Salt Co., with works at Myers and Watkins; Worcester Salt Co., Silver Springs; Rock Glen Salt Co., Rock Glen; Eureka Salt Co., Saltvale; Remington Salt Co., Ithaca; Watkins Salt Co., Watkins; Genesee Salt Co., Piffard; and Le Roy Salt Co., Le Roy.

The Eureka Salt Co. began the manufacture of salt in April 1913, having taken over the works at Saltvale, Wyoming county, formerly owned by the Crystal Salt Co. The plant is equipped with six open pans and two grainers and a mill for the making of table salt.

The nature of the brine used in the manufacture of salt is shown by the following analysis, of which no. 1 represents an average example of the Onondaga natural brines and no. 2 of an artificial brine from the solution of the rock salt:

	1	2
$MgCl_2$	.155	.049
$CaCl_2$	.129	.134
$CaSO_4$	.599	.349
NaCl	16.921	23.295

Literature of salt. The geological occurrence of the salt deposits has been set forth in detail by Luther in his papers, "Geology of the Livonia Salt Shaft" and "Salt Springs and Salt Wells of New York and Geology of the Salt District," published respectively in the 13th and 16th Annual Reports of the New York State Geologist. A good description of the technology of the brine salt manufacture is given by F. E. Englehardt in Merrill's "Salt and Gypsum Industries of New York," which is Bulletin 11 of the New York State Museum. Many records of salt wells are assembled in the papers by Bishop included in the 5th Annual Report of the New York State Geologist and in the 45th Annual Report of the State Museum.

SAND AND GRAVEL

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

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

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

Production of sand and gravel

MATERIAL	1911	1912	1913
Molding sand	$420 780	$422 148	$449 224
Core and fire sand	27 484	55 910	38 571
Building sand	*b* 750 000	1 156 002	1 102 688
Other sand *a*	*b* 50 000	*b* 75 000	*b* 75 000
Gravel	479 103	840 669	918 783
Total	$1 727 367	$2 549 729	$2 584 266

a Includes glass sand, filter sand, engine and polishing sand. The amounts are partly estimated.
b Partly estimated.

Molding sand. The molding sand industry is centered in the middle Hudson valley, where there exist extensive areas underlaid by excellent grades of this sand, although small quantities are occasionally shipped from other sections of the State. The Hudson River district is notable for its supply of the finer sizes of molding sand such as are employed in stove-plate, brass and aluminum casting. These are comparatively rare in other districts in the east where molding sand is obtained and consequently the local product commands a rather wide market. The sand is shipped to the metallurgical centers in New York, New England, New Jersey, Pennsylvania and the Middle West. The favorable trade conditions have led to the development of a large and apparently prosperous industry which is the source of much revenue to a section that otherwise is restricted mainly to agricultural activities.

The distribution and methods of occurrence of the molding sand in the Hudson River district involve many interesting features which have not as yet been fully explained. A brief description of the deposits was given in the preceding issue of this report, and field observations have been collected as a basis for a more detailed paper on this subject.

The molding sand is restricted to the uplands on either side of the Hudson, at elevations of 200 feet or more above sea level. The district forms a narrow belt, usually but a few miles wide, along the river from Washington and Saratoga counties on the north to about the vicinity of Kingston, Ulster county, on the south. The belt widens out notably where important tributaries enter the Hudson, as in the section between Cohoes and Albany where it reaches westward up the Mohawk as far as Schenectady, and also at the outlet of the Hoosac and Batten kill. In the vicinity of Saratoga, Ballston and Round lakes occurs an area which appears to be subsidiary and parallel to the main belt that follows the river; it represents an old river channel and contains a succession of glacial clays and sands like that in the main valley.

The district is thus practically coterminous with the site of Lake Albany, the name given to the expanded waters which occupied the middle Hudson valley in late Pleistocene time. The series of sands and clays may be traced northward from the Hudson valley into the basin of Lake Champlain which also was flooded at the same time, but there appears to be very little of the molding sand in that section.

The molding sand forms a layer directly below the soil. The soil covering averages about a foot thick. Near the bottom it passes gradually into the molding sand through a decrease of organic matter which is indicated by the change of color from dark gray to the light yellow of the sand. In the average, the layer is from a foot to 3 feet thick. Below, it gives way very quickly to a loose " open " sand that lacks the clay bond and is usually a mixture of quartz and shale particles. This material in turn is underlaid by the characteristic Hudson river clays, brown or yellow on top and blue below. The thickness of the whole sand accumulation ranges from 2 or 3 feet up to 10 or 20 feet and in places even more.

The removal of the soil and molding sand is performed wholly by hand labor. With the excavation of the latter, the soil is usually replaced and the land is then returned to agriculture. The grading of the sand according to its quality requires a degree of experience and some skill of which the land owner himself is seldom possessed, and the production is mainly carried on by a few firms who also ship the sand to the market. The owner of the land receives a royalty figured on the basis of yield or else a round sum for the sand on the whole property.

Most of the output comes from the central part of the district from Saratoga, Albany, Schenectady and Rensselaer counties. In Saratoga county, Mechanicville, Round Lake, Elnora, Burgoyne and Schuylerville are the more important localities. In Schenectady the sand is obtained from near the city of Schenectady and also from Carman and Niskayuna. Large quantities are shipped from the vicinity of Albany and from Wemple, Selkirk, Glenmont and other places south of that city. In Rensselaer county the sand is excavated at points along the Hudson river and the Boston and Albany Railroad. The most southerly point from which shipments have been made recently is Kingston.

The sand is marketed under some five or six grades depending upon the fineness. The finest size generally is that called No. 0 and the others include 1, 2, 3 and 4, which is the coarsest. Some shippers supply also intermediate grades or half sizes. There is no absolute standard by which the material is graded and considerable variation exists between the grades furnished by different shippers.

The production of molding sand in 1913 amounted to 504,348 short tons valued at $449,224. The entire output, with the exception of a small quantity from Chautauqua and Cayuga counties, came from the Hudson river district. The returns indicated an increase of about 10 per cent in the production as compared with the preceding year when the total amounted to 469,138 short tons with a value of $422,148.

Core and fire sand. Core sand is a nearly pure quartz sand used in the cores of molds. It must possess refractory qualities and be permeable to gases. Fire sand is a refractory sand of about the same characters, employed in lining the hearths of furnaces. These sands are produced in Erie, Oneida and Queens counties. The output for 1913 was reported as 53,757 short tons valued at $38,571.

Glass sand. The requirements for sand used in glass manufacture are that it shall be practically pure quartz. Iron minerals are particularly objectionable and not more than a trace of iron is allowable. Glass sands are found in New York State in some of the beaches of the interior lakes, particularly Oneida lake, and on the shores of Long Island sound. The natural sands are washed to purify them of clay, mica, magnetite and other ingredients. At one time large quantities were produced around Oneida lake which forty or fifty years ago was an important center of window glass manufacture. At present the output is only a few thousand tons and it is all shipped to points outside the State.

Building sand. The largest quantities of sand are consumed in building and construction work for the making of concrete and mortar. Sands adapted to such purposes have a widespread occurrence, and their excavation and shipment to market is purely a local business, except in a few places which supply the larger cities.

The beach sands of Long Island afford excellent building sands which are shipped to New York City and its environs. In the interior of the State, glacial sands, which may be more or less re-sorted by river action, are mainly employed. Thus Albany derives its supply from a delta deposit within the city limits. Rochester has several sources of supply of which the principal one is the Pinnacle hills just south of the city, a deposit formed by glacial streams. The beach sands of Lake Erie are used in Buffalo.

The amount of sand and gravel used for building and construction purposes each year can only be approximated. Reports received from the principal producers who operated more or less steadily from year to year indicate a total value for these materials in 1913 of $2,021,471. This figure, however, certainly falls considerably short of the real value, possibly by as much as 15 per cent.

Other kinds. Filter sand is produced on Long Island. It is a quartz sand of medium to coarse texture, free of silt, and is employed in water filtration. The principal uses are the municipal filtration plants.

Engine sand is the sand used by railroad and traction companies for sanding the rails to prevent slipping. Almost any quartz sand that is not too coarse or admixed with clay is suitable.

Polishing sand is employed by stone cutting establishments for sawing and polishing soft building stone like marble and limestone. It is a sized quartz sand.

SAND-LIME BRICK

BY ROBERT W. JONES

During the season of 1913 there were in operation in the State of New York four plants producing sand-lime brick, with a total of 22,225,000 having a value of $143,345 at the plant, or an average of $6.40 a thousand. While the number of active plants has decreased, there has been an increase in both production and value over the preceding year when the production was 21,231,000 with a value of $133,736, an average of $6.30 a thousand.

The active producers during the last season include the Glens Falls Granite Brick Co., which in 1903 was the first to produce sand-lime brick on a commercial scale in this State; the Buffalo Sandstone Brick Co., of Buffalo and the Paragon Plaster Co., of Syracuse, which began to operate in 1904; and the Rochester Composite Brick Co., which began operations in 1905.

The commercial outlet for sand-lime brick was overestimated at first, and many entered upon the production without the necessary experience to produce a strictly first-class article. The production fell off from year to year until 1909. During 1908 it reached the lowest figure when 8,239,000 bricks were manufactured, having a value of $55,688, compared with 17,080,000 and a value of $122,340 for the year 1906. Beginning with 1909 the demand began to improve and steadily increased, due to a greater activity in building operations and to a better recognition of the value of sand-lime brick in construction. Methods of manufacture changed and the product now is a strictly high grade sand-lime brick having a calcium silicate bond. The industry of the State is concerned only with this grade of brick, there being at present no commercial production of mortar brick.

The majority of the operating plants in the State manufacture their product with the standard American dry press, though the German rotating press is represented. The crude material in all cases comes from local sources and the finished product supplies generally only the local demand. The following table shows the progress of the industry in the State. The figures for 1903, 1904 and 1905 were not obtainable.

Production of sand-lime brick

YEAR	QUANTITY	VALUE	VALUE PER THOUSAND	OPERATING PLANTS
1906	17 080 000	$122 340	$7 16	7
1907	16 610 000	109 677	6 60	9
1908	8 239 000	55 688	6 44	6
1909	12 683 000	81 693	6 31	6
1910	14 053 000	82 619	5 88	6
1911	15 178 000	92 064	6 05	5
1912	21 231 000	133 736	6 30	5
1913	22 225 000	143 345	6 40	4

STONE

The products of the quarries form a large item in the total mineral production of the State. The last few years have witnessed, however, some notable changes in the relative importance of the different branches of the stone industry. The use of cement and terra cotta has curtailed the demand for cut stone in building operations, so that this branch no longer occupies the prominent place that it once had. Similarly, the market for flagstone and curbstone has fallen off, more especially for flagstone, as a result of the favor shown for cement construction. On the other hand there has been a tremendous development of the crushed stone industry, which has practically counterbalanced the declines in the other departments.

Altogether the changes that have taken place have meant a loss industrially to the State, since the preparation of crushed stone requires a minimum of labor of the unskilled kind.

The statistics of production indicate that the year 1913 was a fairly active one for the quarry business. The total value of the materials of all kinds, as reported by the individual enterprises, was $6,763,054, as compared with $5,718,994 in the preceding year. There was thus a gain of $1,044,060 or about 18 per cent for the year. The output, however, fell below that returned for some of the earlier years and the gain does not seem to indicate any real expansion of quarry operations outside the crushing business. It is to be noted that the totals do not include any products from slate, millstone and cement quarries, for which separate statistics are published elsewhere in this report.

The granite quarries reported a considerably larger output than in 1912, but mainly in crushed stone. Of building and monumental granite, the product was a little less than in the preceding year.

The limestone quarries contributed about one-half of the total reported for the entire industry, maintaining the same relative position which they have occupied in the past. Limestone is more extensively used for crushed stone than any other kind, and it also finds a large outlet in lime making, furnace flux and for chemical manufacturing.

There was little change in the marble industry, the production having been about the same as in 1912. Building stone is the largest item in the local market, with monumental stone ranking next.

The sandstone output showed a small increase, mainly in the item of curbstone. In previous years the production had shown a marked decline owing to the decreased demand for flagstone, which is mainly quarried in the southeastern bluestone region. At one time this was a very large and flourishing branch of the industry, in fact the most important of all.

The trap quarries in the Palisades section made about their usual output, although the future of the industry is somewhat unsettled. The river quarries will eventually have to shut down, as they come within the bounds of the new Palisades park. It is possible that new quarries may be opened inland to take their place.

The production of the different kinds of stone during the past three years is given in the tables herewith.

Production of stone in 1911

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite........	$30 684	$11 353	*a*	$72 401	$34 195	$148 633
Limestone.....	112 082	....	$11 989	1 936 292	1 113 798	3 174 161
Marble........	171 748	79 115	....	....	27 178	278 041
Sandstone.....	327 587	....	526 074	23 883	182 562	1 060 106
Trap..........	....	....	....	896 164	3 250	899 414
Total.....	$642 101	$90 468	$528 063	$2 928 740	$1 360 983	$5 560 355

a Included under "All other."

Production of stone in 1912

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite........	$65 487	$19 130	*a*	$49 307	$68 172	$2 02 096
Limestone.....	108 581	....	$5 481	2 176 368	1 220 015	3 510 445
Marble........	155 411	84 511	....	....	1 925	241 847
Sandstone.....	363 055	....	615 846	45 301	256 541	1 280 743
Trap..........	....	....	....	483 863	....	483 863
Total.....	$692 534	$103 641	$621 327	$2 754 839	$1 546 653	$5 718 994

a Included under "All other."

Production of stone in 1913

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite........	$45 911	$17 013	*a*	$236 650	$36 068	$335 642
Limestone.....	101 198	....	$6 546	2 386 632	1 358 302	3 852 678
Marble........	127 556	81 330	....	....	43 406	252 292
Sandstone.....	285 645	....	682 984	46 267	306 376	1 321 272
Trap..........	....	....	....	1 001 170	....	1 001 170
Total.....	$560 310	$98 343	$689 530	$3 670 719	$1 744 152	$6 763 054

a Included under "All other."

GRANITE

Granite is both a specific and a general term. When used in the restricted scientific sense it means an igneous rock of thoroughly crystalline character in which the chief constituents are feldspar, quartz and mica. Such a rock has a massive appearance, that is, the constituents are uniformly distributed in every direction, and owing to the predominance of the feldspar and quartz, the color is rather light, commonly gray or pink. As a variation to the uniform distribution of the minerals, the latter may develop a plane parallel arrangement through the influence of compression when the mass was still deeply buried in the earth's crust. A granite with this parallel or foliated texture is known as a granite gneiss.

The commercial definition of granite is much broader than that given and includes almost any of the crystalline silicate rocks (usually igneous) that possess the requisite physical qualities for use as architectural or monumental stone. In most cases the commercial product is actually a granite in the true sense, but not infrequently it may be a syenite which lacks quartz, or a diorite consisting of plagioclase, feldspar and hornblende, or anorthosite which contains little else than basic plagioclase feldspar. So-called black granites are mainly gabbros and diabases with a large proportion of the iron compounds pyroxene, hornblende and magnetite.

The broader usage will be followed in the present classification, as all the above named rocks are quarried in this State. The only silicate rock not included under granite is diabase or trap which, on account of the special features surrounding its production and uses, is classed by itself.

Granites and the related igneous types are restricted to two well-defined areas in New York — the Adirondacks in the north and the Highlands in the southeast. Some account of the principal quarries in the two areas has been given in the issue of this report for the year 1911.

The production of granite in the last three years is shown in the accompanying table. The figures represent the commercial value of the output of all quarries with the exception of those operated by contractors on road improvement work, for which it is very difficult to compile any reliable figures. The total value of the granite quarried in 1913 was $335,642, as compared with $202,096 in 1912. The gain was mainly in the item of crushed stone. There was little change in the building, monumental and other kinds, aside from the crushed product.

Production of granite

VARIETY	1911	1912	1913
Building	$30 684	$65 487	$45 911
Monumental	11 353	19 130	17 013
Crushed stone	72 401	49 307	236 650
Rubble, riprap	28 162	27 861	9 722
Other kinds	6 033	40 311	26 346
Total	$148 633	$202 096	$335 642

QUARRY NOTES

Keeseville. The development of quarries in the vicinity of Keeseville was under way during 1913. The Empire State Granite Co. opened two quarries on lands of George W. Smith, about a mile west of Keeseville, near the Clintonville road, and did some exploratory work in the vicinity of Augur lake, southeast of that village. The rock in both places is anorthosite, the same as that once quarried at Keeseville under the name of "Ausable granite." The present openings west of Keeseville yield a more uniform material than the Prospect hill quarries which were the source of the product in earlier years. A notable feature of the stone which differentiates it from ordinary granites is its color — a light, translucent green on both fractured and polished surfaces. The composition, of course, is also quite distinct from that of granite proper, being characterized by a predominance of the lime-soda feldspar labradorite. This constitutes from 75 to 85 per cent of the mass. It composes most of the body where it is finely divided and also occurs in scattered crystals of larger size which lend the effect of a porphyritic texture, as the larger individuals have a dark color. Besides feldspar, there is some pyroxene, black when seen in the hand specimen, red garnet in threadlike aggregates, and ilmenite of opaque black color. The stone is remarkable for its fresh condition at the very surface, there being only a thin skin, not over one-half inch thick, of bleached material on the exposed surfaces which have been subject to weathering since Glacial time.

One of the quarries on the Smith property is on the side of a ridge which affords a working face 50 feet high. The rock is broken by joints at rather wide intervals, there being two main systems of vertical joints, the one about north-south and the other at right angles. A 12 foot diabase dike intersects the quarry face in an east-west direction. The rock is fine in texture, except for the residual crystals which range from a fraction of an inch to several inches across. At the second quarry, which is a pit opening, the rock is coarser and contains a larger proportion of residual feldspars. The joints here run southeast-northwest and northwest-southeast with a horizontal set at intervals of 3 or 4 feet. A dike of trap and one of syenite porphyry were noticed in the walls of the quarry.

On the shores of Augur lake occur extensive exposures of anorthosite; in some places cliffs rise from 75 to 100 feet directly from the lake. The material varies in texture and appearance from place to place. Some varieties have a dark color and contain a large percentage of iron-magnesia minerals in the form of pyroxene and biotite. Other types of the rock are light gray or greenish, being then more feldspathic. The places prospected by the Empire State Granite Co. are on the west side of Augur lake. Nearby is a quarry on the property of C. B. White which was worked several years ago and the product shipped to New York for use in the Criminal Courts building. The stone is of light gray color. The quarry opening is on top of a ledge 80 feet above the lake and is about 150 feet square.

The anorthosite from this section is a strong durable material, well adapted for most structural purposes. It takes a good polish and is attractive on account of its rare color. The polished samples, however, show minute hairlike fractures which seem to mark the direction of the rift and grain. Apparently their presence does not materially weaken the structure, as the crushing is equal to that of the average granite. Tests made by the office of public roads in Washington showed an ultimate strength of 20,500 pounds a square inch on a specimen from the Smith property and 18,500 pounds on a specimen from Augur lake.

Parishville. A new monumental and structural granite has been quarried at Parishville in eastern St Lawrence county. The stone has been marketed under the name of the St Regis Red Veined Granite. It has a dark red fine-grained body in which appear curved and branching veinlets of bright red color and somewhat coarse grain, but of the same mineral composition as the rest. The veining is not sharply defined but shades off on the borders and in places developes into round or irregular unclear patches which give the effect of clouds of lighter color. The appearance of a polished surface is quite attractive, as it is also rare among stones of this class. The coarser grained material is not the result of pegmatitic injection, but a variation produced from different conditions of crystallization, probably in a stage of resoftening of the original rock. The granite belongs to the Adirondack granite gneisses and is composed of feldspar, biotite and quartz, the last in rather small amount for true granite, with some hornblende, magnetite, zircon and chloritic alteration products. It is a well-preserved strong stone. A crushing test made at the Clarkson School of Technology at Potsdam showed an ultimate resistance of 20,000 pounds to the square inch. The chemical composition, as determined by L. K. Russell, is as follows:

SiO_2	66.78
Al_2O_3	13.01
Fe_2O_3	6.50
MgO	.92
CaO	1.31
Na_2O, K_2O	10.89
H_2O	.51
Total	99.92

The quarry is operated by the St Regis Red Veined Granite Co. A sample of the granite in the State Museum shows a good polish and very attractive pattern. Monumental stock is the main product.

LIMESTONE

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

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

Limestones have a wide distribution in the State, the only region which is not well supplied being the southern part where the prevailing formations are sandstones of Devonic age. The microcrystalline varieties occur in regular stratified order in the Cambric, Lower Siluric, Upper Siluric and Devonic systems. In most sections they occupy considerable belts and have been little disturbed from their original horizontal position. On the borders of the

Adirondacks and in the metamorphosed Hudson river region, however, they have been more or less broken up by faulting and erosion and in places have a very patchy distribution.

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

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

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

In the Mohawkian or Trenton group are included the Lowville (Birdseye), Black River and Trenton limestones which have a wide distribution and collectively rank among the very important quarry materials of the State. They are represented in the Champlain valley but are specially prominent on the Vermont side; from the latter area a belt extends southwest across northern Washington county to Glens Falls in Warren county and is continued into Saratoga county. Another belt begins in the Mohawk valley near Little Falls and extends northwesterly with gradually increasing width across Oneida, Lewis and Jefferson counties to the St Lawrence river. There are isolated areas of Trenton limestone in the Hudson valley south of Albany. The limestones vary in composition and physical character according to locality and geologic position. They are often highly fossiliferous. In the northern section they are mostly gray to nearly black in color, contain little magnesia and run as high as 97 or 98 per cent calcium carbonate. The lower part of the group is heavily bedded and well adapted for building stone; the upper beds commonly contain more or less shale. They are used for various purposes including building and ornamental stone, crushed stone, lime, portland cement and flux. In the Champlain valley quarries are found near Plattsburg, Larabees Point and Crown Point; in Washington county at Smiths Basin; in Warren county at Glens Falls where there are extensive quarries that supply material for building purposes, portland cement and lime. The well-known black marble from Glens Falls is taken from the Trenton. Numerous quarries have been opened in Herkimer, Oneida, Lewis and Jefferson counties. The output of the last named quarry is specially important, including limestone for building and road construction and lime for manufacture of calcium carbide. The principal quarries in Jefferson county are at Chaumont.

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

The Cayugan group includes among its members the Cobleskill, Rondout and Manlius limestones, which are economically important. They have furnished large quantities of material for the manufacture of natural cement, being the source of the cement rock in the Rosendale district and in Schoharie and Onondaga counties. The cement rock of Erie county is found in the Salina formation. The Manlius limestone is used for portland cement in the eastern part of the State.

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

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

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

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

Production. Limestone is by far the most important of the quarry materials, accounting for more than one-half of the total value returned by the quarries each year. Its importance depends upon the varied uses which it serves as well as upon its wide distribution. It is extensively employed as crushed stone for concrete and road making, as building stone, and for construction purposes generally, and in addition is an important material in chemical manufacturing and metallurgy. A large and increasing demand for limestone has recently developed in connection with agriculture for which purposes it is either burned into lime or ground into a fine powder.

The output of limestone has shown a steady gain during the last four years and in 1913 it amounted to a value of $3,852,678, much the largest on record. The total for 1912 was $3,510,445. These figures do not show the value of the stone consumed in portland cement manufacture which is a large item, or of any material quarried by contractors on road improvement work, for which no reliable data are obtainable.

The statistical canvass for 1913 showed a total of one hundred four active quarries distributed among twenty-nine counties of the State.

Production of limestone

MATERIAL	1911	1912	1913
Crushed stone	$1 936 292	$2 176 368	$2 386 632
Lime made	400 396	452 002	486 908
Building stone	112 082	108 581	101 198
Furnace flux	454 800	542 154	575 102
Rubble, riprap	20 328	10 696	26 006
Flagging, curbing	11 989	5 481	6 546
Miscellaneous	238 274	215 163	270 286
Total	$3 174 161	$3 510 445	$3 852 678

Erie county outranks all others in importance in this industry; the value of the limestone quarried in the county last year amounted to $832,579. The products are chiefly furnace flux, crushed stone and building stone. The principal quarries are at North Buffalo, Clarence and Akron.

Onondaga county is the second largest producer, with a total value of $501,506 in 1913. A large proportion of the product is quarried by the Solvay Process Co. for use as a reagent in the manufacture of alkali. The quarries operated by the company at Jamesville are very extensive and supply crushed stone as a by-product. A new producer in 1913 was the Lackawanna Stone Co. with quarries in the town of Onondaga.

The other counties reporting a value of over $100,000 in 1913 were Dutchess, Genesee, Rockland, Niagara, Warren, Albany, Clinton and Schoharie in the order of their output. The Wickwire Limestone Co. opened a flux quarry at Gasport, Niagara county.

The distribution of the production of limestone for the years 1912 and 1913 is shown in the accompanying tables.

Crushed stone. Limestone finds its principal application as crushed stone in which form it is employed for road metal, concrete and railroad ballast. There are large quarries supplying crushed stone in Erie, Genesee, Onondaga, Dutchess, Ulster, Rockland and Westchester counties. The canal, highway and other public improvements in current progress have created large markets for the material, and the production has shown a steady increase. A considerable quantity of the fines made by the crushing plants is sold for agricultural purposes as a substitute for burnt rock or lime.

The value of the crushed stone for 1913 reached a total of $2,386,-632 against $2,176,368 for the preceding year. As already stated, the total does not comprise the stone crushed by contractors in temporary plants for use on the highway system. The actual quantity of stone produced by the crushing plants was 3,945,543 cubic yards, as compared with 3,559,257 cubic yards in 1912.

Lime. The value of the lime made for market last year was $486,908 as compared with $452,002 in 1912. In quantity it amounted to 110,083 short tons against 93,176 short tons in 1912. In addition there was a large output made in connection with chemical manufactures, such as alkali, carbide etc., which as it was marketed in the form of lime has been included in the tables under "Other uses." The principal lime-burning industry is in Warren, Washington, Clinton, Jefferson, Fulton, Madison and Dutchess counties. The increase shown in the last two or three years may be attributed to the growing use of lime for agricultural purposes.

Building stone. The product of building stone has diminished steadily from year to year. The output of $101,198 recorded for 1913 was less than half the total returned five years ago. The decline has been caused by the lessened demand for building stone and not to any exhaustion of the quarries. The wide use of concrete and steel construction in the cities has changed the whole market situation, reducing the sales of cut stone, but giving a great impetus to the crushed stone business.

The total value of the building stone quarried in 1913 was $101,-198, as compared with $108,581 in the preceding year. Erie county, as heretofore, contributed the largest part, $56,239 against $67,912 in the preceding year. Cayuga, Onondaga, Monroe and Warren counties made smaller outputs.

Furnace flux. The metallurgical enterprises which are established in the State provide a large outlet for fluxing limestone which is mainly obtained from local formations. Nearly pure high calcium limestones are usually required for the purpose, although in iron smelting the presence of magnesia is not detrimental. The principal flux quarries are in the Onondaga limestone of Erie and Genesee counties, the Clinton limestone of Niagara county, the Precambric limestones or marbles of the Adirondacks, and the Chazy limestones of the Champlain valley. The limestones in these sections carry from 90 to 95 per cent of calcium carbonate.

The production of flux in 1913 was valued at $575,102, representing a total of 1,052,519 net tons. The corresponding figures for the preceding year were $542,154 and 1,032,481 tons. Niagara and Erie counties, which supply the iron and steel works about Buffalo, reported the largest quantities.

Agricultural lime. The use of lime on agricultural lands has become an important factor in the quarry industry. The quantity sold for the purpose is not given separately in the statistical tables for the reason that many of the quarry companies themselves do not know the amount of their product that is thus used. Much of the material sold is really a by-product of which little account is taken, as in the case of the fines and dust of the crushing plants which are now utilized, and also the inferior grades of quicklime. There are a number of quarries, however, that dispose of all or a large part of their product for agricultural lime. Altogether the quantity produced last year probably amounts to 100,000 tons, and may have been considerably more. There has been a very active inquiry for quarry lands in the State which are favorably situated for supplying this market. The material must be delivered to the consumer at a low price to make it economically available, and the tendency, doubtless, will be to develop local quarries so far as possible.

There is an inexhaustible supply of limestone well adapted for agricultural use, though the resources are by no means so distributed as to be always available as commercial quarry sites. The best limestones, that is the high-grade calcium varieties, are mainly to be found in the Precambric and early Paleozoic formations of the northern part of the State. The crystalline limestones or marbles of St Lawrence, Jefferson and Lewis counties, the Trenton limestones on the southeastern, southern and western sides of the Adirondacks, and the Chazy limestone of the Champlain valley are the more important.

Production of limestone by counties in 1912

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$136 690	....	....	....	....	$136 690
Cayuga	32 620	....	....	$7 330	....	39 950
Clinton	8 694	$60 521	$13 423	600	$2 881	86 119
Erie	607 107	75	246 091	67 912	2 662	923 847
Genesee	214 310	6 750	54 557	....	6 000	281 617
Greene	3 250	....	6 000	....	....	9 250
Herkimer	14 826	....	....	....	....	14 826
Jefferson	18 865	*a* 17 942	....	....	....	36 807
Lewis	1 568	35 000	....	39	2 782	39 389
Madison	33 957	....	....	766	....	34 723
Monroe	28 079	6 600	....	2 307	....	36 986
Montgomery	17 794	....	....	7 259	1 886	26 939
Niagara	....	....	192 915	1 407	2 800	197 122
Oneida	51 507	14 280	....	....	....	65 787
Onondaga	204 998	*a*	....	6 407	208 914	420 319
Rensselaer	23 974	....	....	150	....	24 124
St Lawrence	1 035	5 277	24 612	5 149	....	36 073
Schoharie	96 000	....	210	2 089	1 658	99 957
Ulster	38 375	16 360	....	....	....	54 735
Warren	46 434	207 727	....	6 441	308	260 910
Washington	....	43 350	....	300	....	43 650
Westchester	....	11 695	100	....	1 000	12 795
Other counties *b*	596 285	26 425	4 246	425	449	627 830
Total	$2 176 368	$452 002	$542 154	$108 581	$231 340	$3 510 445

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

Production of limestone by counties in 1913

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$141 583	....	....	....	....	$141 583
Cayuga	30 455	....	....	$12 552	$74	43 081
Clinton	42 861	$62 073	$17 810	450	1 255	124 449
Dutchess	433 117	18 392	....	....	....	451 509
Erie	514 619	....	251 011	56 239	10 710	832 579
Genesee	208 881	15 000	60 860	700	3 500	288 941
Greene	2 300	....	....	....	350	2 650
Herkimer	1 800	....	....	....	....	1 800
Jefferson	8 170	58 230	1 000	....	16 400	83 800
Lewis	11 971	43 602	....	114	4 471	60 158
Madison	43 365	41 571	1 380	685	1 950	88 951
Monroe	30 695	7 650	....	5 199	....	43 544
Montgomery	30 949	....	....	4 995	1 361	39 305
Niagara	22 396	....	215 498	2 810	236	240 940
Onondaga	282 425	....	....	9 581	209 500	501 506
St Lawrence	13 407	3 162	18 915	810	453	36 747
Schoharie	86 742	....	400	431	26 438	114 011
Ulster	76 071	16 010	....	....	....	92 081
Warren	32 466	154 618	....	5 435	26 082	218 601
Washington	1 500	43 000	....	250	....	44 750
Other counties	370 859	23 600	8 228	947	58	403 692
Total	$2 386 632	$486 908	$575 102	$101 198	$302 838	$3 852 678

MARBLE

Marble, in the commercial sense, like granite, includes a variety of rocks that lend themselves to building or decorative uses. Most commonly, the name signifies a crystalline aggregate of calcite or dolomite, as distinguished from ordinary limestones which at best are of indistinctly crystalline nature. At the same time it implies the feature of attractiveness by reason of color and the ability to take a lustrous polish. Rocks possessing all these features are marbles in the strict sense to which the name may be applied without qualification. Some compact or granular limestones that lack the elements of thorough crystallinity make, however, a handsome appearance when polished, and such are commercially classed as marbles. Fossil marbles, black marbles, and a few other kinds are commonly of the noncrystalline type. Serpentine marble, or verde antique, is made up for the most part of the mineral serpentine, a silicate of magnesium and iron, and is therefore not related to the varieties already described. Ophitic limestone, or ophicalcite, is a crystalline limestone or dolomite carrying grains and nodules of serpentine scattered more or less evenly through its mass. Its ornamental quality lies in the speckled or mottled pattern and the sharp contrast between the clear white mass and the greenish serpentine inclusions.

Marbles belonging to those various types find representation in the geologic formations of the State and are quarried on a commercial scale or have been so quarried in the past.

The true or crystalline varieties are limited in occurrence to the metamorphic areas of the Adirondacks and southeastern New York. They are of early geologic age, antedating the period of crustal disturbance and metamorphism which in the Adirondacks was brought to a close practically before Cambric time and which in southeastern New York was completed in the Paleozoic. This thoroughly crystalline character is in fact a development of the strong compression accompanied by heat to which they have been subjected; having been originally, no doubt, ordinary granular or fossiliferous limestones similar to those so plentifully represented in the undisturbed formations outside the regions.

The crystalline limestones of the Adirondacks are most abundant on the western border in Jefferson, Lewis and St Lawrence counties where they occur in belts up to 4 or 5 miles wide and several times as long, interfolded and more or less intermixed with sedimentary gneisses, schists and quartzites. They are found in smaller and more irregularly banded areas in Warren and Essex counties on the eastern side, but have little importance elsewhere. The ophitic limestones that have been quarried at different times belong to the same series. The marbles of the Adirondacks comprise both the calcite class with very little magnesia and the dolomite class containing high percentages of magnesia. No definite relation is apparent in regard to the occurrence of the two and both may be found in the same area and in close association.

The southeastern New York marbles occur in belts which follow the north-south valleys, east of the Hudson, from Manhattan island into Westchester, Dutchess and Columbia counties. They range from very coarsely crystalline to finely crystalline rocks, are prevailingly white in color and belong to the dolomite class. They are interfolded with schists and quartzites, the whole series having steep dips like those of strongly compressed strata. The geologic age of the southern belts is probably Precambric, but on the north and east within range of the Taconic disturbance, they may belong to the early Paleozoic.

Bodies of practically pure serpentine of considerable extent are found on Staten Island and in Westchester county near Rye; they represent intrusions of basic igneous rocks whose minerals, chiefly pyroxene and olivine, have subsequently changed to serpentine. They are not important for quarry purposes, owing to the frequency of fissures and joints and the rather somber color of the exposed parts of the masses.

The microcrystalline or subcrystalline limestones that are sometimes sold as marbles include members of the regularly bedded unmetamorphosed Paleozoic limestones, which locally show qualities of color and polish that make them desirable for decorative purposes. They range from dense granular varieties to those having a more or less well-developed crystalline texture and are often fossiliferous. Inasmuch as they have never been subjected to regional compression or been buried in the earth deep enough to become heated, the crystalline texture, when present, may be ascribed to the work of ground waters. These circulate through the mass, taking the carbonates of lime and magnesia into solution, and redeposit them in crystalline form. Originally, the limestones were accumulations of lime-secreting fossils or granular precipitates, for the most part of marine origin. Some of the localities where these unmetamorphic marbles occur are on the west shore of Lake Champlain, around Plattsburg and Chazy (Chazy limestone), Glens Falls (Trenton limestone) and Becraft and Catskill (Becraft limestone).

Production. The production of marble in 1913 was carried on in Clinton, St Lawrence, Warren, Dutchess and Westchester counties by a total of eight quarries. The quarries in the vicinity of Gouverneur, St Lawrence county, contributed the larger quantity of building and monumental stone; the operative companies in that section include the St Lawrence Marble Quarries, Northern New York Marble Co. and Gouverneur Marble Co. In southeastern New York the Dover Marble Co. was active as heretofore in the production of building and decorative marble. The output was about the same as in the preceding year and had a value of $252,-292.

Production of marble

VARIETY	1911	1912	1913
Building marble	$171 748	$155 411	$127 556
Monumental	79 115	84 511	81 330
Other kinds	27 178	1 925	43 406
Total	$278 041	$241 847	$252 292

SANDSTONE

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

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

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

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

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

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

The Clinton sandstone is mainly developed in central New York, being absent from the Clinton belt in the western part of the State. It forms ledges of considerable extent on the south side of the

Mohawk valley from Ilion to Utica and beyond. It consists of reddish brown and gray sandstones, of medium texture and hardness. The stone has been used for foundations and building in Utica and other places in the vicinity.

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

Production of sandstone. Sandstone is the second most important quarry material in the State, the value of the annual product being exceeded only by that of limestone. Its importance largely depends upon its uses for street work — flagging, curbing and paving blocks — although some of the local sandstones find extensive employment as building materials.

The Devonic sandstones, which are collectively known as bluestone, are more widely quarried than the other kinds; their production is carried on throughout the southern part of the State by a large number of individuals and companies. With few exceptions, the quarries are small, giving employment only to two or three workmen each and having very little in the way of mechanical equipment. Such small enterprises are particularly characteristic of the Hudson River and Delaware River regions where much of the flagstone and curbstone is produced. Many of the quarries are worked intermittently by farmers in the off season of their usual occupation. The stone is hauled down the hillsides to the railroad sidings or the river docks where it is purchased by middlemen who ship it to the eastern markets. The stone from the Hudson River district is mainly shipped by barges from Kingston and Saugerties. In the interior it is shipped by rail. A statistical canvass of such small enterprises is a matter of great difficulty and is likely to afford very unreliable results. Consequently, it has been the practice in this report to secure information so far as possible from the dealers who purchase the stone for shipment to the large wholesalers and consumers in the cities.

The production of sandstone during the last two years is shown in the accompanying tables which give its distribution also among the leading districts.

The combined value of all the sandstone quarried in 1913 was $1,321,272, against $1,280,743 in 1912. The total is exclusive of any sandstone quarried by contractors for use on the State highway system, for which it is impossible to assign any accurate value.

Of the value given, a little more than one-half was returned by the quarry companies operating in the bluestone districts, in exact figures $753,510. This industry showed a slight decline, as compared with the preceding year when the output had a value of $824,-949; the decrease resulted from the lessened activity in the building stone business in Chenango and Wyoming counties. The trade in flagstone and curbstone was about the same proportions as in the preceding year. The product of these materials amounted in value $503,607 and consisted of 1,094,643 linear feet of curb and 1,546,845 square feet of flagstone.

Sandstone other than bluestone represented a value of $567,762, against $455,794 in 1912. The largest item in the total was paving blocks valued at $239,389, as compared with $188,802 in 1912. Orleans county alone reported an output valued at $467,636 which was much larger than the figures from the preceding year.

Production of sandstone in 1912

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river	$9 674	$270 544	....	$4 000	$10 000	$1 216
Delaware river	42 944	220 601	....	....	5 367	997
Chenango co	85 622	4 876	....	....	250	2 237
Wyoming co	151 255	5 488	....	660	483	1 100
Other districts	5 955	1 680	....	....	....	....
Total bluestone	$295 450	$503 189	....	$4 660	$16 100	$5 550
Sandstone						
Orleans co	$35 660	$99 074	$185 432	$1 551	$6 732	$12 356
Other districts	31 945	13 583	3 370	39 090	15 930	12 080
Total sandston .	$67 065	$112 657	$188 802	$40 641	$21 653	$24 436
Combined total	$363 055	$615 846	$188 802	$45 301	$37 753	$29 986

Production of sandstone in 1913

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river	$5 977	$238 724	....	$2 250	$3 400	$11 094
Delaware river	51 611	251 080	....	250	3 029	....
Chenango co	66 645	7 523	....	....	....	817
Wyoming co	97 776	1 200	....	180	1 138	....
Other districts	5 636	5 080	....	....	100	....
Total bluestone	$227 645	$503 607	....	$2 680	$7 667	$11 911
Sandstone						
Orleans co	$21 636	$170 725	$230 397	$2 124	$23 791	$19 963
Other districts	36 364	8 652	8 992	41 463	4 655	....
Total sandstone	$58 000	$179 377	$239 389	$43 587	$27 446	$19 963
Combined total	$285 645	$682 984	$239 389	$46 267	$35 113	$31 874

The quarries in the Medina belt reported a good business, especially in the materials used for street work. Medina blocks are recognized as among the more durable and satisfactory paving materials, and they should find a wider market with the growth of public interest in improved methods of highway construction. They are now mainly employed in city streets, but they are well adapted for any highways which bear a heavy traffic. Their cost at the quarries is about $1.50 a square yard, or a little more than paving brick. With the completion of the barge canal, which traverses the district from east to west, the quarries will be able to reach a much larger territory than heretofore.

TRAP

Trap is not a distinct rock type, but the name properly belongs to the fine-grained, dark-colored igneous rocks that occur in intrusive sheets and dikes. In mineral composition it differs from most of the igneous rocks that are classed in the trade as granite by the prevalence of the basic plagioclase feldspars and the higher percentages of the iron magnesia minerals, while it contains no quartz. Some of the so-called "black granites," however, are trap. The name is sometimes applied to fine-grained rocks of granitic or syenitic composition and sometimes even to rocks of sedimentary derivation, but such usage is misleading and indefensible.

The particular value of trap is due to its hardness and toughness. Its fine, compact, homogeneous texture gives it great wearing powers and it is eminently adapted for road metal and concrete of which heavy service is required. The principal product, therefore, is crushed stone. It has been used to some extent, also, as paving blocks, but these are rather difficult to prepare, since trap very seldom shows any capacity for parting comparable to the rift and grain structures of granites. As a building stone it finds very little application, probably on account of its somber color. The expense of cutting and dressing trap is also an obstacle to its employment for building or ornamental purposes.

The trap quarried in New York State is properly a diabase. Its mineral composition varies somewhat in the different occurrences, but the main ingredients are plagioclase, feldspar and pyroxene, with more or less of amphibole, olivine, magnetite and some times biotite. The texture is characteristic, for the feldspar forms lath-shaped crystals which interlace and inclose the pyroxene and other ingredients in the meshes, and it is this firmly knit fabric which gives the stone the qualities of strength and toughness.

The largest occurrence of trap in New York is represented by the Palisades of the Hudson and the continuation of the same intrusion which extends southward through New Jersey onto Staten Island and is also encountered in the interior of Rockland county. The Palisades are the exposed edge of a sill or sheet of diabase that is intruded between shales and sandstones of Triassic age. The sheet is several hundred feet thick, in places nearly 1000 feet, and in general seems to follow the bedding planes of the sedimentary strata which dip to the west and northwest at an angle of from 5° to 15°. The outcrop is narrow, seldom over a mile, and in places is limited to a single steep escarpment. The principal quarries are near Nyack and Haverstraw at the base of the cliffs. Other quarries have been opened near Suffern, Rockland county, on an isolated intrusion, and also near Port Richmond, Staten Island, at the southern end of the Palisades sill.

Trap occurs in numerous places in the Adirondacks, but mostly as narrow dikes. It is especially common in Essex and Clinton counties where there are many thousands of dikes that range from a few inches to 20 or 30 feet thick. On the southern border of the region are a few dikes of notable size, such as that in the town of Greenfield, Saratoga county, and at Little Falls in the Mohawk valley. A quarry has been opened in the Greenfield occurrence for the supply of crushed stone.

The quarrying of trap along the face of the Palisades in Rockland county probably will soon be discontinued, as it is designed to purchase the quarry properties for the Palisades Interstate Park. The lands to be included within the park extend from the river line to the top of the Palisades. So far only the Manhattan Trap Rock Quarry has been taken over, but negotiations are proceeding for the acquirement of the other quarries along the river front.

The future of the industry in this section is somewhat unsettled. It is not unlikely that new quarries may be opened on top of the ridge and in the interior of Rockland county, though the facilities for production and shipment in that section can scarcely be equal to those of the present localities.

Production of trap

MATERIAL	1912		1913	
	CUBIC YARDS	VALUE	CUBIC YARDS	VALUE
Crushed stone for roads....	283 628	$207 957	631 134	$499 776
Crushed stone for other purposes..................	391 681	275 906	640 165	501 394
Total.............	675,309	$483 863	1,271,299	$1 001 170

The production of trap in 1913 was large, in response to the demand for crushed stone in road improvement work. The statistics show a big increase over the reported output for 1912, but the gain did not reflect any actual extension of quarry facilities: the output in 1912 was abnormally low.

TALC

The talc mines in the Gouverneur district, St Lawrence county, had an active year, although operations were hampered somewhat by the long drought that prevailed in the late spring and summer. The talc is all used in ground form and its preparation involves a gradual reduction in crushers, rolls, ball mills and cylinders, which is carried out in plants located on the Oswegatchie river above Gouverneur. This river has splendid water power sites, but the flow is very unequally distributed so that in dry seasons the available power is reduced to a fraction of the average amount. The condition of low water has been a recurrent one in recent years, and the talc industry is vitally consumed with the plans for the regulation of the stream which have been prepared recently by the State Conservation Commission.[1] Cheap power is a necessity, since the grinding operations otherwise would enhance the costs to a prohibitive figure. Talc competes with a number of materials which are substituted for it whenever the prices rise above a certain level. In the present conditions the mill output in the Gouverneur district is probably only from one-half to two-thirds of the capacity under continuous full power.

[1] "Power Possibilities on the Oswegatchie River," Albany, 1914.

The talc industry was established in the late seventies of the last century. From shipments of a few hundred tons the output had expanded to over 4000 tons by 1880 and to over 40,000 tons by 1890. In the following decade it increased to 60,000 tons; in the last 15 years, however, it has remained practically stationary, fluctuating between the limits of 60,000 and 70,000 tons according to the character of the season. The total shipments from the first have amounted to something over 1,500,000 tons, valued altogether at about $13,000,000. The demand has improved of late years, and it is probable that the market would absorb even larger quantities than are now offered.

The uses of fibrous talc are varied, but its most important application is in the paper trade where it is consumed by manufacturers of writing, book and newsprint paper as filler. According to J. S. Diller,[2] recent conditions in the paper trade point to an improved market for the better grades of American talc. Its principal competitor is German clay. Experience with its use in paper seems to show that it is retained to a larger extent than clay and that it is also a better absorbent of ink. The mineral fibers also help to strengthen the paper stock.

The Gouverneur talc industry was described at some length in the issue of this report for 1911. In the last two years a new supply of talc has come into prominence through mining operations in the vicinity of Natural Bridge, where deposits of a massive or finely granular talc have been developed. The deposits apparently are restricted to a relatively small area, rather than distributed over a long belt, as in the Gouverneur district, and seem to be the result of local contact metamorphism from the intrusion of granitic rocks into limestones. They are not made up of talc exclusively, but contain various hydrated magnesian silicates, inclusive of talc, serpentine and a mineral of the chlorite family. An analysis of a small sample by R. W. Jones showed the following percentages:

SiO_2	48.16
Al_2O_3	7.43
Fe_2O_3	3.15
MgO	27.44
CaO	.25
H_2O+	11.06
H_2O-	2.68
	100.17

[2] Mineral Resources of the United States, 1912, 2: 1142–43.

The deposits at Natural Bridge have been worked during the past two years only and are still in process of development. The St Lawrence Talc Co., Inc., the owner, has a mill on the property and ships all the product in ground form, which is consumed in paper manufacture and for other purposes. The mill has been recently enlarged and improved. The equipment includes conical mills and tube mills such as have been described in the article on the Gouverneur district in the report for 1911.

The operative mills in the Gouverneur talc district were those of the Ontario Talc Co., the Uniform Fibrous Talc Co., the Standard Talc Co., and the International Pulp Co. The latter worked Mines 2½ and 3 at Talcville and the Wight mine near Sylvia lake, besides drawing from its reserve at the Arnold mines. The Wight and Arnold properties formerly belonged to the Union Talc Co., and were taken over by the International Company a few years ago. The Standard Talc Co. worked the mine that formerly belonged to the United States Talc Co., and shipped the product to New Jersey for milling. The Uniform Fibrous Talc Co. continued the underground development of its mine at Talcville where in the last two or three years it has opened a very good body of talc. The Ontario Talc Co. operates a property in the center of the district near Fullerville.

The North Country Corporation has been engaged during the past year in opening deposits near Sylvia lake, town of Fowler. The property has been previously prospected by the Dominion Co., and will now be equipped for active production. It lies near the Balmat and Wight mines of the International Pulp Co.

The output of talc by the several companies above named amounted last year to 63,000 short tons, valued at $551,250. This was somewhat more than in 1912 when the total was 61,610 tons with a value of $511,437. Prices averaged a little higher than in the preceding year.

Production of talc in New York

YEAR	SHORT TONS	VALUE	YEAR	SHORT TONS	VALUE
1882	6 000	$75 000	1898	54 356	$411 430
1883	6 000	75 000	1899	54 655	438 150
1884	10 000	110 000	1900	63 500	499 500
1885	10 000	110 000	1901	62 200	483 600
1886	12 000	125 000	1902	71 100	615 350
1887	15 000	160 000	1903	60 230	421 600
1888	20 000	210 000	1904	65 000	455 000
1889	23 476	244 170	1905	67 000	519 250
1890	41 354	389 196	1906	64 200	541 600
1891	53 054	493 068	1907	59 000	501 500
1892	41 925	472 485	1908	70 739	697 390
1893	36 500	337 625	1909	50 000	450 000
1894	50 500	454 500	1910	65 000	552 500
1895	40 000	320 000	1911	65 000	552 500
1896	46 089	399 443	1912	61 619	511 437
1897	57 009	396 936	1913	63 000	551 250

ZINC

There were no commercial shipments of zinc ore last year from deposits within the State, although a quantity of blende was extracted in the course of underground development at Edwards. The product was held for mill treatment. The results of recent activity in the search for zinc ores in southern St Lawrence county have been quite favorable, and there is good prospect that a stable mining industry will be developed there in the near future. The industry will be a small one, but with the exceptional conditions for cheap mining and milling it should prove profitable. The main obstacle that has presented itself thus far in the development of the district is incident to the character of the ore which is usually a fine-grained mixture of blende and pyrite in a limestone gangue. The separation of the pyrite and blende has proved more difficult than was anticipated and has necessitated a good deal of experimental work at the expense of commercial operations.

The developments so far have been carried on by the Northern Ore Co., who some time ago acquired properties in the vicinity of Edwards, the terminus of a branch railroad from Gouverneur that serves the talc district. The company has concentrated attention upon outcrops of blende on the Brown farm, but has other holdings that show more or less ore. The progress of underground work has been related in previous issues of this report, more particularly in those for 1911 and 1912. During the last year the company extended the mine workings containing No. 1 shaft to a total depth of 450 feet, which is the deepest point to which exploitation has been carried. There is a good showing of ore at the bottom. This shaft has been sunk along a band or lens of nearly solid blende and pyrite that at the surface is 4 or 5 feet thick. Lateral drifts extend from the shaft at intervals of 100 feet, of which the largest on the 350 foot level extends a distance of 542 feet. A second shaft northeast of No. 1 has been carried down to 220 feet depth, along an ore body that is 10 feet thick at the bottom and has been developed for a distance of 175 feet from the shaft.

A few hundred tons of the crude ore were shipped in 1911, but the principal grade is too lean and mixed with pyrite to be merchantable without mill treatment. The company has experimented with a process of magnetic separation and constructed a mill for carrying out the process on a working scale. Up to the present season the experiments have not been thoroughly successful.

Besides the occurrences described, zinc blende exists at a number of localities in the vicinity of the talc deposits in the towns of Fowler and Edwards, St Lawrence county. One of the first discoveries was made on the Balmat place near Sylvia lake, a locality described in the reports of Emmons for the First Geological Survey. It is probable that the blende is accompanied by considerable galena which seems to have been the mineral sought for in the earlier operations. The ore proved too complex to be treated by the methods then in use. Other occurrences in this region are on the property of the Dominion Talc Co., near Sylvia lake, the Streeter farm northeast of the Balmat, the Tamlin place east of the Balmat, the McGill farm 2 miles southwest of Edwards, and the Cole place near the Potter talc mine.

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Appendix 3

Entomology

Museum Bulletin 175

175 29th Report of the State Entomologist 1913

University of the State of New York Bulletin

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New York State Museum

John M. Clarke, Director

Ephraim Porter Felt, State Entomologist

Museum Bulletin 175

29th REPORT OF THE STATE ENTOMOLOGIST ON INJURIOUS AND OTHER INSECTS OF THE STATE OF NEW YORK 1913

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The University of the State of New York
Science Department, January 29, 1914

Doctor John H. Finley
President of the University

SIR: I have the honor to transmit herewith and to recommend for publication as a bulletin of the State Museum, the annual report of the State Entomologist for the year ending September 30, 1913.

Very respectfully
JOHN M. CLARKE
Director

THE UNIVERSITY OF THE
STATE OF NEW YORK

Approved for publication this 8th day of May 1914

President of the University

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29th REPORT OF THE STATE ENTOMOLOGIST 1913

Dr John M. Clarke, Director of the State Museum

I have the honor to present herewith my report on the injurious and other insects of the State of New York for the year ending September 30, 1913.

Two leaf feeders attracted general notice the past season, namely, the apple tent caterpillar and the allied forest tent caterpillar. The former, devouring the leaves of many orchard and wild cherry trees, was easily recognized by the large nests in the forks of the limbs. It was particularly injurious in the upper Hudson and Mohawk valleys. The latter pest, distinguished by the somewhat diamond-shaped, silvery white spots down the back, defoliated extensive areas of oak on Long Island, attacked the sugar maples in the upper Hudson valley and stripped poplars in the Adirondacks. The probabilities of such injuries were foreseen last year and timely warnings issued. A number of rare or particularly interesting species have been observed during the year, and brief notes concerning a number of them are given in the body of the report.

Petroleum compounds as insecticides. The serious condition of many sugar maples, following the application of miscible oils in 1911 and similar trouble in several apple orchards in 1912, was followed up the past season by studies of some cases, which, in connection with certain experiments, have resulted in confirming our opinion as to the cause of the trouble. This is a matter of much practical importance, since the injudicious use of these materials may jeopardize the existence of hundreds of valuable shade or fruit trees. The details of this work are given on subsequent pages.

Fruit tree pests. The studies and experiments of the last four years on the codling moth were continued. Some fruit growers became apprehensive in midsummer of severe injury by larvae of the second brood. Examinations by the Entomologist failed to disclose a substantial basis for such fears, and this opinion was confirmed in October by observations made in the orchards of Messrs W. H. Hart of Arlington and Edward Van Alstyne of Kinderhook. These persons sprayed under strictly commercial conditions and with no expectations that the trees would be subjected to a test later. There was a good crop and it was found that from about 95 to 97 per cent of the entire yield was worm-free as a result of one timely spraying.

A small parasite has been exceedingly abundant and widely distributed in orchards infested by San José scale, and in not a few instances has been an important factor in reducing the numbers of the pest. Observations in typical sections show that in most cases the trees in unsprayed orchards were seriously injured in earlier years and, as a rule, we believe that fruit growers must continue to rely upon applications of lime-sulphur washes for the control of this pernicious enemy.

Injuries by red bugs, Heterocordylus malinus and Lygidea mendax, two very similar appearing species which are known to occur in New York, were so abundant in one orchard near Poughkeepsie that they deformed about one-third of a large crop of greenings. A brief account of this outbreak is given in this report.

The work of the pear thrips, Euthrips pyri, one of the newer fruit pests, was studied in the vicinity of Athens, and a marked localization of injury observed as in earlier years. A detailed account of this insect was given in our report for 1912.

The pear psylla is a pest of considerable importance, especially in the western part of the State, and occasionally very injurious in the Hudson valley. Incidentally, the practical value of late spring applications of a lime-sulphur wash for the control of this insect was demonstrated in a badly infested orchard near Athens.

A new grape enemy, Paracalocoris scrupeus, which may become of considerable importance to growers in the Niagara section, in particular, has been discovered. It may be known as the banded grape bug. Its work is described and a discussion of its habits and the best methods of control are given on subsequent pages.

A number of other insect pests of fruits have been studied and records concerning them are given in a series of classified notes.

Gipsy moth. The small colony of the gipsy moth, discovered last year, appears to have been completely exterminated. This occurrence proves, in a concrete manner, the danger of the insect becoming established in New York territory, and amply justifies the maintenance of rigid precautions to prevent this. Evergreens and shrubbery grown in sections where gipsy moth is known to occur should be examined most carefully, especially in the case of evergreens. The presence of broken egg masses usually means the occurrence of living eggs in the packing material or about the roots of the plants in the same bale or box, and a due regard for the public welfare necessitates the destruction of the shipment or the part of the shipment exposed to infestation of this character.

Brown-tail moth. There is little to report concerning the brown-tail moth, though the danger of its establishing itself in the State has not decreased. It is only a question of time before this occurs. The winter nests are so characteristic that there should be little difficulty in recognizing the pest and at the outset preventing its becoming extremely abundant.

Grass and grain pests. The white grub outbreak of last year has largely abated, partly at least as a result of various natural causes. The studies of last year have been continued. The most interesting development was the discovery of many large beneficial maggots of Promachus fitchii O. S. They were abundant in fields badly infested by white grubs the preceding year, and at the time of observation last spring, nearly free from the pests.

A rare or usually overlooked corn pest, the lined corn borer, Hadena fractilinea, was destructive in Ulster county fields. A full discussion of this relatively new insect is given in the body of the report.

The discovery of the European wolf or grain moth, Tinea granella, in a local seed warehouse adds another to the list of important grain insects. A careful study has been made of this insect and a detailed discussion appears elsewhere.

Shade tree insects. Observations show that the comparative immunity from severe injury by the elm leaf beetle the past season is probably due to the exceptionally cool weather in June, a time when the laying of eggs by this pest is at its height and the period when adverse climatic conditions might be expected to exert a maximum influence. There have been some cases of very severe injury locally here and there, due probably to a decreased vitality of the trees and a speedy destruction of the abnormally small leafage. It is undoubtedly true that the more thorough spraying by certain communities during the last few years has been most beneficial. The apparent check of the past season is presumably temporary and any extended reliance thereupon is inadvisable.

The false maple scale (*Phenacoccus acericola*) has been the cause of a number of complaints, though it has been distinctly less numerous than in recent years. It was extremely abundant during late summer in one locality at Mount Vernon.

The tulip tree scale, *Toumeyella liriodendri*, a pest occasionally numerous, was unusually injurious in the vicinity of New York City. Several natural enemies were noted preying upon this species.

Forest pests. Work has been continued upon the hickory bark beetle, *Eccoptogaster quadrispinosa*, and field observations by the Entomologist lead him to believe that the period of severe injury for the vicinity of New York City has largely passed. His investigations of previous years and the studies of this season indicate the practicability of protecting the more valued trees by applications made shortly after the beetles have entered the bark. The probable efficacy of this treatment by no means lessens the advisability of cutting and burning badly infested wood before the borers can mature and escape.

The extensive plantings of white pine in recent years have given the white pine weevil (*Pissodes strobi*) almost ideal opportunities for multiplication and, as a consequence, there have been numerous complaints regarding the work of this insect. The Entomologist, in cooperation with Mr Waldo C. Johnston of Cooperstown, conducted a practical test of the value of collecting the weevils by hand. It was found that four collections could be made for about $1.25 an acre where the trees were three feet high or less and, as a result, no weevils were to be seen later. There are reasons for believing this to be a practical and possibly a profitable method of controlling the pest in such plantings. It is planned to continue the investigations of this important pest.

Original studies were also made of the spotted hemlock borer, *Melanophila fulvoguttata*, an insect which destroyed several hundred valuable hemlocks in the New York Botanical Gardens, and one which has killed many trees in the Appalachian region. A detailed account of this borer is given in the body of the report.

The rhododendron clear-wing (*Sesia rhododendri*) and the pitted Ambrosia beetle (*Corthylus punctatissimus*) were also studied. The first deforms and weakens the valuable rhododendron, while the latter may destroy a considerable proportion of one or more beds of this shrub.

The work of the two-lined chestnut borer, *Agrilus bilineatus*, a pernicious enemy of both chestnut and oak, was observed in several localities about New York City and appropriate recommendations made. A detailed account of this pest has been given in New York State Museum Memoir 8.

The Entomologist has taken advantage of the recent outbreak by bark beetles, to study the general conditions which may result in serious injury by these borers. A careful examination of weather records, especially those relating to precipitation, tends to support the belief that a series of annual droughts may so weaken the trees as to produce conditions very favorable for the multiplication of the borers. A discussion of the data is given in connection with an account of the hickory bark beetle.

Flies and mosquitos. The interest in the control of the house fly and the subjection of the mosquito has continued. The Entomologist sent out several warning notices early in the year and prepared a brief folder concerning the house fly, which was widely circulated in early summer. He has also participated in several public meetings called for the purpose of arousing interest in the control of both flies and mosquitos.

Gall midges. Studies in this group (Itonididae) have been continued and a number of species and three new genera described. The practical character of this work is illustrated by the description of one midge which is considered a most important natural enemy in controlling the red spider on cotton, and a consultation with Prof. Henry Tryon of the Prickly Pear (traveling) Commission respecting the introduction of certain gall midges into Queensland, in the expectation that they might become important agents in practically freeing large areas from the introduced and obnoxious prickly pear. This report contains a detailed account of a Cactus midge, *Itonida opuntiae*, which may prove of great value in Australia, though regarded as a pest under certain conditions in this country. The rose midge, *Dasyneura rhodophaga*, an important enemy of the rose grower, has caused considerable apprehension in the vicinity of Rochester on account of its injuries to young plants.

Lectures. The Entomologist has delivered a number of lectures upon insects, mostly economic forms, before various agricultural and horticultural gatherings, some of them being in cooperation with the Bureau of Farmers Institutes. Several lectures have also been given under the auspices of local improvement associations.

Publications. A number of brief popular accounts regarding such common pests as the house fly, apple tent caterpillar and forest tent caterpillar have been widely circulated through the press. The more important publications, aside from the report of last year, are: *The Gall Midge Fauna of Western North America; Studies in Itonididae* and several papers describing new species of gall midges.

Removal. The moving of the collections and their establishment in the new quarters in the Education Building involved a large amount of work, which necessarily restricted activities along other lines and must continue so to do until the insects are permanently rearranged. The removal was accomplished with practically no breakage or loss of either specimens or equipment and with comparatively little hindrance to the regular office routine.

Faunal studies. This phase of entomology has received some attention almost from the establishment of the office and has an important bearing upon practical work, since data of this character make possible the fixing of boundaries beyond which there is little probability of injurious species maintaining themselves in numbers. Earlier unpublished studies have resulted in the Entomologist fixing approximate boundaries for the various life zones in the State. It has been his policy for some years to collect in representative areas whenever opportunity offered and much valuable material has been secured in this manner. Collections in the Adirondacks, begun by the late Dr J. A. Lintner, have been continued. The past summer the Entomologist collected in several Adirondack localities, spending four days on or near Mount Marcy, while Assistant State Entomologist Young continued his studies of the fauna at Wells. These data are now being prepared for publication.

Collections. A special effort has been made the past season to secure specimens of the work and early stages of various injurious forms, since biological material is a most important component of economic collections and indispensable in elucidating the habits and life histories of the various species. The State collection now contains a large amount of such material, invaluable because of the associated data. Many microscopic preparations of smaller insects have been made and incorporated in the collections as in earlier years.

Much labor has been expended upon the rearrangement of the collections, an undertaking which has been hampered to some extent by insufficient case or tray room. This work, while time-consuming and in a certain measure unproductive, is a necessary preliminary to effective studies in the future, otherwise more time would be lost in endeavoring to find misplaced specimens than would be required to put the collection in order in the first place.

Material provision for the care of the collections is essential. The pinned insects are in boxes or trays in wooden cases. There are not enough of the former to permit the specimens being properly arranged, and the latter should be replaced by steel cases and more provided to accommodate the additional boxes and trays required. The biological material is in an even less satisfactory state. It is in shallow, wooden trays and difficult of access because of the lack of space. There is need of a modern series of metallic trays for the accommodation of such specimens. Some equally satisfactory provision should be made for the large collection of microscopic slides, many of them containing types of species, and therefore impossible of duplication. The constantly increasing collection of photographic negatives requires a metallic filing case of approved design.

Nursery inspection. The nursery inspection work conducted by the State Department of Agriculture has resulted in the Entomologist being required to make numerous identifications and also advise in regard to the policy which should be pursued by the State. Many of the specimens submitted for name were in poor condition, and as they may represent any stage in insect development and frequently originate in a foreign country, such determinations are laborious and require for their successful prosecution a large collection and many entomological works, both domestic and foreign. The correct identification of such material is very important, since the disposal of large shipments of nursery stock depends in considerable measure upon the character of the infestation.

Miscellaneous. Cooperation with the Division of Visual Instruction has been continued and additions made to an excellent and somewhat extended series of photographs, mostly of injurious or common insects or their work.

General. The work of the office has been materially aided, as in past years, by the identification of a number of species through the courtesy of Dr L. O. Howard, chief of the bureau of entomology, United States Department of Agriculture, and his associates. Several correspondents have assisted by securing valuable specimens, and many have rendered efficient service by transmitting local data respecting various insects. It is a pleasure to note that there has been, as in the past, a most helpful cooperation on the part of all interested in the work of the office.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

October 15, 1913

INJURIOUS INSECTS

CODLING MOTH

Carpocapsa pomonella Linn.

Observations the past season, in continuation of the preceding four years' work with the codling moth, show the efficacy in the Hudson valley of one thorough, timely spraying under normal crop conditions. The tabulation of the results for 1909–12 inclusive, demonstrates the possibility of obtaining over 97.5 per cent of worm-free fruit as a result of one such application.

There appears to be doubt in some quarters as to the feasibility of this method, and for this reason the work has been continued to the extent of keeping watch upon subsequent developments. The same orchards were kept under observation, and on examining the fruit last fall it was estimated that Mr W. H. Hart had obtained in his Titusville orchard, between 97 and 99 per cent of worm-free apples on both Baldwins and northern spys. The orchard contains about 1600 trees and this year will average about 4 barrels a tree. It has been the owner's practice to spray but once a season for the codling moth, which has been the rule for the last five years at least, aside from a few experimental plots in 1909 and 1910. Repeated tests in earlier years show that under the same conditions unsprayed or check trees would have 25 per cent or more wormy apples. This limited amount of spraying not only prevented injury by the codling moth, but checked most other insect pests and controlled whatever fungous diseases may have been present. The apples were large in size, smooth, and of excellent color, while the foliage remained vigorous until the end of the season.

Similar observations in the orchard of Mr Edward Van Alstyne showed a very satisfactory condition, the trees which had been sprayed but once producing 95 per cent or more of worm-free apples, while two rows which received a second treatment in early August for the late brood of apple worms, yielded about 97 per cent nonwormy fruit. In size, smoothness and color, little could be desired, while the trees are in a thoroughly vigorous condition.

The important point in the case of these two orchards is that it has been the practice during recent years to spray but once annually for the codling moth and that, as a result of this minimum treatment, the pest has been controlled very satisfactorily and, if anything, conditions have improved from year to year. The work in each instance was practical in nature. There was no special effort to establish a record, and during the last two years there has been no supervision of the spraying by an entomologist. Both of these orchards are in excellent horticultural condition, though they have received no more treatment in the way of spraying, cultivation and fertilization than their owners considered practical from a financial standpoint. Special effort may be justified when attempting to rehabilitate a run-down orchard; after this has been accomplished the important point is to produce the most desirable results at the minimum expense without incurring undue risk. It is our opinion, so far as the codling moth is concerned, that the one timely spraying with a poison just as soon as possible after the dropping of the blossoms and certainly within ten days of that time, will meet all normal requirements in the Hudson valley.

The data upon which the above conclusions are based have been given in detail in the author's reports for the years 1909–12, inclusive.

LINED CORN BORER

Hadena fractilinea Grote

The yellowish, dull brown-striped caterpillars of the lined corn borer, a comparatively unknown pest, were received from Mr C. B. Schoonmaker, Stone Ridge, Ulster county, under date of June 13th. They were accompanied by a statement to the effect that they were destroying his field corn and that of a neighbor by boring into the heart and killing the stalks. The larva lives upon the tender, small shoots, tunneling the stalks and giving evidence of its presence by making irregular holes in the growing tip. Its manner of work suggests that of a stalk borer.

Studies of this species by Prof. F. M. Webster in 1894 showed that the caterpillar entered the stem at the tip and worked downward, while another related species, H. stipata Morr., begins just above the roots and works upward. Professor Webster also reared another allied form, H. misera Grote, from the caterpillars working in the corn. He was unable to separate the two species in the larval stage and has the impression that the caterpillar of H. stipata Morr. closely resembles that of H. fractilinea.

Description. The adult is one of the smaller of the familiar heavy-bodied, owlet or Noctuid moths with a wing spread of nearly 1¼ inches, a variable purplish brown color, and has on the fore wing a silvery, eyelike spot near the middle and a more or less distinct, irregular, brownish yellow, subapical, oblique band, which latter is continued along the posterior margin to the basal third and there expands into a conspicuous, ovoid area.

The larva, described in considerable detail by Professor Webster, may not be that of this species, particularly as it is somewhat larger (26 mm) than those from which our material was reared, the latter producing only H. fractilinea.

Larva. Length 1.8 cm. Head and thoracic shield mostly pale yellowish. Body mostly a light fuscous yellowish with dull brown, rather broad submedian lines and a narrower, dark brown lateral line slightly broken at the incisures; suranal plate mostly fuscous yellowish, irregularly margined posteriorly with brownish; venter yellowish transparent; mouth parts and eyes light brown.

Life history. Comparatively little is known. The larva may be observed in June feeding on corn, becoming full grown probably the latter part of that month, the moths appearing in our breeding cages July 19th to 21st. Professor Webster obtained them somewhat later, namely, from the last days of July to August 10th. The injury last season was on land which had been plowed the preceding fall, and there is at least a fair probability that the caterpillars winter in the sod much as do those of a number of other Noctuids as well as larvae of Crambids. When the presumably natural food, grass, is destroyed these caterpillars are compelled to eat whatever may be available and, under the conditions outlined above, may seriously injure corn.

Distribution. This species has a wide range, having been recorded by the late Doctor Smith from both Canada and New York in August, Illinois, Vermont, Wisconsin, Nebraska, Colorado and New Mexico. Doctor Holland states that this species is not scarce in the Appalachian subregion.

Preventive measures. Injuries by this insect as well as by allied cutworms and the frequently associated grass webworms, is best prevented by midsummer or early fall plowing (the earlier the better the protection) of grass lands which are to be planted to corn the following season. Doctor Forbes recommends, in addition to the above, pasturing pigs on grass or clover lands to be plowed for corn, distributing by the aid of a seed drill, a line of dry bran or middlings poisoned with Paris green at the rate of 1 pound to 30 pounds of bran, or scattering poisoned food in the spring along the borders of the cornfields next to the grass. It should be unnecessary to add that the use of poisoned baits should be restricted to places where there is no danger of destroying domestic animals. Attacks by this class of pests can also be avoided by arranging the rotation, when possible, so that corn will not follow grass. Planting more than the usual amount of seed may be justified in certain cases, since this procedure might enable the farmer to secure a fair stand in spite of considerable injury.

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EUROPEAN GRAIN MOTH OR WOLF MOTH

Tinea granella Linn.

The discovery of the European grain moth in a local seed warehouse adds another to the list of important cereal pests. This moth

Fig. 1 European grain moth (enlarged, original)

is regarded in England as a most serious enemy of stored grains, and according to Barrett, it may swarm to such an extent near grain warehouses as to excite popular wonder. It certainly produced a bad condition of affairs at Albany in stored sweet corn, reducing the value of hundreds of bushels from $5 to 50 cents.

Historical. This pest was discussed by Harris in 1841, though with no positive statement as to its occurrence in America. Glover studied this insect or one with similar habits in 1854. Chittenden is of the opinion that the species mentioned by Glover is Batrachedra rileyi Wals. It was recorded as being on the wing by Clemens in 1859 and described as T. variatella. Packard, in 1877, classes it as an European importation. In the estimation of Chittenden, none of the above records are free from suspicion of one kind or another. Britton, in 1906, records this insect from Connecticut and states, on the authority of Doctor Howard, that it is known to occur in Canada and Michigan. It is probably distributed throughout the northwestern states.

Description. The moth is a grayish, irregularly dark brown spotted insect having a wing spread of about one-half inch. The coloration is quite variable, though the specimens present a fairly characteristic appearance.

Larva. Length 7 mm. Head reddish brown, the body moderately stout, yellowish white and with sparse pale setae; the true legs and prolegs concolorous with the body.

Cocoon masses. A most characteristic feature of injury by this pest is the peculiar masses of cocoons and frass in the vicinity of infested grain. These masses are about half an inch wide and from three-fourths of an inch to two or three inches in length, irregularly oval and a dull reddish brown color. They are composed of groups of cocoons, the meshes of the latter loosely filled

Fig. 2 Kernels of corn eaten by European grain moth (enlarged, original)

Fig. 3 Cocoon masses and exuviae of European grain moth (enlarged, original)

with brownish, gnawed particles. The light brown pupae, prior to the disclosure of the adult, work about half way out of the masses, and one may frequently see such a mass with ten to fifteen or twenty pupal cases. The groups of cocoons may be so abundant as fairly to plaster considerable areas of adjacent walls.

Life history and habits. This insect is generally credited in Europe with producing two broods annually. The females are said to deposit thirty or more eggs on various grains, the young caterpillars entering the kernels and, in the case of corn, displaying a marked preference for the softer and more nutritious germ. The individual caterpillars may attack several grains and seriously injure or spoil as many as twenty. On attaining maturity they forsake the grain, spin cocoons in masses as described above, and, in the case of the fall brood, winter in such retreats, the moths appearing in early spring.

An examination of conditions in Albany in May 1913 resulted in our finding a number of larvae, both naked and in cases, and numerous recent cocoons on the outside of bags containing seed corn and within the bags, kernels with webbed particles of chewed grain attached thereto, were numerous. These conditions prevailed in a seed warehouse where there was no provision for heating during the winter. At the time of our visit there were thousands of moths upon the walls of the storeroom, two or three frequently within an inch of each other. On one wall there were many of the characteristic cocoon masses described above. Hosts of adults were obtained from material collected at this time, May 20th and 21st, a few issuing as late as June 20th. Attempts to rear the insect were unsuccessful and it was therefore impossible to ascertain the time necessary for the production of a generation, though it would seem probable that breeding might be continuous throughout warm weather wherever conditions were favorable.

Food habits. This insect has been recorded as infesting all kinds of cereal grain, such as wheat, rye, oats and barley. There are records of its having been reared from dried fruits and woody fungus. Kearfott, in Smith's *List of New Jersey Insects,* records obtaining the moths from larvae in tulip and crocus bulbs. Adults apparently indistinguishable from this grain pest have been reared by us from mushrooms.

Distribution. This species is with little question a cosmopolitan form and is likely to appear wherever grain is shipped or handled in quantities, especially if it be stored at moderate temperatures for a considerable period. It has been recorded in literature from western-central Europe, northern Persia and Japan, North Africa, Australia and North America.

Control measures. This species, like other cereal pests, is more likely to cause trouble in warehouses or other places where grains are held at moderate temperatures for extended periods. Seed houses are particularly liable to infestation if stock is carried over from season to season. The most obvious remedy is to avoid holding grains and seeds liable to attack, longer than necessary. This should be supplemented by care in cleaning out crevices or preventing the accumulation of grains in situations where the moths can breed unchecked. These measures should ordinarily suffice. Occasionally it may be necessary to resort to fumigation with either carbon bisulphid or hydrocyanic acid gas. A badly infested building might require several treatments, and owing to the habits of the pest, it is obvious that not much reliance can be placed upon fumigating the infested grain itself, since the insects leave it in large quantities prior to changing to the moth. It may, in some instances, be necessary to provide nearly gas-tight rooms for the storage of grain, so that in cases of serious infestation the apartment and its contents can be easily and safely fumigated. Another method of obtaining the same end is by making provision for heating storage quarters to a temperature of 120 degrees and holding it there for at least 30 minutes. This has been tried on an extensive scale in flour mills with very satisfactory results. It is perhaps needless to add that the resistance of seeds to this treatment should be carefully ascertained before the method is extensively used in seed warehouses.

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Below are given a few of the more important references to American literature relating to this species:

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RHODODENDRON CLEAR-WING

Sesia rhododendri Beutm.

Wilting or yellow rhododendron leaves are signs which may indicate the work of the whitish caterpillar of this species, particularly if the evidences of injury are confined to a branch or portion of a stem. This borer limits its operations largely to stems or branches a foot or more above the ground. It appears to be generally distributed in the New York Zoological Park as shown by specimens forwarded by Mr Herman W. Merkel, and Mr G. P. Engelhardt of the Children's Museum informs us that it is common in and about Prospect Park, Brooklyn. The species has also been recorded from Cheltenham, Pa., and, according to its describer, is closely allied to S. pyri Harr. and S. scitula Harr.

Habits and life history. The young larva frequently works just under the bark and in the sapwood, excavating an irregular, longitudinal, more or less frass-filled gallery some 3 inches in length and terminating in an irregular, oval, sparsely silk lined cell about three-eighths of an inch long where the insect evidently hibernates. This borer shows a marked tendency to excavate one or two broad, short, transverse galleries, possibly designed to girdle the infested twig partly and thus reduce its vitality.

This species has been studied by Mr Engelhardt, who has kindly placed at our disposal the following notes respecting its life history. The moths begin to emerge during the last week of May but more generally appear during the first half of June. Eggs are deposited singly on small twigs, though on the trunks and branches of large plants they occur in numbers in close proximity. The larva at first attacks the inner bark, working gradually through the cambium layer into the sapwood, forming irregular galleries 1 to 2 inches in extent. Late in August the young larva is about one-half grown, and the last of October many may be full size. The larva remains dormant within its gallery during the winter and early in the spring begins to prepare a place for pupation. This consists of a tunnel reaching from a lower chamber in the sapwood, up through the outer bark, leaving a thin, circular layer at the opening through which the imago can easily escape. The larva incloses itself in its lower chamber within a slight cocoon composed of small chips of wood and silk. The change to the pupa takes place in May, this stage lasting about fifteen days.

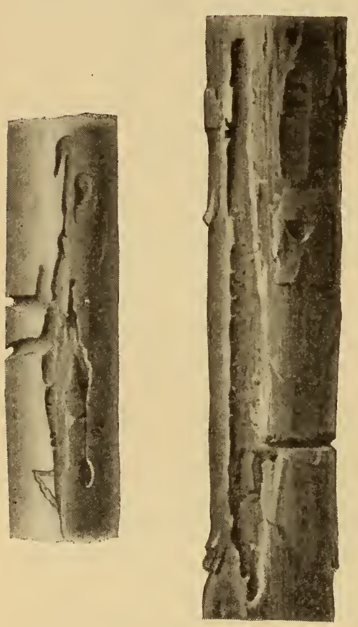

Fig. 4 Work of rhododendron clear-wing borer in stems (natural size, original)

Young plants or small twigs are frequently girdled and soon wilt and die. Larger stems are more resistant, but on account of the preference of the insect for places previously attacked, the injury increases from year to year and eventually results in death. Large plants show ugly scars on the trunk and branches. These may be either devoid of bark or loosely covered with dead and perforated pieces. There may also be more or less fine, yellow, granular, not powdery borings thrown out by the caterpillars. The plants are rarely injured within one foot of the ground.

Mountain laurel and azalea are also attacked, though according to the observations of Mr Engelhardt only when they grow with rhododendrons.

This insect is subject to attack by a parasitic wasp, apparently a species of Macrocentrus which Mr Engelhardt reared from infested branches. The downy woodpecker destroys many of the larvae, though not without inflicting deep wounds which may result in more injury than that caused by the operations of the insect.

Description. Larva, partly grown. Length 8 mm, diameter 1.3 mm. Head yellowish red, the anterior portion and the mouth parts a variable reddish brown. Antennae biarticulate, light reddish brown; eye spots dark brown. Thoracic shield semitransparent. The body sparsely and finely haired, smooth, and mostly whitish transparent, except for the reddish brown intestinal contents; terminal segment yellowish transparent and bearing a series of moderately stout, yellowish brown hairs; true legs yellowish brown; prolegs on segments 3 to 6 whitish transparent, the hooklets light brown, the anal pair apparently rudimentary.

Control measures. The most effective method of controlling this insect is to prune out thoroughly and burn all dead or infested portions of bushes during the winter or fall. If it is desirable to preserve large plants, Mr Engelhardt suggests first scraping the injured portions and then applying a coat of thick tar paint, one application in the fall as a repellent to woodpeckers, and another in the spring, preferably in late April or early May, to prevent the emergence of the moths.

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AZALEA LEAF SKELETONIZER

Gracilaria azaleae Busck

1914 **Busck, August.** Insec. Inscit. Menstr. 2:1–2.

Several complaints were received during the winter of 1911 from men interested in greenhouses in Yonkers and Rochester, to the effect that azaleas were being seriously injured by a small caterpillar. Mr August Busck of the United States National Museum, a specialist in the Microlepidoptera, concluded that the species was not of European origin but represented a new American form.

Life history and habits. The small, yellowish, nearly full-grown caterpillars only about one-fourth of an inch long, usually turn over the tip of an azalea leaf, webbing it down with fine, silken strands and eating away the tissues of the infolding under side. The injured portion turns dry and the retreat contains numerous small, black particles of frass. The young larvae are probably miners in the leaf. The whitish, silken cocoons in which the final transformations occur, are frequently made on the leaves close to the affected area, though an occasional cocoon is spun under the partly rolled leaf tip. Moths were reared March 25, 1912 and, judging from reports received from various persons, it is probable that breeding may be more or less continuous under the usual greenhouse conditions.

Description. The parent insect is a delicate moth with a wing spread of only about three-eighths of an inch. The forewings are yellowish, with large, purplish areas and a series of purplish dots along the costal margin of the broad, yellowish portion. The hind wings are slender, light pearly gray and long-fringed. This species, according to Mr Busck, is allied to G. violacella Clem.

Larva. Length, one-fourth of an inch. Head unusually large, depressed, yellowish, the mouth parts well developed and the eyes apparently represented by a large, circular, brown spot. Thoracic legs well developed. Thorax yellowish and with the region just above each leg marked by several distinct swellings. Abdomen apodal, yellowish, and with a distinct though irregular fuscous band on the penultimate segment.

Cocoon. This is nearly one-fourth of an inch long, about three-thirty-seconds of an inch in diameter and faintly suggests the familiar Bucculatrix cocoon, though there are no distinct longitudinal ribs. It is a well-defined, thin, silken structure usually lying longitudinally on the under side of the leaf and frequently covering more or less of the mined area.

Remedial measures. Treatment with tobacco preparations, either by fumigation or spraying, appears to be a very effective method of controlling this insect, since practically no caterpillars were to be found in greenhouses after such treatment. It is not known whether spraying or fumigation gave the best results.

ARBOR VITAE LEAF MINER

Argyresthia thuiella Packard

The small caterpillar of the arbor vitae leaf miner limits its operations largely to mining the terminal sprays of arbor vitae foliage and causing the latter to turn brown. There is, as a rule, more disfiguration than damage, since there is generally only a small portion of the foliage involved.

Habits and life history. Early last June our attention was called to the work of this insect (kindly determined by Mr W. D. Kearfott) by Mr Henry Hicks, Westbury, N. Y., because of its being so numerous that the browned, mined leaves rendered many ornamental arbor vitae unsightly and therefore unsatisfactory. Occasionally this insect may become so abundant as to affect a considerable proportion of the foliage and give infested trees a rusty, brown appearance. The operations of the pest are usually confined to a terminal half inch of leaves here and there, and sometimes its work is so restricted as to involve only one-half of a portion of the leaflet. Transformation to the pupa occurs in the mine, the moth emerging therefrom about the midde of June, the dates in our rearings ranging from the 9th to the 17th. There seems to be an erroneous association by Packard of this adult with a cocoon and, with this in mind, there may be a question as to his having described the true larva of this species. Kearfott[1] states of a closely allied species, Recurvaria thujaella Kear., that the eggs are deposited in the summer, the young larvae begin mining the leaves of the preceding year and eventually transform within the mines, the moths appearing in June. We found nearly full-grown larvae next to the green portion of browned leaflets October 14th and have reared this species from the leaves of Juniperus utahensis, kindly forwarded by Prof. E. Bethel of Denver, Col. This is probably a fairly correct outline of the life history of the species under consideration. A. thuiella has also been reared, we are informed by Mr Kearfott, by the late Professor Slingerland. A parasite, Pentocnemus bucculatricis How., kindly determined by Messrs Howard and Crawford, was reared from leaves infested by this leaf miner.

Fig. 5 Spray of arbor-vitae showing tips injured by the leaf miner (natural size, original)

[1] 1903, N. Y. Ent. Soc. Jour., 11:154–55.

Larva. Length 2.5 mm. Head a variable yellowish and dark brown, mostly the latter, the mouth parts yellowish brown. Thoracic shield pale brownish yellow with an irregular, quadrate, median area a variable dark brown. Body smooth, a nearly uniform yellowish white, the anal shield fuscous yellowish, with irregular, dark brown areas on the median line anteriorly and sublaterally posteriorly. Moderately long, sparse, whitish hairs occur on both the head and body. True legs and prolegs pale yellowish, the hooks of the latter yellowish brown.

Described from living caterpillars October 14, 1913.

Remedial measures. The cutting off and burning of the infested leaves during fall or early spring would undoubtedly result in destroying many of the pests and, if persistently followed up, might prove the most satisfactory method of controlling the insect. It is very possible that thorough spraying with a contact insecticide, such as black leaf 40 (diluted approximately 1 to 800) to which soap has been added to increase its adhesiveness, would prove effective if the application were made early in July for the purpose of destroying the young caterpillars before they are well sheltered by the leaf tissues.

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WHITE GRUBS AND JUNE BEETLES

The extensive injury of last year by white grubs was followed by a considerable disappearance of the pests last spring, due in part, at least, to the activity of natural enemies and the influence of other adverse factors. It would appear from conditions as they now exist that comparatively few white grubs will be found in the soil in 1915, owing to the fact that no very large number lived through the season and could therefore be expected to appear as beetles in the spring of 1914.

Observations of 1913. A sample digging in a slight hollow on the farm of Mr W. S. Miller, East Greenbush, included approximately one and one-half square feet and uncovered nine nearly full-grown white grubs, four adults of Lachnosterna fusca Froh. and the cocoon of a parasite, probably that of Tiphia inornata Say. Most of the insects were found at a depth of approximately 15 inches. A second sample digging near the first resulted in securing five full-grown grubs and two Tiphia cocoons. A third digging comprising about 1 square foot produced only three grubs. The occurrence of a few beetles in these and other diggings suggests the possibility that a few individuals of L. fusca may complete the life cycle in two years, as Davis has found to be the case with L. tristis Fabr.

The most interesting development of the season was on the farm of Mr Jesse Weaver in East Schodack. Here were found, April 24th, large numbers of a stout, white maggot, the larvae of a bee fly or a robber fly. The abundance of this enemy is evidenced by the following data. The turning of four furrows each a few feet long and in a field badly infested with white grubs the preceding season, resulted in finding one adult, Lachnosterna fusca, nine white grubs, four Tiphia cocoons and twenty-six of the Dipterous maggots. The white grubs and the maggots occurred at an approximate depth of 4 to 6 or 7 inches. The above numbers are fairly indicative of the relative abundance of the grubs and maggots. The latter were mostly moderately large and stout, though a few were about half the size of the larger ones. Practically all were in a vigorous condition and were most abundant in portions of the field which had been very badly infested by white grubs the preceding season. They were presumably important factors in destroying these grass pests.

Similar conditions obtained June 18th in an adjoining field belonging to Mrs Kane. There was, as in the other case, a marked restriction of the maggots to grass areas which had been seriously affected by white grubs the preceding season and, as a rule, where maggots were numerous few white grubs were to be found, while the latter were relatively more numerous where there were no maggots. The most obvious explanation of this condition is that the parent flies oviposited freely in the badly infested areas, and as a result most of the white grubs were destroyed, while the sparsely infested parts of the field were largely overlooked by the flies, and as a consequence the grubs were relatively more abundant last spring. The probability of these maggots preying upon white grubs was well shown by the fact that in one box a maggot was observed actually attached to a white grub, while in other instances there was a marked mortality among white grubs confined in breeding jars in which there were a number of these Dipterous larvae. The proportion of the two forms is shown by a collection of seventy-nine maggots and fifty-five white grubs as a result of following the plow for less than two hours. There appeared to be no difference between these maggots and the ones collected in April, and an examination of a breeding jar July 21st showed a continuation of the larval existence. September 13th maggots were again found on the farm of Mr Weaver and adults of Promachus fitchii O. S. were reared in April 1914, indicating a three year life cycle.

Larva. Length 2.5 cm, diameter 5 to 6 mm, whitish or pale yellowish white, slightly thickened near the middle and tapering somewhat toward both extremities, especially posteriorly, the segmentation distinct. Head small, partly retracted, brown to dark brown, approximately conical, the prominent mouth parts forming the anterior half; mandibles stout, slightly decurved, tapering to an obtuse extremity and practically inclosing the slender, minutely and retrosely barbed, lancetlike maxillae; antennae inserted at the base of the mandibles, short, stout, biarticulate, the basal segment disk-shaped, the apical one narrowly oval; a slender seta above and near the base of the antennae; clypeus V-shaped; the epicranium with an irregular series of stout, proclinate setae. Body walls firm, slightly wrinkled, shining. A well-developed circular spiracle with two slitlike orifices occurs near the posterior fourth on the first body segment, and larger spiracles near the middle and subdorsally on the penultimate segment, the latter circular and with but one orifice; terminal segment tapering, broadly rounded, with two pairs of sublateral slender setae near the anterior third and two pairs of submedian setae at the posterior extremity, one pair being just above the lateral line, the other just below; ventral surface of the last two segments excavated to form a median elongate rounded depression, margined laterally and posteriorly by broadly rounded ridges.

SPOTTED HEMLOCK BORER

Melanophila fulvoguttata Harr.

Early last spring our attention was called to dying hemlocks in the New York Botanical Garden, and an investigation showed a serious infestation by the spotted hemlock borer. Dr W. A. Murrill, acting director, stated that five hundred dead trees had been cut out during the past two years, most of them probably having been killed by this insect. Dying hemlocks were also noted in adjacent territory and at Tarrytown, the trouble in some instances, at least, being due to the operations of this insect. The severity of the attack was such that one hundred and twenty-seven beetles and seventy-two parasites were reared from a section of a log about 2½ feet long and 12 inches in diameter. The tree from which this was cut was infested from the very base of the trunk nearly to the top, the inner bark of the lower portion being badly riddled by the galleries.

This insect is credited by Burke with having caused the death of a large amount of hemlock timber throughout the Appalachian and Northeastern States. About 1900 we received reports of dying hemlocks from near Syracuse. An investigation of burned areas in the Adirondacks during early July 1903 showed that beetles were then ovipositing in dying and dead trees on tracts near Big Moose which had been swept by fire April 30th. An examination on August 10th resulted in finding some trees, untouched in July, infested by the borers. This species has also been recorded from spruce, though no records of serious injury by it to this tree have come to our notice.

Description. The beetle is about three-eighths of an inch long and has a dark metallic color with grayish reflections above the mouth. The head, thorax and wing covers are marked with somewhat coarse, irregular, transverse punctures slightly resembling the graining of morocco leather. Each wing cover bears three more or less distinct, nearly circular or lenticular-shaped, yellowish or white spots.

Pupa. Length, three-eighths of an inch, moderately stout, flattened, and of the ordinary Buprestid shape. The older pupa shows a distinct infuscation of the eyes, labium, mandibles and the basal portion of the anterior and mid tibiae. The nearly mature pupa shows most of the color of the beetle, the wing covers apparently darkening last.

Larva. Length five-eighths of an inch, white, moderately slender, the second thoracic segment distinctly enlarged and with yellowish brown thickenings dorsally and ventrally. The mouth parts of the head are more or less fuscous.

Life history. The beetle is mostly a midsummer species occurring in New York State the latter part of June and during July, though Dr A. D. Hopkins records taking the adults in West Virginia late in March and during May, June and July. Specimens reared under insectary conditions began issuing April 4th, appeared in numbers April 17th to 28th and continued to emerge until May 14th — a total of nearly seven weeks. Beetles in the State collection and taken in the open bear dates from the last of June to the latter part of July.

The eggs are evidently laid in crevices of the bark, sometimes in pairs, since the young larvae make slender, sinuous galleries diverging from one point in the inner bark, the presumably common entrance of the two. The older larvae excavate broader and more irregular, partly frass-filled burrows which frequently run into each other and most effectively girdle badly infested trunks. Our observations indicate a preference on the part of the insect for the thicker bark of the lower portion of the tree, since the borers in this latter situation were nearly twice the size of those found under the thinner bark of upper part of the trunk. It is

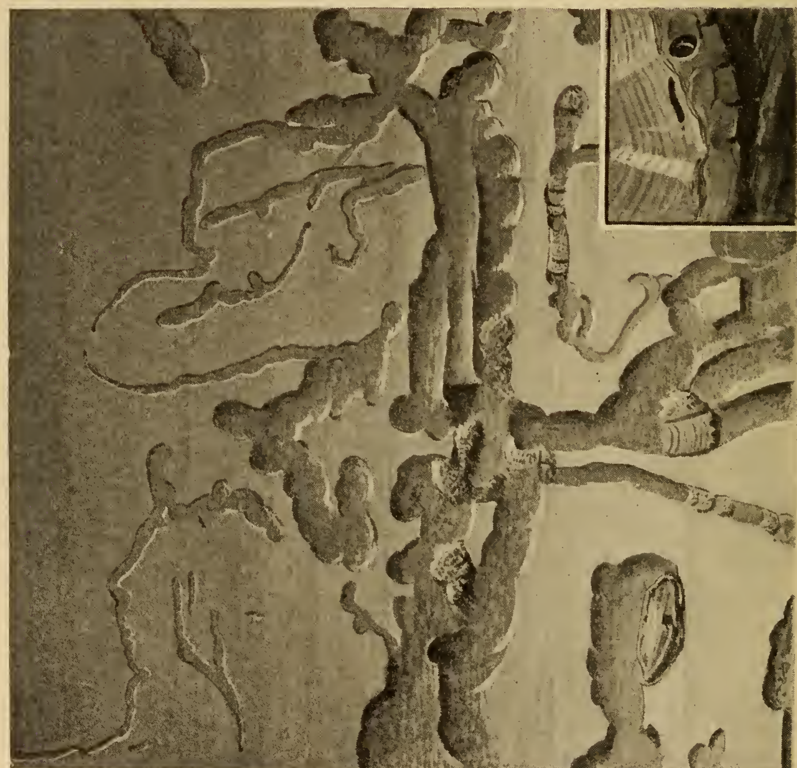

Fig. 6 Work of spotted hemlock borer; note two galleries originating from near a common point; galleries of adult and larva in section shown in upper corner (natural size, original)

possible that the latter come from later deposited eggs. The full-grown larvae winter in the galleries and in the spring pupate in shallow cells excavated in the outer bark. The beetles emerge through obliquely oval holes with a major diameter of about one-eighth of an inch.

Distribution. This species occurs throughout the middle and northern part of the United States, being very abundant about Lake Superior, according to Le Conte. It has been taken by Mrs Slosson on Mount Washington and appears to be prevalent in the Appalachian region.

Parasites. The material obtained from New York, as noted above, produced a considerable number of parasites, by far the most abundant being Odontaulacus bilobatus Prov., the exposed pupae of which may be found in small cells within the bark. The light brown, narrowly oval, papery cocoons about one-half an inch long, of Bracon pectinator Say, were found singly or in clusters in the galleries of this insect and the adult reared. A third parasite, Spathius trifasciatus Riley, was also obtained. The borings of this beetle were inhabited by the pinkish larvae of a gall midge, Camptomyia tsugae Felt. This latter species occurred in some numbers and probably subsists upon the dead or decaying woody tissues. Aulacus abdominalis Cress., Bracon pectinator Say and Eupelmus cleri Ashm. have been reared by Doctor Hopkins from wood infested by this borer. He also took upon the infested bark, specimens of Xylonomus insularis Cress.

Control measures. The most effective method of checking this borer under ordinary conditions is to cut out all dead or sickly trees and burn the thicker bark, at least, during winter or early spring. Hemlocks injured by fire or wind storms, after April 1st, may well be left as trap trees and removed the following winter.

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WHITE PINE WEEVIL

Pissodes strobi Peck

The extensive planting of white pines in the reforestation work of recent years has produced conditions very favorable for this weevil, since the pest breeds by preference in vigorous shoots of trees 2 to 10 or 15 feet high. The species is widely distributed and quickly establishes itself throughout even large plantings. There appears to be no practical way of preventing this invasion of reforested areas. The beetles feed upon the vigorous shoots of the previous year's growth, placing their eggs in shallow pits just under the bark. The white, brown-headed grubs hatching therefrom soon destroy most of the vital tissues, killing many leaders and practically ruining the young trees.

Signs of injury. A serious infestation is liable to result in many leaders turning brown and dying in early July. Affected shoots have the inner bark and more or less of the sapwood riddled by irregular galleries partly filled with borings. The first evidences of attack in the spring are drops of resin or pitch exuding from small punctures made by the beetles, the severity of the damage depending upon the extent of feeding and the number of eggs deposited. An examination of a recent planting at Cooperstown, N. Y., July 8, 1913 showed all gradations of injury from wilting leaders to those which had been entirely destroyed. Occasionally a young tree bore pitch masses an inch or two below the uppermost ring of branches, and in such cases the leaders were usually infested. In cases where the injury extended for perhaps 3 or 4 inches along the stem there was a distinct shortening of the new growth with a corresponding massing of the needles. This looked a little as though there might have been a fungous infection, though an examination showed that the trouble was with little question due to the work of the weevil. Unless the grubs are numerous enough to girdle the leaders partly, there seems to be a fair chance of the shoot recovering from the attack and developing satisfactorily the following year.

Description. The parent insect is a snout beetle about one-fourth of an inch long, reddish brown to dark brown, with a peculiar whitish spot near the posterior third of each wing cover and white mottlings upon the sides and the legs.

The globular eggs are whitish transparent, about one-sixteenth of an inch in diameter, and are placed just under the bark.

The grubs are moderately stout, white, footless borers, with a brownish head, and when full grown are about three-eighths of an inch long.

The creamy white pupa is about one-quarter of a inch long, white, except for the dark brown eyes and the brownish tips of the jaws. It may be easily recognized by the stout beak lying against the breast. The tip of the last abdominal segment bears a pair of slender, curved spines. As the pupa attains maturity the color of the beetle begins to appear.

Life history. The weevils commonly winter in any available shelter and, according to observations upon allied forms abroad and in this country, it is probable that the beetles live two or three years, depositing eggs each season. The latter are usualy placed in the leading shoots during May and June. An examination at Cooperstown May 21, 1913 showed that many of the leading shoots bore feeding punctures and a number of eggs were found, although the season was cold and backward. The eggs are said to hatch in from six to ten days, and the small, white grubs at first feed upon the inner bark and sometimes extend their operations down to portions of the stem two years old. At Cooperstown July 8th there were numerous full-grown grubs in the cells and about 10 per cent of the shoots in the planting had been killed. The grubs are sometimes so numerous in a stem as fairly to riddle the inner bark and, in some instances, there is hardly room enough for the oval pupal cells, each about one-quarter of an inch long. The beetles escape from the shoots the latter part of July through to early September. It is well known that the weevils persist throughout the season, they being more abundant, according to our collections, from the

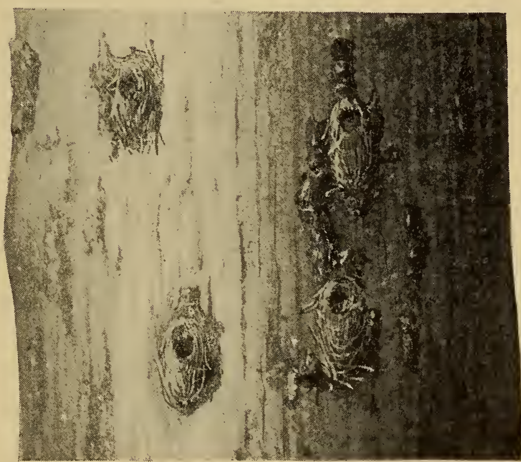

Fig. 7 Pupal cells of white pine weevil (natural size, original)

middle to the latter part of June and from the 9th to the latter part of August. This pest displays a marked preference for the more vigorous leaders of white pine, though it also attacks pitch pine and spruce.

Natural enemies. This borer is preyed upon by woodpeckers and a number of parasitic insects. The latter should be protected and allowed to escape wherever practical.

Preventives and remedies. Cutting out and burning the infested leaders in midsummer, if systematically followed, will result in material benefit. It is well to delay this operation until pupae have begun to develop, since it will then be easier to recognize the infested leaders and there will be little or no danger of weevils escaping. Generally speaking, from the middle to the latter part of July will be the best time for this work. The infested shoots should be placed in a barrel laid upon its side, or other receptacle, and the open end covered with ordinary wire screen (one-tenth inch) fine enough to prevent the escape of the weevils and yet allow the issuance of parasites. It is desirable to leave these infested tips among the trees so that the parasites will have less difficulty in finding their natural prey.

The difficulty with the procedure described above is that one generation at least is allowed to injure the trees before much is accomplished. Earlier collecting in the field showed a surprising scarcity of weevils on trees which had been systematically gone over. The fact that adults may live two or even three years and deposit eggs each season, makes it even more desirable that they should be destroyed early. It is comparatively easy to beat the weevils from small trees into a moderate to fair sized insect net. In cooperation with Mr Waldo C. Johnston of Cooperstown this method was tried on an area of fifty acres set with about 60,000 pines. The work was started a little late, namely about May 21st, and the trees carefully collected over four times at intervals of approximately four or five days, each. At the outset two to four weevils were caught on each tree, and toward the last only one or two insects for each row of probably 400 trees would be obtained. The cost of these four collections amounted to $64 or only $1.28 an acre. An examination July 8th resulted in our not being able to find any weevils on the pines. It is very probable that three collectings, particularly if the first was a little earlier, namely the first or second week in May and the other two at about ten day intervals, would have resulted in capturing most of the weevils at a comparatively slight expense. The probabilities are that relatively few insects will occur upon the trees another season and only one or two collections may be necessary to secure practical immunity for the planting until the trees attain a size which will make them immune from serious injury. There is no reason why, with improved devices, the cost of this operation could not be materially lowered.

HICKORY BARK BORER

Eccoptogaster quadrispinosa Say

The operations of the destructive hickory bark borer have been followed another season in the vicinity of New York City, and it is gratifying to state that in a general way the injury has not been so severe as in 1912. This is probably due in part to natural causes, since several localities were found the preceding season where the young grubs had evidently been destroyed by natural agents. In some instances this beneficial result was undoubtedly due to the activities of a small parasite and in other cases only Dipterous maggots, possibly a species of Medeterus, were found in the otherwise empty galleries.

Last season some adults were observed near New York entering the trees and laying eggs about July 10th, and an examination July 16th, of two hickories with trunk diameters of approximately 7 or 8 inches showed that practically all the leaves of one tree had wilted and those of the upper portion of the other. This injury was so general that it could not be attributed to petiole infestation. An examination the next day on Long Island showed other trees in a similar condition. In this latter case the galleries of the larvae extended from one-half to one and one-fourth inches from the parental burrow. In both cases the trees had been attacked by so many insects that they were speedily girdled, and an examination of the Bronxville trees September 24th showed that both were dead, although they were in excellent condition the preceding summer. There was no evidence of any material injury to these trees prior to 1913.

Continued work with remedial applications has shown little or no material injury from the use of a 10 per cent Barcurol solution upon the trunk, and decided benefit so far as destroying beetles, eggs or young grubs are concerned. This treatment, in order to be most effective, should be made as soon as possible after the beetles have entered the tree, otherwise there is danger of the grubs working so far into the tissues as to be unaffected by the insecticide.

Inasmuch as the beetles may attack trees in force during a period of several weeks, it is obviously desirable to watch closely for the appearance of the pest.

Through the courtesy of Mr Herman W. Merkel, forester of the New York Zoological Park, we were allowed to examine some small hickories treated with 25 and 50 per cent solutions of Barcurol, and also one painted with the undiluted material. It was found that the 25 per cent solution caused little injury to the tissues beyond the area traversed by the borers, and that a considerable proportion of the grubs was destroyed. The 50 per cent solution and the undiluted material, however, penetrated the galleries readily and then soaked to a depth of half an inch or so into the inner bark and sapwood and laterally to a distance of one and one-half inches from the gallery. It is therefore obvious that the stronger preparations can hardly be advised for this purpose.

Drought and borer injury. Serious injury by the hickory bark borer began to develop at Geneseo in 1898, and by 1900 many trees, located for the most part on moderately low, naturally moist soil, had died. Unfortunately, weather records for that locality are not complete. It is worthy of note that at nearby Avon from April to June 1896 there was a deficiency of over 1 inch for each of these months, the record being as follows: April, 1.05; May, 1.98; June, 1.97 inches. Approximately the same conditions obtained in 1897, the precipitation being, April, 1.21; May, 1.75 and June, 1.96 inches. These figures should be compared with the normal precipitation for these months, which is: April, 2.09; May, 2.64 and June, 3.22 inches. The total precipitation for this year was only 20.36 inches, while that for 1899 was but 19.35, the normal being 29.46. The data are not so extended as could be desired, but are nevertheless somewhat suggestive.

The outbreak by the hickory bark beetle in New York and vicinity began about 1908 and had greatly extended its area and become rather general by 1912. An examination of the weather bureau records in New York City shows an interesting condition. From 1906 to 1912 inclusive there has been a deficient rainfall except for the year 1907 alone, at which time there was an excess of only half an inch. The total deficiency during this period amounted to 28.56 inches. The most marked deficiency for any year was in 1910, with a precipitation 8.75 inches below the normal, a reduction of approximately one-fifth. A scrutiny of the monthly precipitation shows that in 1906 the scarcity of rainfall occurred mostly from

June to September, there being during these months from an inch to nearly an inch and a half less than the normal precipitation. The next year, 1907, although there was a slight increase in the annual precipitation, there was a considerable shortage for the months of July and August, this amounting respectively to 3.36 and 2.05 inches. In 1908 there was a shortage of 1.56, 1.99 and 1.79 inches for the months of June, September and October respectively. The following year, 1909, there was a scarcity of rain during May, June and July, amounting respectively to 1.46, .09 and 2.56 inches, there being an excess of 3.41 in August, and a shortage in September of 0.93. In 1910 there was a shortage in May of 1.52 inches, an excess in June of 1.84 and a shortage in July, August and September amounting respectively to 4.31, 2.40 and 2.16 inches. The slight excess in June could hardly offset the large deficit of July and the continued scarcity in August and September. Again, in 1911 there was a deficient precipitation in May, July and September, amounting respectively to 2.27, 2.99 and 2.08 inches, while in 1912 there was a deficiency from June to September, amounting to 2.09, 1.28,. 1.76 and 0.21 inches, for the four months in the order named.

It will be noted from the above facts, although the deficiency during this period was not as a whole very excessive, it was progressive and the shrinkage in rainfall almost invariably came during the growing months and at times most likely to affect vegetation adversely. The general result in this region was abundantly evidenced by the unfavorable condition of the trees throughout the section, it being particularly marked in 1910 and 1911 and was accompanied by an abnormal scarcity of water. Many cities and villages in this general region suffered about this time from a severe shortage of water. A number of trees, particularly soft maples and others standing in naturally moderately moist, low localities, died, the major cause probably being scarcity of moisture.

With the above facts in mind, it seems very reasonable to believe that these unfavorable climatic conditions may have reacted upon our hickories, reducing their normal resistance considerably and resulting in conditions which were extremely favorable to the multiplication of bark borers and the subsequent destruction of many trees which would otherwise have survived.

There are doubtless other factors which may be primary in bark borer attacks, especially in extended forest areas. Fires, wind storms and injudicious cutting may precipitate an outbreak by producing conditions favorable for the development of hosts of these insects. Such is very likely to be followed by attacks upon trees which, under normal conditions, would escape unharmed. Causes such as those just mentioned are rare in the less thickly wooded and more settled sections where extended, close stands of timber and extensive logging operations are almost unknown. It is in just such regions as these that severe droughts are most prevalent and injurious, and in such localities it seems very probable that a great scarcity of moisture for an extended period may be an important primary cause in inducing serious injury by bark borers.

PITTED AMBROSIA BEETLE

Corthylus punctatissimus Zimm.

The work of the pitted ambrosia beetle is indicated by wilting or dead shoots easily broken off near the surface of the ground and revealing a series of blackened, closely set, nearly horizontal galleries some one-sixteenth of an inch in diameter and frequently containing, especially in the vertical brood chambers, stout, cylindric, black beetles about one-eighth of an inch long. This borer, working, as it does, at the base of the shoots, weakens the entire stem, while the rhododendron clear-wing, noticed elsewhere in this report, may limit its injuries to portions of a shoot and its galleries are rarely within a foot of the ground. The hybrid rhododendrons appear to be exempt from attack.

Injuries. An examination September 24th of conditions on the estate of Mr C. H. Matthiessen, Irvington, N. Y., showed that portions of rhododendron beds 50 to 150 feet in length which, it was stated, had earlier been in a thriving condition, and standing from 3 to 5 feet high were then in a very unsatisfactory condition. Few of the shoots were over 2 feet in height, there were open places here and there and sickly or wilting shoots were plainly in evidence. Mr Matthiessen stated that this trouble has been apparent upon his place for several years and that, in his opinion, much of the injury due to this beetle had been blamed by growers, upon drought and other untoward conditions. The stems attacked varied in diameter from approximately half an inch to an inch or an inch and one-fourth. Specimens received from Mr Charles Goodyear, Rockwood, Tarrytown, showed that this borer is also at work there, though examinations of rhododendrons in the New York Zoological Garden and in Prospect Park, Brooklyn, have failed to reveal the presence of this beetle.

There is an extremely interesting record of injury by this species in 1882. Dr C. Hart Merriam states that about the first of August he observed that a large percentage of the sugar maple under growth in Lewis county appeared to be dying, the leaves drooped, withered, finally shriveled and died. Most of the seedlings attacked were about a half an inch in diameter. He estimated that hundreds of thousands of young sugar maples were killed in that locality. This outbreak was evidently sporadic in nature, since there have been no records of serious injury subsequently.

Description. The original description of this borer is as follows:

Long. $1\frac{1}{4}$ lin. Short, thick, compressed, shining black, antennae and feet ferruginous; front glabrous; prothorax roughly tuberculate in front, shining behind, with fine sparse punctures; elytra punctured strongly, but not in rows, behind rounded, without furrows or teeth.

Dr A. D. Hopkins, in describing the allied C. columbianus Hopk. states that in C. punctatissimus the head of the female is deeply and coarsely punctured in front, the declivity of the elytra plain, and that the middle and hind tibiae have only three teeth near the tip.

Galleries. The beetles enter the side of the stem at or below the surface of the thick mulch, through a circular hole about one-sixteenth of an inch in diameter. This may be more or less oblique and opens into a more or less regular series of circular, closely placed, horizontal galleries. These latter may be so numerous as to leave only a very thin shelter of bark with a little of the outer sapwood externally and almost no direct longitudinal wood fibers between the outer and the inner horizontal galleries. From each of these galleries there are a series of vertical brood chambers, each about one-eighth of an inch long, and there is usually one or more vertical or nearly vertical galleries which may lead to a lower or upper series of workings, not infrequently both. These galleries may be easily recognized by reference to the figure, on account of their regular plan and the characteristically blackened walls. The operations of this insect are confined to parts of the plant within 3 inches above the ground, and so far as our observations go, do not penetrate the roots, though the lowest galleries may approach very closely to the crown.

Life history and habits. The life history of this species has not been worked out in detail. Dr C. Hart Merriam first studied the insect in sugar maple and has faithfully described its method of work. It is perhaps significant that his attention was not attracted to the operations of the insect until early in August. Dr E. A.

Schwarz studied the operations of this insect in the common huckleberry and states that it occurs here and there in huckleberry beds and is apparently very local. His explanation for this condition is that the beetles are probably subterranean, appearing only rarely above the ground, apparently being very much at home in the soil. He states that the adults winter either in the larval chambers or special hibernating galleries. He found as many as fifteen larval cells in one stem. Dr A. D. Hopkins records adults and pupae of this species August 19, 1893 in Wisconsin, while our observations the latter part of September 1913 resulted in finding no larvae and only a very few pupae, most of the insects having changed to adults. An examination of one rhododendron stem only half an inch in diameter resulted in finding twenty-four brood chambers opening from one series of galleries. Two and three series of galleries in stems of this size or larger, should mean fifty to seventy-five beetles, respectively. This gives an idea of the prolificacy of the insect and explains the death of badly affected shoots. A practical point in regard to this insect as a rhododendron enemy is that its operations appear to be confined largely to shaded localities where there is an abundant mulch. Sunny, grassy areas which obviously afford comparatively little shelter are practically free from injury. Doctor Hopkins points out that not all shrubs attacked by this beetle succumb, since he has found galleries of this species deeply imbedded in growing wood, an indication of infestation years before. This is probably true of only the slighter infestations and does not necessarily apply to rhododendrons.

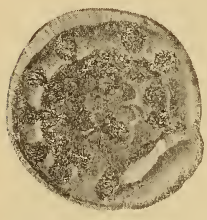

Fig. 8 Transverse sections of rhododendron stem showing work of pitted ambrosia beetle (natural size, original)

Food plants. This borer has been found in sugar maple (*Acer saccharum*), sassafras, dogwood (Cornus), water-beech (Carpinus), ironwood (Ostrya), hazel (Corylus), huckleberry (*Gaylussacia resinosa*), and Rhododendron.

Distribution. This borer appears to be widely distributed, it having been recorded from points in the eastern, middle, southern and western United States.

Remedies. The most obvious method of control is to cut out the wilting infested stems and burn them. Care should be taken to avoid breaking the shoots at the point of injury and thus allowing a number of the beetles to fall out of the galleries and make their way to nearby stems. Systematic cutting out of weakened plants is advisable in most cases and, as a rule, no special expense will be necessary to check this pest.

Bibliography. An extended bibliography accompanied by a record of distribution and food plants is given in Museum Bulletin 134, page 91, to which the reader in search of further information is referred.

CACTUS MIDGE

Itonida opuntiae Felt

Species of Opuntia, the flat-leaved, oval cacti, not the columnar forms, may be injured by the deep red larvae of the cactus midge and most seriously affected by a bacterial or fungous trouble which gains access to the inner tissues through the injuries. The fungus or bacterium is by far the most destructive and is apparently dependent for favorable media, so far as cacti are concerned, upon the work of the midge larvae.

Signs of injury. Infestation is first indicated by an indistinct swelling, usually at the base of a spine, presenting so few characteristics that the person in charge of the plants and therefore familiar with the work of the insect, could not be certain of the presence of maggots without cutting into the tissues. This swelling gradually becomes somewhat larger and eventually an opening appears. The maggots work themselves out and either crawl down the plant or drop to the ground. The desertion of the cacti is followed by an infection which results later in a copious exudation of a mucilaginous fluid or sap which hangs in irregular masses an inch or so in length (pl. 15, fig. 2). This infection is followed by the slow death of the affected lobe and may eventually result in the destruction of portions of the plant or even entire plants. In some instances the work of the maggots is inhabited by a small Ptinid beetle belonging to the genus Catorama.

Early history. This pest was first brought to our notice in 1909 by Mr George V. Nash, head gardener of the New York Botanical Gardens. The species, according to his statements, occurs in Opuntia banburyana from Italy and an Opuntia from the British West Indies. Not much further was heard of this insect until 1913, at which time it was characterized as a very serious pest in a valued collection of cacti. Earlier it was thought that this midge might be American, since the original distribution of the host plant is limited to America, though subsequent statements would seem to indicate that this insect may possibly be Italian in origin. Mr

Becker, connected with the New York Botanical Garden, states that some recent cuttings received from Italy and kept in a house well separated from previously infested material, was found after a few weeks to be infested by this midge. This is suggestive, though not necessarily conclusive, evidence as to the original home of the insect.

Life history. Conditions in the cactus house indicate that this species may breed almost continuously throughout the winter months, and there would seem to be no reason why this process might not continue during the summer if the plants were not exposed to too low temperatures. The midges may be observed in the greenhouses, flying around the plants and alighting on the pots or the cacti. They do not seem to make their way to the windows and there was no evidence of their being captured in spider webs. A cactus lobe, apparently in a healthy condition, was cut into and the interior found to be fairly honeycombed by the maggots. The larvae, on attaining their development, emerge from the plants and may be found lying on the surface of the soil in the pots or in the coal ashes covering the benches. The transformation to the pupa and emergence of the adults occur in these situations without any difficulty.

An effort was made to ascertain the duration of a life cycle but without much success, since the midges do not appear to thrive under ordinary cage conditions, although a small greenhouse is well adapted to their requirements. Infested cacti were received and placed in a large breeding jar March 10th, adults emerging therefrom as follows: April 15th, 1; 21st, many; 23d, 12; May 9th, 8; 10th, 10; 12th, 5; 16th, 3; 17th, 4; 19th, 12; 21st, 5; 22d, 3; 23d, 24; 27th, 8; 28th, 2; 29th, 4; 31st, 11; June 2d, 4; 4th, 9; 5th, 5; 7th, 4; 9th, 3; 11th, 2; 13th, 7; 25th, 2; 26th, 1; July 11th, 6; 12th, 3; 14th, 4.

A distinct periodicity will be noted in the appearance of the midges, in that they were much more abundant April 21st and 23d, May 19th and 23d. There was apparently no breeding in this jar, aside from the larvae already in the soil and the plants attaining maturity. If this be the case it would appear that under certain conditions a generation may extend over a period of four months, the flies issuing at irregular intervals. This periodicity in the appearance of the midges was also observable in the greenhouse, and in at least one case numerous midges appeared in both at the same date. There may be a period of nearly three weeks between the time the larva leaves the plant and the issuance of the imago, since on March 14th, one larva and a pupa were placed in a tumbler with a little sand and on the 3d of April a midge issued. It is possible that this period marks the duration of the pupal stage.

Description. The larva is about one-eighth of an inch or 3 mm long, rather stout, deep red and with a well-developed bidentate breastbone.

The midges are delicate, dark reddish brown flies, the male having a length of about 1 mm, the female 2 mm. Technical descriptions of both sexes have been published by the author.

Remedial measures. This pest appears to have been controlled by thorough and repeated fumigation with hydrocyanic acid gas, during a period of about three months, beginning March 1st and continuing until the weather became so warm that the ventilators of the greenhouses were kept open. Dr A. B. Stout has kindly given me the following summary of the treatment: "The greenhouse was closed about 5 o'clock, three stone jars containing 175 cc of 25 per cent sulphuric acid (1 part acid of 1.84 specific gravity to 3 parts water) were placed at equal distances in the greenhouses. In each of these was dropped a paper bag containing 45 gramms of potassium cyanide, 60 per cent strength. These bags were dropped in quickly, the doors securely closed and the fumigation continued until the next morning, and the greenhouse was thoroughly ventilated for a few minutes. The house contained about 1600 cubic feet, hence the treatment was about one-third the strength usually recommended for fumigation." It was stated that not only did the fumigation destroy the midges, but it appeared to have a paralyzing influence upon the larvae lying upon the surface of the soil and they seemed unable to survive the daily treatments. The cacti showed no ill effects and an examination of the plants as they were brought in this fall, indicated entire or nearly entire freedom from this midge.

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BANDED GRAPE BUG

Paracalocoris scrupeus Say

A new pest of the grape apears to be developing in the western part of the State, since the young of this species have been found by Mr L. F. Strickland, damaging fruit of Campbell's Early and Worden grapes in the Niagara district.

Evidences of injury. Irregular blasted clusters (plate 16) and minute, black spots on the affected fruit are the most apparent signs of injury. This damage may be so general as to include entire clusters, portions of clusters or limited to berries here and there on the bunches. The owner estimated that half the crop was lost in one vineyard. The injury is caused by a young, greenish brown and white-marked bug (easily recognized by the white-banded antennae and legs), about one-sixth of an inch long, the adult, appearing later, being one-fourth of an inch long, brownish gray in color and somewhat resembling the very common tarnished plant bug. The two insects are related and appear to have somewhat similar habits.

Early history and depredations. Very little is known concerning this insect. It was described in 1831 by Thomas Say, with no more precise indication of its habitat than "United States." It has been taken by Mr E. P. Van Duzee during June and July about Buffalo. The late Dr J. B. Smith records it from Staten Island and several New Jersey localities.

The following observations by Mr Strickland give an idea of its potentialities. In one instance he noticed a good thrifty vine with fifty-two clusters formed, all of which had been destroyed by the bug. The tabulation given below shows in more detail, conditions which may obtain in fields infested by this pest.

Injury by banded grape bug

NUMBER OF BUNCHES COUNTED	NUMBER OF GRAPES DESTROYED	NUMBER OF GRAPES MATURING
1	13	44
1	36	39
1	40	38
1	36	41
1	24	91
1	51	90
1	54	14
2	All	None
1	46	94

The above data, omitting the two bunches which were entirely destroyed, shows that nearly 40 per cent of the fruit on the clusters counted had been ruined. Mr Strickland believes this bug to be causing serious damage to Campell's Early grapes throughout the region. The work of this species was observed in the vineyards of Messrs S. C. Treichler, Sanborn and F. L. Young, Lockport, the insect having apparently become established in the latter vineyard.

Niagara grapes, even when growing among Campbell's Early, appear almost exempt from the trouble.

Life history and habits. The young bugs or nymphs cause most of the injury in early June, blasting blossoms and the young fruit by sucking the sap. They attain maturity early in July and the winter is presumably passed in the egg stage as in the case of the allied tarnished plant bug. It is possible that this insect can maintain itself in vineyards where no other food plant is present. It has been recorded from both sumac and the bladder nut, Staphylea.

Description. The adult, kindly determined by Mr E. P. Van Duzee, has been characterized briefly above and the original description is reproduced herewith.

Body black. Head with a dull yellowish line and superior orbits, variegated at the mouth and beneath. Antennae, first joint more than half the length of the second, and rather robust, hairy; second joint a little thicker at tip. Thorax yellowish, anterior margin, two dots, and a slight dot near the posterior angles black; scutel yellowish, dusky on the middle of the base and on the basal angles. Hemelytra immaculate. Feet with minute, pale points.

Length to tip of hemelytra nearly one-fourth of an inch.

This species is said by Van Duzee to be very variable. He states that the most abundant form in the vicinity of Buffalo is the pale or ochreous variety generally taken on Staphylea. There is another variety, possibly a distinct species, which has the pronotum black with the narrow edge and three longitudinal vittae ochreous.

A detailed characterization of the nymph is given below.

Nymph. Length 4 mm, width 1.75 mm. Antennae about as long as the body, the basal segment rich brown and thickly set with short, stout setae, the second segment more than twice the length of the first, the distal two-thirds dark brown and thickly setose, the basal portion white, the third segment about half the second, the basal portion white, the distal dark red, sparsely setose, the fourth segment one-third longer than the third, brownish yellow, each segment more slender than the preceding. Face short, roundly triangular, the base of the rostrum sparsely setose; occiput a variable yellowish green with indistinct brownish markings anteriorly; eyes reddish brown. Mesonotum mostly yellowish green, the anterior and posterior lateral margins a variable fuscous. Wing pads greenish basally, reddish brown apically and extending to the third abdominal segment. Abdomen dorsally with the basal segment greenish, the succeeding segments to the sixth greenish and variably mottled sublaterally with dark reddish brown, the distal segments dorsally dark reddish brown, except for an indistinct oval median area apically, which is mostly green; the entire dorsum of the body rather thickly set with short fuscous setae. Legs; femora mostly dark reddish brown, variably mottled with whitish; dorsally and basally greenish, the posterior with an indistinct irregular, greenish band near the middle dorsally; tibiae, the basal fourth similar to femora, the second and distal fourth white, the third fourth dark reddish brown; tarsi, the first segment and basal half of second white, the distal half of the second and claws dark brown; venter a nearly uniform pale green, except for a variable striping or marking laterally, that of the thorax rather narrow and dense, while on the abdomen it is broader and diffuse; terminal segment yellowish orange with dark reddish brown markings laterally.

Remedial measures. The most promising method of controlling this insect in vineyards where its abundance justifies such measures, is spraying with black leaf 40, using 1 quart to 200 gallons of water to which is added soap for the purpose of promoting distribution and adhesiveness. The spraying should be early in June, possibly earlier in order to destroy the young nymphs before they have an opportunity of causing much damage. Particular pains should be taken to cover the vines thoroughly with the spray, especially the lower inner portions which are most likely to shelter the insects.

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THE USE OF MISCIBLE OILS ON TREES

There have been during the last three years some exceptionally unfortunate developments following the application of miscible oils to trees, especially sugar maples. Some have questioned the possibility of oil being the principal cause of the trouble, and since the matter is of considerable importance and may involve the life of highly valued shade trees, observations of earlier years have been continued and are given in some detail below. The data, in our estimation, abundantly justify a refusal to recommend these materials as applications to dormant sugar maples and warrant the employment of cautions couched in no uncertain terms concerning their employment in a similar way for other trees. It is axiomatic that the remedy should not be worse than the disease.

LARGER SUGAR MAPLES AND MISCIBLE OILS

The behavior of the sugar maple commonly found on roadsides, after applications of certain oily compounds, is so characteristic that there should be little difficulty in recognizing the cause of the trouble. A sugar maple at Port Chester, N. Y., having a trunk diameter of about 8 inches was examined July 16, 1913. Nearly all the lower limbs were dead and a few brown leaves were hanging here and there. This tree, we were informed, was sprayed the last of the preceding November or early the following month, with one of the commercial miscible oils diluted at the rate of 1 to 15. It was the intent of the operator to spray the entire tree thoroughly, but in practice there is little question but that more of the insecticide was thrown on the lower portions of the tree — the parts dead at the time we saw the tree — than higher up. Observation showed at once that it was in a vigorous condition last year, and an examination of the foliage, limbs and trunk failed to disclose any adequate cause for the trouble, such as insect enemies or fungous diseases. The hanging leaves showed that the foliage started on the dead limbs and if subsequent developments had been closely followed, there are good reasons for believing that the leaves became unhealthy, thin, pale, then brown spots appeared and there was serious drying, which was followed by the assumption of a rather dark brown color and usually by the dropping of many of the leaves. This showed first on the seriously injured parts, that is places to which considerable oil was applied and where the bark was thin enough so as not greatly to hinder penetration to the underlying living and necessary vital tissues. This latter was indicated first by brown spots in the inner bark, these discolored parts becoming deeper, extending in area and eventually including all the inner bark and most of the outer active layers of wood. There was then a gradual progressive dying from the points where the tissues had been killed. This latter means the death of limbs and branches above the injury and may involve considerable below, unless the tree possesses sufficient vitality or so little oil has been applied that the maple is able to prevent further invasion of its living tissues. The more vigorous vital portions below may produce suckers, though in some instances even these may succumb later. The injury does not necessarily involve all the lower branches; it may be limited to a few on all sides of the tree or to several on one side, the determining factor, in our estimation, being the amount of oil applied locally. There may be a late dying of individual branches and there are good reasons for believing that not all the injury may become apparent at the end of the first or even the second season following the application.

Other changes may occur in conjunction with the death of the limbs. The bark on the trunk, especially if this be smooth and comparatively thin, may be so seriously affected that large areas die. July 16th, the bark on the trunk of one tree and at the base of the affected branches was badly cracked, these cracks being 12 to 15 inches long. September 24th there was a white fungus showing at the base of the lower limbs and also on the trunk to a distance of about 4 feet from the ground. An examination at this later date showed that considerable areas of the bark on the trunk were dead and loose, though the cracking was in an incipient stage. Some of the bark on the base of the larger affected limbs was loose and nearly ready to drop. The trunk of the tree at this time had been entered by a number of Ambrosia beetles, the insects unconsciously giving testimony to the dying or dead condition of the underlying tissues.

SIGNS OF OIL INJURY

Severe injury following application of oil preparations appears earlier in the season than that due to drought and, as pointed out above, is frequently limited to the lower branches, a condition almost never seen in the case of trees suffering from fungous affection, insect attack, drought or other adverse conditions. The injury may be comparatively slight and followed by enlarged lenticels, the discoloration, death and cracking of the outer layers of the bark and, in some instances, accompanied the first season by abnormally large, dark green leaves. The point of injury is definitely indicated by the abundance of sap in the lower parts of the affected tree, the death of the middle portion and a gradual drying out of the terminal parts above the injury. The dead leaves usually have a darker brown color than those on the limbs suffering from drought, sun scald or similar affections. An examination of the inner bark of affected limbs shows a well-marked, girdled or dead area from which point there may be progressive dying in both directions, much depending upon the severity of the injury.

Young fruit trees may have the bark badly blistered in late spring and early summer, the underlying tissues being soft and evidently unhealthy. The death of affected trees or parts of the same may occur the following spring, drag through the summer or be deferred for a year or more. Only recently our attention was called to some trees in an unsatisfactory condition, the owner blaming this upon the painting of the trunks with petroleum some ten years earlier. In the case of very severe injury even the buds may fail to develop the spring following the treatment, or the vital processes may be arrested by the time the leaves are one-fourth grown.

NOTES FOR THE YEAR

Two rare scale insects were found the past season. The first was the inconspicuous Aspidiotus osborni New. & Ckll. on white oak at Scarborough. It has not been previously recorded from the State. The second was Pulvinaria acericola Walsh on flowering Cornell, Cornus florida, at Tarrytown. Both species were relatively abundant on their respective food plants, though apparently causing no material injury. Another scale insect worthy of mention is the Pseudococcus ledi Ckll., which was found abundant upon Ledum by Prof. C. H. Peck at West Sand Lake, N. Y.

Fig. 9 Regal rose gall (natural size, original)

The peculiar regal rose gall, Rhodites gracilis Ashm., was received September 13th from Mrs E. P. Gardner, Canandaigua, who found it in numbers on Rosa blanda. This is not only a new species for the State, but appears to be the first precise locality and food plant record for the species.[1] Another interesting though extralimital insect gall, that of Dryocosmus favus Beutm., has been identified in the collection. It was found by Mr W. H. Leivelsperger at Fleetwood, Pa., August 26, 1908.

The balsam plant louse, Mindarus abietinus Koch., has been unusually abundant and injurious in a number of Adirondack localities. The spruce gall aphid, Chermes abietis Linn., is very prevalent and frequently seriously deforms infested trees. A related gall insect, Chermes floccus Patch, was received August 23d from Mr John Nill of Star Lake and also from St Huberts, the galls being numerous in both places. This latter is another new record for the State.

[1] 1907 Amer. Mus. Nat. Hist. Bul. 27:645–46.

The spruce bud moth, Tortrix fumiferana Clem., was very abundant in the Adirondack region and the tips of many trees were browned as a consequence. The moths were flying in numbers at Westport early in August. Though this insect has been extremely numerous at times, we have yet to see evidences of serious injury as a result of its work. This species was reported as extremely abundant in several Maine localities by correspondents of the office.

Gnophomyia tristissima O. S. was reared June 8, 1912 from larvae found at Albany under decaying willow bark. In the State collection there are specimens taken at Albany September 11, 1902, at Poughkeepsie June 8, 1902 and one captured by Mr C. P. Alexander at Johnstown August 31, 1907.

The striking Psilocephala melampodia Loew was reared May 1, 1911 from a white larva about 1 inch long and tapering at both extremities, found under badly decayed pine bark at Albany.

FRUIT TREE PESTS

Apple tent caterpillar (Malacosoma americana Fabr.). The extended depredations of this common insect have been more disastrous than in 1912. Wild cherry trees in the Hudson valley, Mohawk valley, portions of the Adirondacks and in other sections of the State were often defoliated, while all too frequently many of the trees in apple orchards were stripped of their leaves. The latter was so general in some sections as to result in the loss of practically the entire apple crop. Furthermore, these trees are in no condition to produce fruit another year, although a fairly good second crop of leaves was developed. It is perhaps unnecessary to state that damage of this character was confined to unsprayed trees. The probability of severe injury was announced last winter, and it would have been comparatively easy to have checked the pest early by timely spraying with a poison. The characteristic brownish egg belts of this pest are about half an inch long and wherever they are moderately abundant on the smaller twigs, a recurrence of the outbreak may be expected.

This insect is rather easily controlled in several ways. It is not difficult to detect and remove the egg belts in winter, especially on small to moderate sized trees. The nests of the young caterpillars are fairly conspicuous before any material damage is done, and they can be quickly removed with a stiff, conical brush attached to a long pole, a procedure far preferable to the more popular burning of the nests. The latter permits many of the caterpillars to escape and at the same time is likely to result in injury to the limb. Better than either of the preceding is early and preferably systematic spraying with a poison such as arsenate of lead, using a standard preparation at the rate of 2 to 3 pounds to 50 gallons of water. In the case of badly infested trees it may be advisable to make this application just after the leaves appear, though as a rule the one thorough spraying recommended for the codling moth and given just after the blossoms drop, is ample to prevent injury by this tent caterpillar as well as to take care of the apple worm. The cutting out of wild cherry trees along roadsides and fences is an important preventive measure, because such trees and bushes are a favorite breeding place for the pest.

Plum curculio (Conotrachelus nenuphar Hbst.). An interesting modification of habit was caused by a late frost last spring, killing the plums locally at Nassau. As a result, the curculios attacked and severely injured a large setting of young fruit on an adjacent crab apple tree, though comparatively few of the grubs developed successfully. This tree, in earlier seasons when plums were available, was practically free from curculio injury.

Pear thrips (Euthrips pyri Daniel). This new pest, noticed in detail in the preceding report,[1] was abundant in the vicinity of Hudson and was controlled for the most part by thorough and timely applications of a tobacco extract. In some orchards there was an unusually large drop of young pears, presumably caused in part at least by the injuries inflicted by this small insect when laying its eggs in the stems. The same marked restriction to certain localities or portions of orchards observed in earlier years was noted the past season. This pest is an extremely local one and operations against it should be regulated accordingly.

The most evident signs of the insect's presence are the sticky buds, the brown, blasted appearance of the blossom buds and an unusual drop of bud scales followed later by small, crinkled, spoon-shaped leaves. In the earlier part of the attack a slender, dark brown insect only about one-twentieth of an inch long may be seen upon the opening of the fruit buds and especially in crevices between the stems of the partly expanded fruit clusters.

In the case of badly infested orchards it is advisable to delay the winter treatment with lime-sulphur wash for San José scale until the buds have started and then add to this preparation a

[1] 1913 N. Y. State Mus. Bul. 165, p. 70–74.

tobacco extract such as black leaf 40, 1 to 800. This will destroy many of the thrips before they have had an opportunity to find shelters in the buds which have opened just sufficiently so that they can make their way down between the stems of the young fruit. Later, if the insects are numerous, it is advisable to spray with the tobacco extract at the above given strength just as soon as the young pears have separated sufficiently so that the thrips at the base of the stems are exposed. This application, in particular, should be directed so that the spray will be driven down into all the crevices of the fruit clusters. Another spraying with the tobacco extract may be advisable after the blossoms fall. This insect works so rapidly and seeks shelter so persistently that timeliness is a prime essential of the spraying.

False red bug (Lygidea mendax Reut.). This pest appears to be on the increase, and last summer was so numerous in an orchard near Poughkeepsie as to deform and practically ruin one-third of a good crop of greenings. Fortunately for the owner there were many apples on the infested trees, and the dwarfing and dropping of so much fruit was not so serious as it might have been under other conditions. The red bug injury, according to observations made by Mr C. S. Hubbard, begins on the fruit produced by the late blossoms in the center of the tree, and from these shelters the insects gradually work outward. The young apples are frequently pierced to the core. As they develop, depressions with pithy centers extending deep into the tissues may be noted and there is a marked irregularity in the shape; many of the apples are dwarfed and drop about midsummer. The insects rarely attract notice; the young bugs are bright red in color and shelter themselves largely in curled leaves, producing conditions resembling a serious plant louse infestation and with ill-defined, brown spots on the leaves, suggestive of sun scald, or on tender foliage there may be a discoloration resembling that produced by the four-lined plant bug, Poecilocapsus lineatus Fabr., on currant leaves. Small apples are seriously affected by the feeding punctures as described above, the earliest evidence of injury being a slight exudation accompanied by a local discoloration and hardening. The full-grown bugs are shy and not easily captured.

Both of the red bugs are about one-quarter of an inch long and have the same general shape as the common and well-known tarnished plant bug, Lygus pratensis Linn. They may be easily recognized by their red color, the young being a brilliant red and somewhat resembling large plant lice, except for the absence of the conspicuous cornicles or so-called honey tubes. The adult red bug may be recognized by the sprinkling of fine, whitish scales on the head, thorax and wing covers, the dark or fuscous area anteriorly on the pronotum and the absence of a fuscous margin posteriorly — characters absent in the adult lined red bug. Practically speaking, there seems to be little need of differentiating between the two species, since their habits are so similar and control measures almost identical.

These two plant bugs are widely distributed in New York State and appear to have spread to the apple from the thorn apple or Crataegus. The eggs are laid in late June or during July in the bark, usually two year old wood, and do not hatch until after the leaves of the fruit buds are open, in the case of the red bug; those of the false red bug hatching about a week later. The young pass through several stages, those of the two species resembling each other closely and attaining maturity in June.

These pests appear to be very susceptible to tobacco preparations, since experiments have shown that a black leaf extract diluted 1 to 65 or black leaf 40, 1 to 800, will destroy the young. The first application should be made just before the blossoms open and the second with the usual spray for the codling moth, the only additional expense being the addition of the tobacco extract to the poisoned fungicide usually employed. Where practical it is suggested that the winter application for San José scale be delayed as late as possible and three-fourths of a pint of black leaf extract added to each 100 gallons for the purpose of destroying red bugs as well as the San José scale. This treatment would also be very effective in checking plant lice. It is quite possible that the tobacco added to the codling moth spray would, under most circumstances, be all that would be necessary to prevent material injury by either of these pests.

Comparative descriptions of the adults of these two species with observations upon their habits are given in the 26th report of the State Entomologist (Museum Bulletin 147) and Prof. C. R. Crosby of Cornell University has published a detailed account of the two forms, illustrating the various stages, in Bulletin 291 of the Cornell University Agricultural Experiment Station. The readers desiring additional details are referred to these two publications.

Pear Psylla (*Psylla pyricola* Riley). The pest was rather abundant last July in orchards in and about Barker, especially where there had been some slackness in treatment. The foliage in some orchards was seriously blackened as a result of sooty fungus developing in the honeydew exuded by the Psyllids. There is decidedly less injury, as a rule, by this insect in the Hudson valley than in western New York, though it occasionally becomes excessively abundant locally in the eastern part of the State.

The efficacy of a late spraying with a standard lime-sulphur wash for the control of this insect was well shown in a previously neglected and consequently badly infested orchard near Athens. Psyllas had been numerous and at the time of spraying (April 17th-19th) most of the adults had disappeared and the small, yellowish eggs were abundant on many twigs. The one spraying at this time practically annihilated the pest in that orchard, only a very few insects being seen throughout the summer.

The control of this insect is greatly aided by keeping the rough bark scraped from the trunks of the older trees, thus materially reducing the number of winter shelters for the "flies." Summer applications of a contact insecticide, such as a tobacco extract, are sometimes necessary.

Plant lice were somewhat abundant, especially on young trees, early in the season, probably because of the cool, backward weather. In some instances the foliage on shoots 10 to 12 inches long of small trees was nearly covered with the pests. Mr W. H. Hart of Arlington reports plant lice almost absent from young trees which had been very badly infested the preceding season and had then been thoroughly sprayed with a whale oil soap solution used at the rate of 1 pound to 12 gallons of water.

A number of natural enemies were observed preying upon plant lice, such as the black grubs of the two-spotted lady-beetle, *Adalia bipunctata* Linn., the white-tufted larvae of *Hyperaspis signata* var. *binotata*, and the varicolored larvae of Syrphid flies, were very serviceable in checking the injury, especially as the weather became warmer about June 20th or a little later. In some instances it was found advisable to spray with contact insecticides rather than to rely upon the beneficial action of natural agents.

San José scale (*Aspidiotus perniciosus* Comst.). As a rule this insect has not been causing appreciable injury in orchards systematically sprayed, though occasionally neglected trees become very badly infested. The experience of the past season shows that even under such conditions, one thorough application will check the pest in a most effective manner.

The Entomologist supervised the spraying of a neglected and badly infested pear orchard early in April. One of the standard concentrated lime-sulphur washes was used and an effort made to do very thorough work, though owing to the softness of the ground, the height of the trees and a moderately high wind, conditions were not so favorable as they might have been. Some of the trees were in such bad condition that large limbs were dead or nearly so as a result of the infestation, and many of the smaller limbs were fairly incrusted with living scale. The one treatment resulted in practically cleaning up the pest.

An examination last August on another farm showed an equally satisfactory result under different conditions. Owing to certain unfavorable developments the preceding year, it was impossible to spray the apple orchard under consideration and, to make matters worse, the treatment of the preceding year or two had not been any too thorough. As a consequence, in August 1912 many of the trees were very badly infested, the limbs being literally covered with scale and a number of branches dying. Last fall the pest was so prevalent that the owner even refused to sell the fruit for cider apples. This orchard was sprayed last fall and again in the spring with a standard lime-sulphur wash and, as a result of the treatment, very little scale was to be found last August, aside from a scattering infestation on an occasional limb. Most of the fruit was so clean that there was no reason for suspecting the presence of the insect. These results were secured on moderate sized apple trees about twenty years old and with a trunk diameter of 6 to 8 inches.

Several small four-winged parasites became exceedingly abundant in a number of badly infested orchards in various parts of the State. A personal investigation in several Schodack, Stuyvesant and Poughkeepsie orchards showed these beneficial insects generally distributed and in several localities very abundant. The latter was confirmed by an examination of representative limbs. One twig only an inch in length and five-sixteenths of an inch in diameter had 184 exit holes. In another case it was estimated that 85 per cent of the scales had been destroyed by parasites, though owing to the natural variation in the degree of infestation and the fact that parasitism is not easily ascertained prior to the emergence of the adults, it was impossible to do more than make an approximate estimate. The appearance of parasitized scales is shown on plate 15, figure 1.

A tabulation of our rearings shows Prospaltella perniciosi Tower to be a well-distributed and rather abundant parasite, it emerging from collected material from the latter part of November into the following February and constituting over 85 per cent of the total parasites bred. The next species in importance is Aphelinus fuscipennis Howard, which appears to have an equally wide distribution and prolonged breeding season and constituted about 12 per cent of the total parasites reared. Coccophagus immaculatus Howard was obtained in small numbers, and the same is true of Chiloneurus species and Psyllaephagus species. The last named, however, was reared in late January and early February from only one lot, in unusually large numbers, which latter would seem to indicate that under certain conditions it might be much more efficient than the two preceding.

It is certain that parasites of the San José scale were much more abundant than has been observed before in New York State. Several of these small forms are generally distributed, and in 1900 the late Dr J. B. Smith expressed the belief that Aphelinus fuscipennis Howard, a species which he reared in numbers, was established in New Jersey wherever San José scale had obtained a foothold. The same year the late Prof. W. G. Johnson reared thousands of this little insect from infested twigs collected in Maryland orchards and advised correspondents not to burn branches and twigs from infested trees during the fall and winter and thus allow these minute insects an opportunity to escape in the spring. This is sound advice and we would recommend such procedure in all cases where parasites are found to be present in any numbers.

The fact that parasites of the San José scale have been so abundant the past season, by no means justifies the abandonment of spraying, or even the relying in considerable measure upon the good offices of these insects. It should be remembered that in most cases the parasites become numerous enough to control the scale only after the trees have been seriously injured. The middle portion of one orchard, approximately a third of it, where parasites were abundant, had been almost ruined by San José scale and severe injury was not uncommon in others. The probabilities are at least fair that the parasites will not be so abundant another season and they may not render any material aid in controlling the scale for another decade. Their appearance in extraordinary numbers the past season may have been due in part at least to unusually favorable climatic conditions. We have repeatedly investigated earlier statements to the effect that the San

José scale was dying out locally and, prior to last summer, were unable to find evidence of any material control through the agency of parasites. These small insects are sufficiently important so that their development should be carefully watched and an effort made to estimate their true value as natural checks. It should be remembered that these insects have been known to entomologists practically since the introduction of the scale in the eastern United States and the cases of material benefits resulting from their presence are comparatively few.

For the present at least, we would not hesitate to advise continued spraying for the control of San José scale, a treatment which in most cases is profitable, even though the trees are not badly infested; since if a lime-sulphur wash is used, valuable fungicidal effects are secured as well as protection from a number of insect pests.

Variegated cutworm (Agrotis saucia Hubn.). Under date of July 15, 1913 Mr J. A. Thompson, nursery inspector of Rochester, N. Y., forwarded specimens of this cutworm, accompanied by the statement that they were feeding on clover and fallen apples. Specimens of the latter were received and from one-half to two-thirds of the fruit, which attained 2 inches in diameter, were eaten away in a very irregular manner. There was no evidence to show that these cutworms, although known to be of climbing species, had ascended the trees and attacked the fruit while still hanging.

SHADE TREE PESTS

Elm leaf beetle (Galerucella luteola Müll.). The destructive work of this pest has been greatly checked in many localities during recent years, by thorough and systematic spraying. Indications early last spring were favorable for very severe injuries to unsprayed trees, as the beetles appeared early and fed vigorously. There was a period of exceptionally cool weather in June, the thermometer dropping to 40 degrees on the 9th, 44 on the 10th and to 47 on both the 8th and the 11th, the mean during this four day period being 64 on the 11th, 58 on the 10th, 54 on the 8th and 51 on the 9th, while the maximum was 80 on the 11th, 72 on the 10th and but 62 on both the 8th and 9th. It appears quite possible that this unseasonable weather coming at a time when normally egg production should be at its height, may have greatly checked the laying of eggs and resulted in a comparatively small number of larvae.

A marked restriction of severely injured areas was noticed in a number of places, due in some instances to very local causes and in others possibly to be accounted for by the sickly condition of the trees. It is well known that severe injury is likely to develop on weakened trees, and this was noted as in earlier years. It is not necessary to assume that these elms were special favorites with the insects, since the reduced vitality would, of itself, result in the production of much less than the normal amount of foliage, and an average infestation of the voracious grubs would make short work of the small leafage. This condition probably explains some of the local and severe injury which can not be accounted for in any other way. Such trees can be protected, though they require special care. It is a decided advantage to trim judiciously, so as to remove all the dead wood and promote a vigorous growth so far as practical and then protect the leaves by giving a very thorough spraying and, in extreme cases, more than one. The reduction in the numbers of this pest is probably only temporary and should not be construed as a justification for abandoning the spraying of earlier years.

The first essential in protecting shade trees is efficiency, the second, economy. Experience and modifications in apparatus have shown it to be possible to spray trees thoroughly and very rapidly and thus effect a material economy in the cost of treatment. The tendency now is to use the high pressure, a rather coarse nozzle and to avoid climbing so far as possible. The most efficient outfits are sufficiently powerful so that practically all the spraying is done from the ground at an enormous saving in both time and money. The most serious disadvantage of these outfits is the very high cost of the apparatus and the difficulty of controlling the stream on narrow streets. There is no question as to their utility and value on broad avenues, in parks or woodland areas.

English elm pouch gall (Tetraneura ulmisacculi Patch). This species, kindly determined by Miss Edith M. Patch, represents an addition, probably of English origin, to our fauna. The galls were found in small numbers July 17, 1913, on an English elm, Ulmus campestris, on the estate of S. G. Rosenbaum, Roslyn, N. Y. They were also found at Stamford, Conn. There was only a scattering infestation and no serious injury resulted.

The galls are pedunculated, oval sacks arising from the upper surface of the leaf half an inch to possibly an inch in diameter in the case of the larger deformations. They are smooth, bright yellowish

Fig. 10 English elm pouch gall (natural size, original)

green, appearing almost as if varnished and decidedly paler than the leaf, and as they age, assume variable purplish tints. The entrance to the gall is on the under side of the leaf and is guarded by pale, fuzzy hairs. Three or four galls frequently occur on a leaf, though Miss Patch has recorded as many as thirty-six. The interior of the gall is slightly ridged and inhabited by numerous plant lice. Technical descriptions of this species are given by Miss Patch (Me. Agric. Exp't Sta. Bul. 181, p. 216–19, 1910) to which the reader is referred for further details. This species presumably has a wide American distribution and can be controlled, if necessary, only by picking the infested leaves early in June before the plant lice have begun to escape and burning them. This recommendation is practical only in the case of small trees.

Our most common elm gall is the cockscomb gall (Colopha ulmicola Fitch) which is sometimes so abundant on American elms as to distort the foliage badly. The much rarer slippery elm gall (Pemphigus ulmifusus Walsh) is confined to the red or slippery elm and is easily distinguished from the more recent introduction by its larger size and particularly by its occurrence only on a very characteristic food plant. The smell of the leaves is often sufficient to identify the leaf and, secondarily, the gall.

Fig. 11 Slippery elm pouch gall (natural size, original)

False maple scale (*Phenacoccus acericola* King). There were a number of inquiries concerning this insect during the summer, though in a general way it was not so abundant and injurious as in earlier years. A very abundant infestation was located September 24th on certain trees at Mount Vernon, a little east and south of the New Haven Railroad station. Some of these trees were so badly infested that practically every leaf bore 6 to 25 of the conspicuous cottony masses indicating females, while the portions between the adult insects were thickly spotted and in some instances practically coated with the numerous yellowish young. The trunks of these trees were liberally plastered with the white cocoons of the male and, in some places, fairly covered with yellowish masses of the young. This local outbreak was evidently the culmination of a series of generations and apparently very restricted in extent.

A number of small parasites and the beneficial ladybeetle, *Hyperaspis signata* var. *binotata*, were obtained from this material. A peculiar obscure, yellowish gray Syrphid larva was observed among the scale insects; later it transformed to a somewhat similar though stouter puparium from which the imago of *Baccha fascipennis* Wied. was obtained. Several other natural enemies are known to live at the expense of this scale insect.

The sugar maples, although so very badly infested with this scale insect, did not seem to be seriously injured, aside from a somewhat thinner, paler foliage. This latter development came so late in the season, September 24th, that it probably would not have any very material effect upon the vitality of the tree.

Spruce bud scale (*Physokermes piceae* Schr.). Specimens of Norway spruce infested by this insect were received June 12th from Mr Arthur Dummett, Mount Vernon, N. Y. An examination of one twig evidently representing a condition on a portion of a tree or perhaps entire trees showed this scale insect to be numerous at the base of the branches or new growth. The peculiar budlike enlargements contained numerous pale purplish, broadly oval eggs which would probably hatch the latter part of July. One scale was infested by parasites. Specimens of this insect were received from other localities and in several instances from trees which were also infested by the spruce gall aphid, *Chermes abietis* Linn.

This species was observed by us in 1908,[1] though at that time it was confused with the spruce gall aphid. It occasionally becomes exceedingly abundant as recorded by Mr B. N. Gates.[2] He found it so numerous on spruces at Amherst, Mass., that the honeydew attracted swarms of bees, and these in turn called his attention to the infestation. Mr A. T. Gillanders[3] has observed this insect very commonly on sickly Norway spruce in England, especially those infested by the spruce gall aphid. This scale insect is subject to attack by a number of parasites and only occasionally becomes sufficiently abundant to cause material injury.

Tulip tree scale (Toumeyella liriodendri Gmel.). This, the largest of our native scale insects, is confined to the tulip tree and occasionally becomes very abundant and injurious in the vicinity of New York City. Several complaints concerning this insect were received during the past season and our attention has been frequently called to the pest in earlier years.

This insect winters in New York State in a partly grown condition, the young being from one-quarter to one-half full size, closely attached to the branches, usually on the under side. They have a very dark brown, almost black color, and on that account generally escape attention. Observations the past season show that the young begin to appear at Flushing August 16th, while specimens received September 4th from Tarrytown showed some young established, others crawling and many still issuing. This latter process evidently continues till the latter part of September. The full-grown females may be observed in August. They measure about one-third of an inch in diameter, are very convex and light brown in color. Badly infested trees have the leaves smeared with honeydew excreted by the insects; the sooty mold developing therein discolors the foliage below. There is also a rather characteristic sourish odor about badly infested trees or twigs.

One of the easiest methods of keeping this pest in check on small trees is by scraping off the scales or brushing them from the under side of the branches with a stiff brush, about the middle of August or even a little earlier. Thorough spraying of infested trees in the spring with a kerosene emulsion, the standard formula diluted with 4 parts of water is a very effective treatment. Spray as late as practicable since the insects are presumably more susceptible then.

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[1] N. Y. State Mus. Bul. 134, p. 55.

[2] 1909 Econ. Ent. Jour. 2:466–67.

[3] 1908 Forest Entomology, p. 228–29.

FOREST TREE PESTS

Forest tent caterpillar (Malacosoma disstria Hübn.). The depredations of this species recorded in 1912 have been continued on a more extended scale the present season. The caterpillars defoliated a number of acres of woodland in Roslyn and Jericho on Long Island, were abundant in Putnam and southern Dutchess counties, attacked maples at Granville, Elizabethtown and Ogdensburg and defoliated extensive tracts of poplar in Franklin and Clinton counties.

The last of May and early in June many of the oaks in Roslyn and Jericho were defoliated, a few of the caterpillars being only half grown, must of them fully developed, and some, particularly in the warmer, more advanced situations, had commenced to spin their cocoons. The injury in this locality was practically confined to the oaks. At Granville, Elizabethtown and Ogdensburg the caterpillars were most numerous upon the sugar maple, while in Frankin and Clinton counties there was a marked preference for the poplar (Populus tremuloides), particularly the tops of trees 30 feet or more in height. The feeding, in certain cases at least was confined to the vicinity of water. The aspen or poplar was the preferred food plant in this section, though willow, when standing near stripped trees, was eaten to some extent. The pin or bird cherry was partly defoliated and evidently eaten by the caterpillars only when forced by hunger. Elms and Cornus close to poplars were badly eaten or nearly stripped, respectively. The red maple and birch were nearly exempt from injury, unless next to defoliated trees. Pine, balsam and spruce, in fact all coniferae observed, were practically unharmed, though numerous cocoons were to be found among the needles (June 27th). The area of serious injury in this section begins at about Rainbow lake, Franklin county, and extends eastward through Clinton county nearly to Lake Champlain.

Natural enemies were observed at work both at Rainbow lake and Chazy lake. At Rainbow lake a large Carabid beetle was taken on a tree trunk some 4 feet from the ground. It was there evidently in search of caterpillars. Numerous Tachinid and Sarcophagid flies were observed about the caterpillars and were presumably ovipositing thereon. A number of Hymenopterous parasites, particularly Pimpla species, were observed on the cocoons at Chazy lake.

The probabilities of continued injury another season can best be determined by examining the trees during the fall or winter for the characteristic brown egg belts about half an inch long, encircling the smaller twigs. Wherever these are numerous there is very good prospect of serious depredations another season. The low value of timber and land in the Adirondacks precludes the adoption of comprehensive measures for the control of the pest. This does not apply to the more highly valued holdings in the vicinity of New York City and in such places it may be advisable to make provision for early spring spraying of the woodland areas where the eggs of this insect are numerous. The work against the gipsy moth in eastern Massachusetts has shown that fairly open woodland can be sprayed at the very moderate cost of $6.50 an acre with the modern high pressure outfit so extensively used in eastern Massachusetts. This equipment, while costly, is really the most economical where areas of any size are to be sprayed, since the high power and special nozzle renders climbing unnecessary and thus effects a great saving in time.

Locust borer (Cyllene robiniae Forst). Injuries by this common borer have attracted an unusual amount of attention, and local investigations disclosed serious damage. It is rare to find any number of black locust trees in New York State not infested by this borer though, as a rule, the damage is confined largely to dying branches and the deforming of old trees.

The past season our attention was called to a hedge row at Salamanca so badly infested that a number of young trees broke off in moderate to high winds. Investigations on Long Island showed numerous trees with limbs killed by this insect. A more serious condition was noted east of Poughkeepsie, in that here and there good sized trees had apparently succumbed to the activity of this pest, while many others were in more than the usual bad condition. The most striking injury was at Millbrook where nearly one acre of young transplanted locusts had been killed, probably the present year, by this insect. The trunks ranged in diameter from 1 to 2½ or 3 inches and were repeatedly girdled and well riddled by the galleries. There were a few larger trees with a diameter of 4 inches or over in this area which were not very seriously affected. The general killing of these trees was evidently due to an unusual increase in the borers and, as a consequence, the numerous larvae were literally compelled on account of the lack of space to girdle the trees repeatedly in making their galleries. The outbreak was evidently one of those periodic increases in the number of insects, which are not readily explainable. The mere fact that this planting was in a section where the locust borer was generally abundant and injurious should have served as a warning regarding the possible outcome of such an undertaking.

This latter case is undoubtedly an extreme one, and yet it is one of the probabilities which must be faced by those contemplating extensive plantings of this valuable tree.

The parent of the locust borer, as most people realize, is a rather slender, black beetle less than three-quarters of an inch long and very prettily marked with golden yellow. It may be found in considerable numbers feeding on goldenrod blossoms. The females deposit their oval, whitish eggs here and there in crevices of the bark and the young grubs spend the winter in the outer part of the living inner bark. The larger grubs, as is well known, when abundant may riddle the inner portion of the trunk with galleries about one-quarter of an inch in diameter and running mostly with the grain of the wood.

As suggested above, from our present state of knowledge, it appears unwise to plant the black locust in sections where this borer is abundant and destructive. Plantings already established should be carefully watched for early indications of injury, most easily detected during the spring and early summer by bleeding and ejected borings. Very badly infested trees or parts of trees should be cut and destroyed before the first of August, in order to prevent the insects maturing. It is perhaps unnecessary to add that the general adoption of this plan would probably result in a very satisfactory control of the borer. Doctor Hopkins states that the hibernating larvae may be destroyed by spraying the trunks and branches with a strong solution of kerosene emulsion. Ordinarily, in our opinion it would be safer to make this application in the spring and not later than the first of April. Pure kerosene, petroleum or petroleum compounds may result in injury to the trees unless used with much care. Experiments at Salamanca last July showed that the nearly full-grown grubs could be killed or driven from their burrows by applications of a creosote preparation which was said to be harmless to the trees.

Some trees appear to be more resistant to attack than others, and it has been suggested by Doctor Hopkins that work along this line might be attempted in the case of the black locust and an effort made to obtain borer-resistant trees, either by cross-breeding or through propagation by cuttings.

Spruce aphid (Mindarus abietinus Koch.). Specimens of the work of this aphid were received through the State Conservation Commission under date of June 14, 1913 from Mr John Nill of Star Lake, N. Y. The balsam shoots had the tips to a length of 1 to 2 inches badly curled and twisted, while the foliage as a whole was very sticky, indicating an abundant earlier infestation by this plant louse. Mr Nill stated that the infested trees upon his place were all young and thrifty and not more than 20 years old. Some are uniformly infested all over and others only in part, there appearing to be no difference between those standing in groups and isolated trees. The shoots submitted for examination had numerous Syrphid larvae and practically no plant lice, indicating that the attack so far as these particular trees are concernd, is at an end. The affected balsam tips, however, will probably wither and perish.

Specimens of the work of this aphid were also received under date of June 9th from Lake Clear, N. Y., through Mr George L. Barrus, state forester. These latter tips bore a number of 15-spotted lady beetles, Anatis ocellata and practically no aphids, indicating that natural enemies were checking the pest early.

MISCELLANEOUS INSECTS

Drug store beetle (Sitodrepa panicea Linn.). The stout, light brown beetle, only about one-eighth of an inch long and its white, curled grub is well known to entomologists as a feeder upon a considerable variety of substances, such as flour, meal, breakfast foods, condiments, roots and herbs and animal matter. It has even been known to colonize itself in a human skeleton which had been dried with the ligaments on, and has been recorded as perforating tinfoil and sheet lead. Only two months are required to complete the life cycle, and in warm buildings breeding may be continuous throughout the year.

Last summer a ledger bound in half morroco was received from a local manufacturing company, with an inquiry as to the source of certain insect injury. It developed that the sample was from a California dealer who had held some of the books in storage for a period of about fourteen years. The infested ledgers were fumigated prior to their return to the manufacturer in the same manner as is customary with citrus trees in that section. An examination resulted in our finding nothing alive. It was seen that the insects confined their operations largely to making sinuous galleries in the morocco, occasionally invading the sheepskin and working mostly on the inner face of the leather, partly on account of the protection afforded and presumably attracted somewhat by the glue used in binding the book. Attacks of this kind are evidently unusual and can generally be avoided by examination from time to time and fumigation, if necessary, with either carbon bisulphid or hydrocyanic acid gas.

Mason bee (Osmia felti Ckll.[1]). Very little is apparently known concerning the habits of this genus, though the related leaf cutter bees, Megachile, commonly attract notice because of the characteristic circular or nearly circular pieces so frequently cut from rose and other leaves and used by these insects in the construction of larval cells, the latter being placed end to end and located sometimes in the ground, usually in burrows in the wood, and even in crevices such as those occurring between shingles in a bunch or on a roof.

Fig. 12 Galleries of a mason bee, Osmia felti, in hard pine (natural size, original)

A number of small bees were observed June 18, 1902, around a circular entrance in the thick bark of a hard pine at Karner, and on capturing specimens and submitting them to Prof. T. D. A. Cockerell, an authority on this group, they were described by him as new. An examination of the galleries showed a circular entrance

[1] 1911 Ent. News, 21:18.

with a diameter of nearly a quarter of an inch, leading into a complex series of galleries (figure 12), some of which were occupied by a number of cells. The latter are not lined by leaves as in the genus Megachile, the separations apparently being composed mostly of comminuted particles of bark. The individual cells are evidently divided much as in Megachile, and the larvae, on attaining maturity, spin yellowish brown, oval cocoons occupying the entire diameter of the gallery and with a length of approximately five-eighths of an inch. A parasite, Leucopsis affinis Say, was reared from wood containing the cells of this insect.

White-winged Bibio (Bibio albipennis Say). Dirty yellowish gray larvae of this species were found March 26, 1900 by Mr W. F. Smith, White Plains, N. Y., in stable manure spread the preceding fall on flower beds. The larvae pupated in oval cells in the earth, and hosts of adults emerged April 18th. The black flies, with a length of only three-eighths of an inch, have white wings when they first appear above ground. These soon become transparent. This insect is a common species about gardens and orchards in early spring.

Larva. Length about 1.3 cm, diameter 2 mm. Head reddish brown, strongly chitinized, the dorsum with a sublateral seta near the anterior third, a little below this there being apparently a rudimentary eye. Labrum subquadrate, rounded anteriorly; mandibles moderately large, subtriangular, rounded, bidentate. The maxillae appear to be represented by a pair of ventral, irregularly ovate sclerites. The labium is subcordate. The body is a dirty yellowish gray, rather strongly annulate and composed of 12 segments, the anterior 4 being divided into 3 annuli, the divisions on the other segments less marked. There is at the posterior third of the segments, on the middle annulus in the anterior ones, a transverse row of short, stout, fleshy processes, which latter are somewhat produced laterally and on the posterior segment. The skin is coarsely shagreened. On the first body segment there is a moderately well-developed brown spiracle, rudimentary ones being seen upon succeeding segments to the twelfth, which latter has a well-developed sublateral spiracle on the anterior fourth. The posterior extremity is obliquely truncate, excavated, the anus being guarded by two broadly oval, subdorsal flaps, a pair of subventral triangular processes and a ventral rounded lip.

The use of ground, unslaked lime or naphthalin is advised by Collinge for the destruction of larvae of the allied Bibio marci Linn. in leaf mold, in which they occur.

Bolitophila cinerea Meign. Numerous white, black-headed larvae of this species were found in the base of a decaying, probably fungous-infected, birch stump at Albany in March, the adults issuing early in April. The larva appears to be unknown and is described below.

Larva. Length 4 mm. Head shining jet black. Body white, with jet black tubercles. The head is moderately large, having a width fully two-thirds that of the body and with moderately well-developed triarticulate or possibly quadriarticulate palpi. Each antenna is supported upon a broad base surrounded by a narrow ring of fuscous chitin, possibly the first segment; the next segment is cylindric, tapers slightly and has a length one-half greater than its diameter; the third segment is conical and about one-third as long as the preceding; the terminal segment is very slender, about two-thirds the length of the preceding. Body stout, apodous, the segments distinct; posterior extremity tapering slightly to a somewhat narrowed, subtriangular terminal segment. Ventral surface, the margins of the abdominal segments broadly banded with transverse lines of fine, chitinous points resembling somewhat those of Miastor.

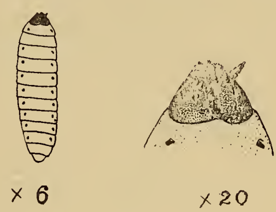

Fig. 13 Boletophila cinerea; larva enlarged, head still more enlarged (original)

PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1913. The titles,[1] time of publication and a summary of the contents of each are given. Volume and page number are separated by a colon.

The Gall Midge Fauna of Western North America. Pomona College Journal Entomology, 4:753-57, 1912

A list of species with food habit records so far as known.

Studies in Itonididae. New York Entomological Society Journal, 20:236-48, 1912

Two new genera, Neocatocha and Neptunimyia, were erected and the following new species described: Neocatocha marilandica, Neptunimyia tridens, Porricondyla dorsata, P. juvenalis, Contarinia coloradensis, Thecodipolsis dulichii, Dicrodiplosis antennata, D. californica, D. helena, Itonida aphidivora, I. putrida and I. aprilis. A sex is described or biological observations given of the following: Rhabdophaga aceris Shim., Phytophaga ulmi Beutm., Thecodiplosis ananassi Riley, Itonida resinicola O. S. and Cecidomyia ocellaris O. S.

Notes. New York Entomological Society Journal, 20:292-93, 1912

Brief notes are given on the fiery ground beetle, Calosoma calidum, Neuroterus saltatorius, and two-spotted lady beetle, Adalia bipunctata.

Prevention of Mosquito Breeding. American Society Civil Engineers Proceedings, 39:153-54

A brief discussion of certain phases of mosquito control.

Fly Campaign. West Winfield Star, p. 4, January 31, 1913; Democratic Register (Ossining) February 1, p. 4; Whitney Point Reporter, February 13, p. 4

A brief note urging a serious fly campaign the coming season.

Some Orchard Insects. Department of Agriculture, Bulletin 42, 1912, p. 102-3

Summary of methods for controlling several of the more important insects.

Household Entomology. Department of Agriculture, Bulletin 42, 1912, p. 109-10

Brief directions are given for controlling the chief insect pests of the house.

[1] Titles are given as published. In some instances articles appearing in a number of papers have been given different titles by the various editors.

Save the Hickory Trees. New York Times, New York Herald, March 3, 1913

A summary statement of conditions about New York City advising the cutting of infested hickories and the burning of the bark.

Cystodiplosis eugeniae n. sp. Entomological News, 24:175–76, 1913

Description of a midge reared from a hairy, spherical leaf gall on Eugenia buxifolia collected at Key West, Florida.

Insect Enemies of Trees and Shrubs. Arbor Day Annual, New York State Education Department, 1913, p. 23–28

A brief, popular, illustrated account of some of the more injurious or common shade tree and shrub insects.

Save the Trees. Northern Budget (Troy, N. Y.), April 13, 1913, p. 2

A summary account of elm leaf beetle conditions. Spraying is advised in most localities.

Gall Midges in an Aquatic or Semiaquatic Environment. New York Entomological Society Journal, 21: 62–63

Annotated list of gall midges occurring under such conditions.

The Caterpillar Pest. The Freeman's Journal (Cooperstown, N. Y.), April 23, 1913

Brief warning notice of probable injury by the apple tent caterpillar, Malacosoma americana Fabr., with directions for control.

Itonida anthici n. sp. Economic Entomology Journal, 6:278–79, 1913

The gall and all stages of this midge occurring on bald cyprus, Taxodium distichum are described.

Phytonomus meles Fabr. Economic Entomology Journal, 6:283–84, 1913

A record of the distribution and abundance of this weevil.

Bleeding Trees. Economic Entomology Journal, 6:285–86, 1913

A Dipterous larva, probably Ceratopogon, is recorded as causing bleeding from wounds in maple and elm trees and described.

Spraying in the Hudson Valley. New York State Fruit Growers Association Proceedings, 1913, p. 267–75

A record of work in controlling the codling moth and observations upon trees sprayed with a miscible oil.

Self-Boiled Lime Sulphur. Rural New Yorker, April 26, 1913, 72:600

Gives data on the value of summer sprays for the control of San José scale.

White Grubs. Troy Times, April 29, 1913; Poughkeepsie Evening Star, May 9; New York Farmer, May 8, p. 4

Brief resumé of white grub conditions with observations on several natural enemies.

Spraying for the Codling Moth. Recorder (Catskill), May 9, 1913, p. 7

A summary of results obtained with one spray and directions for effective work.

Two Rose Pests. Florist's Exchange, May 10, 1913, 35:1122

Early spraying with soap or tobacco extract advised for aphids and leaf hopper, Typhlocyba rosae Linn.

Fly Control. New York State Education Department, State Museum, p. 1–9, May 1913

A brief, summary discussion of the house fly and methods of controlling it.

Caterpillar Pests. Northern Budget (Troy), June 1, 1913, p. 5

Brief, popular notice of the apple tent caterpillar and the forest tent caterpillar.

Gouty Pine Midge (Itonida inopis O. S.) Economic Entomology Journal, 1913, 6:331

A brief record of abundance and injuries by this midge at Karner, N. Y.

Orchard Insect Pests. New York Farmer, July 10, 1913, p. 5

Brief, practical accounts of the San José scale, oyster scale, codling moth, plant lice and red bugs.

Mosquito Control. American Society of Civil Engineers Transactions, 1912, 76:771

A brief note calling attention to the importance of roadside pools and making suggestions regarding the treatment of catch basins and of general mosquito breeding areas.

Notes on Care of Fruit Trees, Bushes and Vines. Correct Methods of Preserving Fruit, Muncie, Indiana, 1913, p. 36–40

Formulas for standard insecticides and fungicides.

Remedies and Preventives for Plant Enemies and Diseases. Correct Methods of Preserving Fruits, Muncie, Indiana, 1913, p. 41–54

Spraying calendar for orchard trees, small fruits, shade trees, garden crops and the flower garden.

Insecticides and Fungicides. New York State Museum, Handbook 18, p. 1–24, May 1913 (issued August 1913)

Formulas for the principal insecticides and fungicides (revised from earlier editions).

Descriptions of Gall Midges. New York Entomological Society Journal, 21:213–19, 1913

A new genus, Astrodiplosis, is erected and the following species are described: Winnertzia aceris, Camptomyia tsugae, Dasyneura cercocarpi, D. parthenocissi and Astrodiplosis speciosa.

Miscellaneous Notes. New York Entomological Society Journal, 21:273–75, 1913

Drosophila repleta Woll. was reared from a jar containing galls of Asphondylia conspicua O. S. received from Highspire, Pa. The larval habits of Phormia regina Meign. and Sarcophaga georgina Wied. are summarized. A species of Seius is recorded on Helobia punctipennis and the work of Platypus punctulatus Chap. on mahogany in a local lumber yard noted.

Drought and Insects. Albany Evening Journal, p. 12, September 10, 1913; Albany Argus, September 12, 1913

A brief outline of shade tree conditions with suggestions for the better protection of elms another season.

Three New Gall Midges. Canadian Entomologist, 1913, 45:304–8

The following new species are described: Karschomyia cocci, Mycodiplosis insularis and Clinodiplosis examinis.

Table of Hickory Leaf Gall Midges. Brooklyn Entomological Society, Bulletin 8:98–99, 1913

A key for the separation of the species based on larval and gall characteristics.

28th Report of the State Entomologist on the Injurious and Other Insects of the State of New York, 1912. New York State Museum Bulletin 165, p. 1–264, 1913 (issued October 1913)

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ADDITIONS TO COLLECTIONS, OCTOBER 16, 1912–OCTOBER 15, 1913

The following is a list of the more important additions to the collections:

DONATION

Hymenoptera

Lophyrus abbotii Leach, Abbott's pine sawfly, larvae on pine, October 1, G. W. Crawford, Ballston Spa

Janus integer Norton, currant stem borer on currant, February 21, F. R. Lossoe, Troy

Kaliofenusa ulmi Sund., European elm leaf miner, larvae on elm, June 4, F. A. Smith, Ticonderoga

Hylotoma pectoralis Leach, birch sawfly, larvae on birch, July, F. Chase, Loon Lake

Trichiosoma tibialis Steph., European hawthorn sawfly, cocoon on rose, November 27, England. Through State Department of Agriculture. Same, cocoon on barberry, February 27, Flushing. Through State Department of Agriculture

Aylax pisum Walsh, gall on Lygodesmia juncea, September 30, E. Bethel, Denver, Col.

Rhodites gracilis Ashm., regal rose gall, galls on Rosa blanda, September 29, Mrs E. P. Gardner, Canandaigua. Through S. H. Burnham. Same, gall on rose, October 5, Mrs E. P. Gardner, Canandaigua

R. globulus Beutm., globular rose gall, gall on rose, October 5, Mrs E. P. Gardner, Canandaigua

Myrmecocystus melliger Llave, honey ant, adult, November 30, E. Bethel, Manitou, Col.

Coleoptera

Eccoptogaster quadrispinosa Say, hickory bark borer, larvae on hickory, January 28, J. James de Vyver, Bronxville

Corthylus punctatissimus Zimm., pitted Ambrosia beetle, adult on Rhododendron, September 13, C. H. Matthiessen, Irvington. Same, work, October 1, Charles Goodyear, Tarrytown

Cryptorhynchus lapathi Linn., mottled willow borer, grubs and work on poplar, June 18, William Hilligas, Rensselaer

Lixus concavus Say, rhubarb curculio, adult, March 31, J. R. Gillett, Kingston

Pissodes strobi Peck, white pine weevil, work on pine, January 20, E. H. Anderson, Mount Kisco. Same, larvae and work on pine, July 14, E. R. Pease, Poughkeepsie

Galerucella luteola Müll., elm leaf beetle, adults in house, May 28, Mrs A. C. Iceland, Middletown

Nodonota tristis Oliv., strawberry root worm, adult on strawberry, June 23, G. W. Tilly, Mechanicville

Typophorus canellus Fabr., strawberry root worm, May 8, W. F. McDonough, Albany

Chrysochus auratus Fabr., gold gilt beetle, adults, November 6, J. J. Sullivan, Valley Mills

Neoclytus erythrocephalus Fabr., adult and work on ash, September 3, Hermann Von Schrenk, St Louis, Mo.

Chion cinctus Dru., banded hickory borer, adult, March 16, Mrs C. A. Van Deusen, Hudson

Euphoria inda Linn., bumble flower beetle, adult on apple, September 4. Through State Department of Agriculture

Allorhina nitida Linn., green June beetle, adult, July 3, W. D. Robertson, Roslyn, N. Y.

Anomala lucicola Fabr., light-loving grapevine beetle, adult, July 7, E. R. Farrar, South Lincoln, Mass.

Lachnosterna fusca Froh., white grubs infested by the peculiar fungus, Cordyceps ravenelii Berk., February 14, W. S. Miller, East Greenbush

Sitodrepa panicea Linn., drug store beetle, larvae, adults and work in account book, June 12, Saugerties Manufacturing Company, Saugerties

Agrilus ? bilineatus Web., two-lined chestnut borer, work on oak, October 30, C. A. Coffin, Locust Valley

Melanophila fulvoguttata Harr., spotted hemlock borer, larva on hemlock, December 2, H. W. Merkel, Scarsdale. Same, January 30, J. Downer, New York City. Same, bark of hemlock, May 16, C. L. Torbert, Syracuse

Dicerca divaricata Say, divaricated Buprestid, adult, June 20, Charles McMillan, Cambridge

Alaus oculatus Linn., owl beetle, adult, June 20, Charles McMillan, Cambridge. Same, beetle, July 28, E. V. Titus, Glen Cove

Anatis 15-punctata Oliv., 15-spotted lady beetle, adult on balsam, June 9, Lake Clear. Through State Conservation Commission

Dytiscus harrisii Kirby, water beetle, adult, September 17, Andrew Lacky, Johnsburg

Diptera

Frontina frenchii Will., adults, March 31, J. R. Gillett, Kingston

Bibio albipennis Say, white-winged Bibio, larvae on stable manure, March 28, W. F. Smith, White Plains

Contarinia pyrivora Riley, pear midge, larvae on pear, May 7, Thomas Albright, New Baltimore. Same, adult, September, F. V. Theobald, Wye, Kent, England

Thecodiplosis ananassi Riley, galls and larvae on Cypress, October 29, W. L. McAtee, Carlisle, Miss.

Clinodiplosis florida Felt, gall on oak, May 27, H. Garman, Louisville, Ky. Same, June 13, Charles Goodyear, Tarrytown

Monarthropalpus buxi Lab., box leaf miner, larvae on Box, August 21, Roslyn. Through Frost & Bartlett Co., Stamford, Conn.

Hormomyia crataegifolia Felt, coxcomb thorn gall, gall on Crataegus, August 12, Roy Latham, Orient Point

Cincticornia pilulae Walsh, oak pill gall, gall on oak, October 5, Mrs E. P. Gardner, Canandaigua. Same, October 24, W. L. Mc Attee, Riverdale, Md.

Schizomyia coryloides Walsh & Riley, clustered grape gall, gall on grape, August 8, Henry Shelter, Springwater

Lasioptera corni Felt, ocellate dogwood gall, gall on Cornus, September 21, A. Cosens, Toronto, Ont., Can.

Dasyneura rhodophaga Coq., rose gall midge, larvae on rose, July 16, Jackson & Perkins Company, Newark

D. communis Felt, galls on red maple, October 9, Mrs P. A. Rorty, Goshen. Same, May 27, H. Garman, Lexington, Ky.

Rhabdophaga strobiloides Walsh, pine cone gall, gall on willow, September 30, E. Bethel, Denver, Col.

Camptomyia tsugae Felt, larvae on hemlock, December 2, H. W. Merkel, Scarsdale

Siphonaptera

Ceratophyllus gallinae Schrk., hen flea, adults in hens' nests, May 29, Miss Marcia J. Sherwood, Barker

Ctenocephalus canis Curtis, house flea, adult, August 26, J. R. Heilman, Poughkeepsie

Lepidoptera

Laertias philenor Linn., pipe-vine swallowtail, larva on Dutchman's pipe, June 24, Charles Goodyear, Tarrytown

Automeris io Fabr., Io caterpillar, larvae on sweet clover, August 27, Miss Nina Carl, Breesport. Same, larva on corn, September 4, R. L. Cushman, Yonkers

Halisidota caryae Harr., hickory tussock moth, larvae on hickory, September 27, C. M. Reed, Sinclairville

Peridroma margaritosa Haw. var. saucia Hübn., variegated cutworm, larvae on apple and grass, July 15, Rochester. Through State Department of Agriculture

Hadena fractilinea Gr., lined corn borer, larvae on corn, June 19, C. B. Schoonmaker, Stone Ridge

Xylina antennata Walk., green maple worm, larva on linden, May 19, Miss Isabella M. Bartlet, New Hamburgh. Same, larvae on apple, June 9, C. A. Clark, Castleton

Papaipema ? merriccata Bird, stalk borer, larvae on May apple, May 13, Hermann Von Schrenk, St Louis, Mo.

Datana integerrima Grote & Rob., black walnut caterpillar, larva on hickory, September 27, C. M. Reed, Sinclairville

Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae, July 8, J. R. Heilman, Poughkeepsie

Hemerocampa leucostigma Sm. & Abb., white-marked tussock moth, larvae on Wisteria, August 27, Miss Nina Carl, Breesport

Malacosoma disstria Hübn., forest tent caterpillar, eggs, December 17, J. J. Levison, Brooklyn. Same, larvae on oak, May 26, F. R. Appleton, Jr., Jericho. Through State Forester. Same, May 30, Charles Hechler, Roslyn, L. I. Same, cocoons, June 21, S. S. Terry, Elizabethtown. Same, larvae and cocoons on maple, June 23, Irving Wynkoop, Granville. Same, eggs on apple, September 5, J. A. Seely, Ogdensburg

Cladora atroliturata Walk., imago, April 11, Peter Dunwald, Rio

Anisopteryx pometaria Harr., fall canker worm, males, females and eggs, December 3, Interstate Tree Treating Company, Mount Vernon

Phigalia titea Cram., imago on forest trees, April 11, Peter Dunwald, Rio

Erannis tiliaria Harr., ten-lined inch worm on linden, May 19, Miss Isabella M. Bartlet, New Hamburg

Lagoa crispata Pack., flannel moth, caterpillar on apple, September 18, H. W. Niles, Rye. Through State Department of Agriculture

Harrisina americana G. & M., cocoons on Virginia creeper, September 5, Mrs E. H. Cooper, Saratoga Springs

Zeuzera pyrina Linn., leopard moth, larva, May 31, A. G. Harris, Pelham. Same, larvae, September 4, Charles Goodyear, Tarrytown

Sesia rhododendri Beutm., Rhododendron clearwing, work and larvae on Rhododendron, September 29, H. W. Merkel, New York City

Pinipestis zimmermanni Grote, pine tip moth, work on Austrian pine, July 1, Westchester county. Through State Department of Agriculture

Tinea granella Linn., European wolf moth, larvae on sweet corn, November 13, F. W. Eberle, Albany

Tmetocera ocellana Schiff., bud moth, larva on apple, April 16, G. E. Ward, Ravena. Same, larva on apple, April 17, Theodore Haney, Ravena. Same, larva on plum, April 26, C. B. Jansen, Kingston. Same, larva on pear, April 28, Fred Hunt, Kingston. Same, April 30, H. B. Vincent, Old Chatham. Same, May 15, Clyde St John, Canajoharie

Archips argyrospila Walk., fruit tree leaf roller on apple, July 7, Collamer orchard, Hilton. Through State Department of Agriculture

Tortrix fumiferana Clem., spruce bud moth, larva, adult and work on spruce, July 6, George Lintner, Squirrel Island, Me. Same, adults on spruce, July 15, Mrs James T. Gardiner, Northeast Harbor, Me.

Eulia politana Haw., pine tube builder, work, November 12, J. J. Levison, Brooklyn

Coleophora limosipennella Dup., elm case bearer, work on elm, June 24, Charles Goodyear, Tarrytown

Coptodisca splendoriferella Clem., resplendent shield bearer, larvae and cases on apple, January 22, M. C. Albright, West Coxsackie

Argyresthia thuiella Pack., Arbor vitae leaf miner, pupae on Arbor vitae, June, Isaac Hicks & Son, Westbury. Larvae of same, October 4

Phyllonoryter hamadryadella Clem., white-blotch oak leaf miner, larval mines on oak, May 28, E. L. Torbert, Syracuse. Same, work on oak, October 22, J. James de Vyver, Mount Vernon

Corrodentia

Caecilius pedicularius Linn., nymph and adult, October 14, J. H. Gardner, Fort Covington

Hemiptera

Philaenus lineatus Linn., lined spittle insect on grass, June 23, Mrs M. S. Miller, Boonville

Phylloxera caryaecaulis Fitch, hickory gall aphid, galls on hickory, June 20, D. C. Pierce, Hamburg. Through State Conservation Commission. Same, July 10, H. S. Paine, Glens Falls

Chermes pinicorticis Fitch, pine bark aphid, adult on white pine, December 6, J. W. L. Coffin, Katonah. Through State Conservation Commission. Same, adult on pine, May 5, Brentwood. Through State Department of Agriculture. Same, June 18, Miss N. Neilson, Nyack

C. abietis Linn., spruce gall aphid, galls on spruce, January 20, M. S. Crosby, Rhinebeck. Through State Conservation Commission. Same, gall on Norway spruce, June 16, S. G. Harris, Tarrytown. Same, June 17, C. C. Laney, Rochester. Same. July 10, P. V. D. Gott, Goshen

C. strobilobius Kalt., woolly larch aphid, adults and eggs on larch, June 23, Mrs M. S. Miller, Boonville

C. floccus Patch, galls on spruce, August 23, John Nill, Star Lake

Tetraneura ulmisacculi Patch, English elm pouch gall, galls on Ulmus campestris, June 5, Frost & Bartlett Company, Stamford, Conn.

Pemphigus ulmifusus Walsh, slippery elm gall, gall on elm, June 24, Charles Goodyear, Tarrytown. Same, August 23, Frost & Bartlett Company, Stamford, Conn.

P. tessellata Fitch, alder blight, adults on soft maple, July 5, Townsend Cox jr, Setauket

Schizoneura lanigera Hausm., woolly apple aphis on apple, November 5, Richard Harrer, New York City. Same, adults on apple, June 28, G. M. Patten, Poughkeepsie. Same, young on apple, September 5, J. A. Seely, Ogdensburg

Longistigma caryae Harr., hickory aphis, adults, June 4, J. F. Rose, South Byron

Aphis maidis Fitch, corn leaf aphis on corn, November 2, Roy Latham, Orient Point

? Nectarophora solanifolii Ashm., potato plant louse on potato, September 27, C. S. Conkling, Gouverneur

Mindarus abietinus Koch., balsam aphid, work on balsam, June 9, Lake Clear. Through State Conservation Commission. Same, adults and work on balsam, June 21, S. S. Terry, Elizabethtown. Same, June 14, John Nill, Star Lake. Through State Conservation Commission

Gossyparia spuria Mod., elm bark louse, females on elm, June 13, C. C. Woolworth, Castleton. Same, adults on elm, June 18, Miss N. Neilson, Nyack

Phenacoccus acericola King, false maple scale on hard maple, October 18, A. M. Voorhis, Nyack. Same, November 5, Richard Harrer, New York City. Same, adults on bark, February 17, M. J. Naramore, Ossining. Same, adults on maple, June 28, G. M. Patten, Poughkeepsie. Same, females and young on sugar maple, September 26, J. James de Vyver, Bronxville

Pulvinaria acericola Walsh, adults on Cornus, June 13 and 24, Charles Goodyear, Tarrytown

P. vitis Linn., cottony maple scale, adults and eggs on soft maple, June 14, Charles R. Towson, New York City. Through State Conservation Commission. Same, June 18, E. L. George, New York City. Same, July 14, Carleton Macey, Hewlett. Same, adult on sugar maple, July 15, M. J. Devers, Hoosick Falls

Toumeyella liriodendri Gml., tulip tree scale, adults and young on tulip, February 1 and 5, J. H. Livingston, Tivoli. Same, August 15, Mrs T. W. Powell, Flushing, L. I. Same, adults and young on tulip, September 4, Charles Goodyear, Tarrytown

Eulecanium lintneri Ckll, & Benn., sassafras soft scale, adults and young on sassafras, July 21, Roy Latham, Orient Point

E. rugosum Sign., quince soft scale, adults on quince, June 3, A. E. Stene, Kingston, R. I.

Coccus hesperidum Linn., soft scale, adults on fern, May 29, E. H. Porter, New York City

Physokermes piceae Schr., spruce bud scale on spruce, January 29, P. L. Huested, Blauvelt. Same, eggs on Norway spruce, June 12, Arthur Dummett, Mount Vernon

Chionaspis euonymi Comst., Euonymus scale, adults on privet, probably Ligustrum bota, November 21, Benjamin Hammond, Hudson Heights, N. J.

C. furfura Fitch, scurfy scale, eggs, April 17, Theodore Haney, Ravena

C. pinifoliae Fitch, the pine leaf scale, adult on Austrian and white pine, November 12, J. J. Levison, Brooklyn. Same, adults on pine, July 12, S. S. Terry, New York City

Diaspis echinocacti Bouché, Cactus scale, adults and young on Cactus, September 30, Porto Rico. Through F. J. Seaver, New York City

D. carueli Targ., Juniper scale, adults on Arbor vitae, June 23, Leonard Barron, Garden City

Drosicha lichenoides Ckll., fig scale on Ficus nata (fig), October 22, T. D. A. Cockerell, Los Banos, P. I. Coll. C. F. Baker, 1912, cotypes

Aonidia lauri Bouché, Bay tree scale on Bay tree, October, T. F. Niles. Through State Department of Agriculture

Aspidiotus pernicosus Comst., San José scale, adults and young on rose, January 15, Albany. Through State Department of Agriculture. Same, young on elm, March 3, M. C. Albright, Coeymans. Same, adults and young on pear, July 8, T. E. Bullard, Schuylerville

A. ostreaeformis Curt., European oyster scale, adult on apple, May 15, H. M. Doyle, Oswego

A. osborni Newell & Cockerell, oak scale, adults on white oak, October, F. J. Stubing, Mount Vernon

Lepidosaphes ulmi Linn., oyster shell scale on poplar and maple, December 9, H. W. Gordinier, Troy

Neurocolpus nubilis Say, adult on sumac, July 12, L. F. Strickland, Lockport

Paracalocoris scrupeus Say, nymphs on grape, June 13 and July 12, L. F. Strickland, Lockport

Lygus pratensis Linn., tarnished plant bug, adults on Chrysanthemum, September 4, L. C. Griffith, Lynbrook

Plecoptera

Pteronarcys ? biloba Newm., May 8, G. G. Atwood, Albany

P. proteus Newm., giant stone fly, adult, June 6, Miss Eliza S. Blunt, New Russia

Thysanoptera

Euthrips pyri Dan., pear thrips, adults, April 25, F. M. Brooks, Athens

Thysanura

Schoturus nivicola Fitch, snow flea, adults, December 26, E. H. Rodgers, Mount Kisco. Through State Department of Agriculture

Acarina

Eriophyes quadripes Shimer, gall on maple, May 12, Miss Louise Hunter, Cornwall

E. abnormis Garm., gall on linden, September 30, E. Bethel, Denver, Col.

Bryobia pratensis Garm., red spinder, adults and eggs on Arbor vitae, June 23, Leonard Barron, Garden City

APPENDIX

A STUDY OF GALL MIDGES II

ITONIDIDINAE

This subfamily comprises by far the larger number of species belonging to the Itonididae and includes practically all the gall-making forms. Species belonging in this group may be recognized by the metatarsus being always shorter than the following segment and by the presence of but three or four long veins in the wings, in connection with the peculiar circumfili, auditory in function and evidently important, of the antennae. These latter structures appear to be present throughout the subfamily, though they do not occur in either the Heteropezinae or the Lestremiinae. Species of the two last named groups appear to depend mostly upon various olfactory organs.

There is great diversity in this subfamily, though its representatives possess much in common. Extreme types of development may be seen in Didactylomyia of the Epidosariae, Clinorhyncha of the Lasiopterariae, Cincticornia of the Asphondyliariae, and in a number of the genera of the Itonididinariae. A large proportion of the species in this subfamily, aside from the Epidosariae, display a marked preference for living plant tissues and may be found inhabiting all portions of a plant, leaf and flower buds being favorite points of attack. Many species produce characteristic galls, while in some instances, at least, several forms may occur in the same gall.

Key to tribes

a A crossvein uniting the third vein and subcosta and usually parallel with costa ....Tribe Epidosariae

aa No distinct crossvein uniting the third vein with subcosta

b Antennal segments cylindric, the flagellate never binodose in the male

c Claws toothed

d Costa rarely thickly clothed with scales, the third vein well separated from costa; antennal segments usually stalked in the male..........................Tribe Dasyneuriariae

dd Costa thickly clothed with scales, the third vein usually very close to costa; antennal segments cylindric, sessile, not produced ....Tribe Lasiopteriariae

cc Claws simple

d Antennal segments cylindric or subcylindric, not elongated, usually stalked in the male.........Tribe Oligotrophiariae

dd Antennal segments cylindric, elongate, sessile, the ovipositor usually aciculate.....................Tribe Asphondyliariae

bb Flagellate antennal segments usually binodose in the male, circumfili usually greatly produced.....................Tribe Itonididinariae

DASYNEURIARIAE

The species belonging to the tribe Dasyneuriariae may be recognized by the dentate claws, the third vein well separated from costa and by the antennal segments of the male being almost invariably with a distinct stem. The palpal segments may vary in number from one to four and the antennal segments from 12 to over 20.

This group comprises a large number of Phytophagous species, the zoophagous Coccidomyias being exceptions. The two most important genera are Dasyneura and Rhabdophaga, the former being of medium size and usually brownish or yellowish. Rhabdophaga includes a number of large, usually reddish or reddish brown species which display a marked preference for woody tissues, especially the cortical layers of willow. Members of these genera occur very largely in leaf folds, leaf buds or loose, leafy bud galls.

The reared parasites, recorded on the following pages, have been kindly determined by Mr C. T. Brues of the Bussey Institution.

Key to genera

a Palpi at least quadriarticulate
  b Antennae usually with 14 or more segments
    c Third vein uniting with costa very near or at the wing apex, straight and usually tapering distally......................
      d Ovipositor not chitinized apically, claws plainly unidentate.. Rhabdophaga Westw.[1]
      dd Ovipositor chitinized apically, bladelike, claws weakly toothed......................Procystiphora n. g.
    cc Third vein uniting with costa distinctly before the wing apex, straight or curved anteriorly and tapering but little distally
      d Wings hyaline, the membrane not scaled; female ovipositor long, sometimes longer than the body; circumfili not greatly produced................Dasyneura Rond.[2]
      dd Wings fuscous, the membrane scaled; female ovipositor short; circumfili in male sometimes strongly produced, much as in male of Bremia....Lasiopteryx Westw.
  bb Antennae with 11–12, rarely 13–14 segments
    c Basal clasp segment of the male genitalia rather stout
      d Third vein nearly straight, uniting with costa near the apex, antennal segments sessile in both sexes.......... Arnoldia Kieff.
      dd Third vein strongly curved, uniting with costa at the distal 4th, antennal segments of the male stemmed...... Neuromyia Felt.

[1] Riveraella Kieff., Trichoperrisia Kieff., Xyloperrisia Kieff. and Pernettyella Kieff. appear to be closely related.

[2] We are unable at present to separate satisfactorily Microperrisia Kieff. from all members of this large series.

cc Basal clasp segment of the male genitalia very stout........... Macrolabis Kieff.

aa Palpi triarticulate

b Antennae with 15–20 segments, genitalia of male normal.......... Dryomyia Kieff.[1]

bb Antennae with 13–14 segments, the terminal clasp segment of the male genitalia short, swollen, the ovipositor moderate, stout with a slender apical spine................Cystiphora Kieff.[2]

bbb Antennae with 12 segments, the terminal clasp segment of the male genitalia long, slender, the ovipositor short, lobed.......... Rhizomyia Kieff.[3]

aaa Palpi biarticulate

b Antennae with 12 segments...............Coccidomyia Felt.

bb Antennae with 18 segments...........Diarthronomyia Felt

aaaa Palpi uniarticulate

b Antennal segments 17 or 18, claws trifid......................... Guarephila Tav.[4] (Brazilian)

RHABDOPHAGA Westw.

Dichelomyia Rübs. in part

Bertieria Kieff.

1847 **Westwood, J. O.** Gardeners Chronicle, p. 588
1850 **Loew, H.** Dipt. Beitr., 4:20, 21 (Cecidomyia in part)
1861 **Rondani, C.** Soc. Sci. Nat. Milano Atti, 2:286 (Cecidomyia in part)
1864 **Schiner, J. R.** Fauna Austrica Fliegen, 2:369 (Cecidomyia in part)
1876 **Bergenstamm, J. E. & Low, Paul.** Syn. Cecidomyidarum, p. 24
1892 **Rubsaamen, E. H.** Berl. Ent. Zeitschr., 37:346 (Dichelomyia in part)
1892 **Theobald, F. V.** Acct. Brit. Flies, p. 50 (Cecidomyia in part)
1896 **Kieffer, J. J.** Soc. Ent. Fr. Bul., p. 188–89 (Bertieria)
1897 ———— Syn. Cecid. de Eur. & Alg., p. 5 (Bertieria)
1900 ———— Soc. Ent. Fr. Ann., 69:444
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 351
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 45
1910 **Rubsaamen, E. H.** Zeitsch. Wissenschaft. Insektenbiol., 15:337
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:43

This genus comprises a number of large, usually reddish brown forms breeding mostly in woody galls, particularly those on willow. It intergrades with Dasyneura and the more typical members may be distinguished by the usually tapering third vein uniting with the

[1] Calopedila Kieff. and Spartomyia Kieff. are related forms.
[2] Geocrypta Kieff. is allied to this genus.
[3] Ctenodactylomyia Felt, MS may be separated from Rhizomyia by the larger number of antennal segments and especially by the pectinate claws.
[4] Scheuria Kieff. is recognizable by the unidentate claws and reticulate circumfili.

margin at or very near the apex of the wing. The type is Cecidomyia viminalis Westw. a species Kieffer considers identical with R. salicis Shrnk.

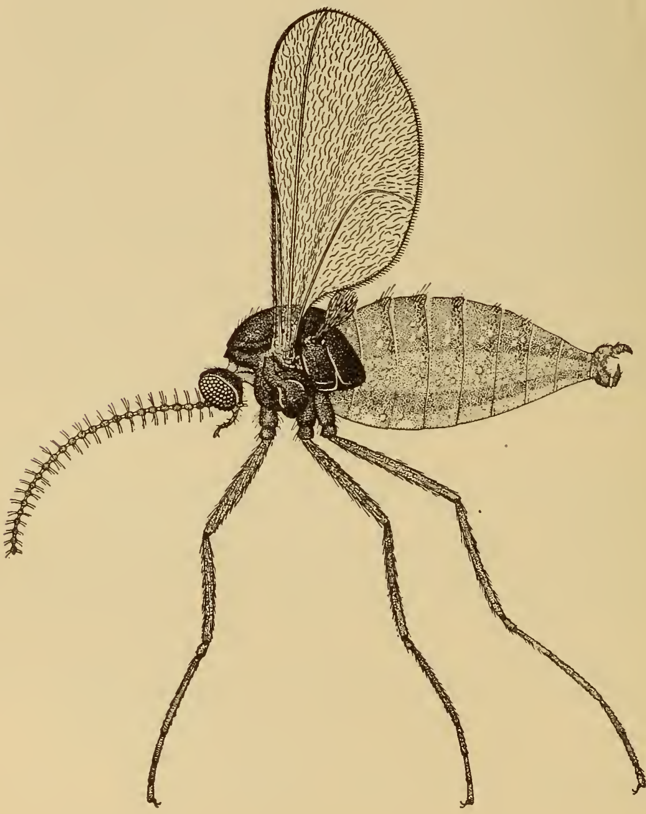

Fig. 14 Rhabdophaga species, showing the general characteristics of the genus (enlarged, original)

Key to species

a 14 antennal segments

b Segments sessile; abdomen reddish brown; claws rather stout. Reared apparently from a Rigidae gall........................... sodalitatis Felt, a1074b

aa 15 to 17 antennal segments

b Females; antennae short, segments sessile

c Third vein uniting with the costa at the apex; the ovipositor shorter than the body

d 17 antennal segments, the fifth with a length twice its diameter; the fourth palpal segment one-quarter longer than the third; the lobes of the ovipositor with a length three times the width. Reared from Triticoides and Hordeoides galls of Walsh............................
triticoides Walsh, a1087x, a1073x, a1101, a1076

dd 16 antennal segments

e Fifth antennal segment with a length twice its diameter, tapering distally; the fourth palpal segment with a length one-half greater than the third; the lobes of the ovipositor with a length three and one-half times their width. Reared from an apparently typical Strobiloides gall..persimilis Felt, a1811a

ee Fifth antennal segment with a length three times its diameter; fourth palpal segment a little longer than the third; lobes of the ovipositor broadly oval, with a length about one-quarter greater than the width. Reared from Elymus americanus..........
elymi Felt, C. 1044

ddd 15 antennal segments

e Fifth antennal segment with a length one-half greater than its diameter; ovipositor lobe with a length one-quarter greater than its width; abdomen dark red, yellowish basally. Reared from nodular gall at base of willow twigs............nodula Walsh, a1412

ee Fifth antennal segment with a length two and one-half times its diameter; ovipositor lobe with a length three times its width; the third and fourth palpal segments equal. Reared from willow twig..................
ramuscula Felt, a1449a ? C. 1242

cc Third vein uniting with the costa a little before the apex; ovipositor long

d 15 antennal segments

e Fifth antennal segment with a length one-half greater than its diameter

f Fifteenth antennal segment slightly extended, with a length only three times its diameter, the fourth palpal segment one-half longer than the third. Reared from rolled willow leaves..............
plicata Felt, C. 1037

ee Fifth antennal segment with a length twice its diameter

f Fifteenth antennal segment reduced, partly fused with the fourteenth; fourth palpal segment twice the length of the third; reared from crumpled soft maple leaf.........rileyana Felt, C. 1041

ff Fifteenth antennal segment normal, with a length three times its diameter; fourth palpal segment with a length one-half greater than the third; reared from maple leaves..aceris Shimer a2344

fff Fifteenth antennal segment extended, with a length fully five times its diameter; third and fourth palpal segments equal; ovipositor lobe with a length four times its diameter. Reared from small, clustered, rosette bud galls on willow.........
racemi Felt, C. 1245

dd 17 antennal segments

e Wings broad; fifth antennal segment with a length one-half greater than its diameter; fourth palpal segment with a length twice that of the third; ovipositor lobe with a length two and one-half times its diameter....
marginata Felt, C. 81

ee Wings narrow; fifth antennal segment with a length twice its diameter; the fourth palpal segment one-quarter longer than the third; ovipositor lobe with a length three times its width. Reared from irregular twig gall on willow.........salicis Schrank, a1356

bb Males; antennal segments stemmed

c Stem of fifth antennal segment with a length one-quarter that of the basal enlargement. Reared from rose.............
rosacea Felt, C. 1244

cc Stem of fifth antennal segments with a length one-half that of the basal enlargement

d Antennae slender, the basal enlargement of the fifth segment with a length twice its diameter; the palpi slender, the fourth one-quarter longer than the third; harpes with a long chitinous process apically. Reared from willow twig......................ramuscula Felt, a1449a

dd Antennae stout, the basal enlargement of the fifth segment with a length one-half greater than its diameter; the third and fourth palpal segments equal; harpes without long chitinous processes apically. Reared from a nodular gall at the base of willow twig..nodula Walsh, a1412, C. 779

ccc Stem of fifth antennal segment with a length three-quarters that of the basal enlargement

d Antennae nearly as long as the body

e The basal enlargement of the fifth antennal segment with a length twice that of its diameter

f Wings broad with a length only about one-half greater than the width

g 17 antennal segments, the fourth palpal segment one-half longer than the third. Reared from apparently normal willow buds.......
latebrosa Felt, C. a1958

ff Wings slender, with a length about two and one-half times their width

g Claws strongly curved, the basal tooth long

h 17 antennal segments, the basal enlargement of the fifth with a length two and one-half times its diameter; the fourth palpal segment one-quarter longer than the third. Reared from irregular stem gall on willow.........s a l i c i s Schrank, a1356.

gg Claws long, slightly curved, the basal tooth small

h 17 antennal segments, the basal enlargement of the fifth ovate, with a length twice its diameter..c a l i f o r n i c a Felt, C. 1012

hh 18 antennal segments, the fifth having the basal enlargement cylindric, with a length two and one-half times its diameter......
o c c i d e n t a l i s Felt, C. 1073

ee Basal enlargement of the fifth antennal segment with a length only one-half greater than its diameter

f 16 antennal segments; reared from a Triticoides and Hordeoides gall of Walsh......................
t r i t i c o i d e s Walsh, a1076, a1087c, a1093

dd Antennae about two-thirds the length of the body

e Subcosta uniting with the margin just before the basal half

f 15 antennal segments, the fifth having the basal enlargement with a length one-half greater than its diameter, the fourth palpal segment one-half longer than the third; reared from maple leaves
a c e r i s Shimer, a2344

ff 16 antennal segments, the fifth having the basal enlargement with a length twice its diameter; the fourth palpal segment twice the length of the third.................p r a t e n s i s Felt, C. 141

fff 16 antennal segments, the fifth having the basal enlargement one-half longer than its diameter; the third and fourth palpal segments equal; reared from small clustered rosette bud galls on willow
r a c e m i Felt, C. 1245

ee Subcosta uniting with the margin at the basal third

f Fifth antennal segment having the basal enlargement with a length one-half greater than its diameter

g 15 antennal segments; the ventral plate slender, deeply emarginate, the lobes short; harpes subacute..........a c e r i f o l i a Felt, C. 36

ff Fifth antennal segment having the basal enlargement with a length twice its diameter

g 15 antennal segments; harpes obliquely truncate with conspicuous quadrate teeth; reared from a subglobular polythalamous gall on side of willow twig..........g l o b o s a Felt, a1084

gg 17 antennal segments; harpes subacute with variable quadrate teeth; reared from a Triticoides and Hordeoides gall of Walsh......
t r i t i c o i d e s Walsh, a1076, a1087, a1093

cccc Fifth antennal segment with a stem one-quarter longer than the basal enlargement
d 16 antennal segments; the dorsal plate triangularly incised; ventral plate deeply and narrowly incised; reared from a deformed willow bud..........gemmae Felt, C. 254
ccccc Fifth antennal segment with a stem three times the length of the basal enlargement............porrecta n. sp., C. 1301
aaa 18 to 20 antennal segments
b Females, antennal segments sessile
c 18 antennal segments
d Antennal segments tapering distally
e Length 2.5 mm; abdomen dark brown; the fifth antennal segment with a length one-half greater than its diameter; thinly setulose; the fourth palpal segment one-half longer than the third; reared from whitish cocoons on poplar..populi Felt, C. 78x, a322, a1126
ee Length 3 mm; abdomen dark brown; the fifth antennal segment with a length twice its diameter; thickly setulose; fourth palpal segment one-quarter longer than the third; reared from a small, oval, rosette gall on willow............normaniana Felt, C. 1246
eee Length 3.5 mm; abdomen reddish brown; the fifth antennal segment with a length two and one-half times its diameter; fourth palpal segment a little longer than the third; reared from slender willow twigs....
caulicola Felt, C. a1822
eeee Length 1.5 mm; abdomen reddish brown; the fifth antennal segment with a length twice its diameter; thickly setulose; the fourth palpal segment one-quarter longer than the third; reared from twigs on Cephalanthus.........cephalanthi Felt, C. 1048
cc 19 or 20 antennal segments
d Abdomen dark brown; the fifth antennal segment with a length one-half greater than its diameter; the third and fourth palpal segments equal; reared from a gouty twig gall on willow......batatas Walsh, a686, a1102, a1108
dd Abdomen reddish brown; the fifth antennal segment with a length twice its diameter; the fourth palpal segment one-quarter longer than the third; reared from a fleshy pouch gall on Spiraea leaf...........................
salicifolia Felt, C. 1045, a1505
bb Males, antennal segments stemmed
c Stem of the fifth antennal segment one-third the length of the basal enlargement
d 19 antennal segments; length 3 mm; dorsal plate very deeply incised, almost divided; the harpes truncate............
consobrina Felt, C. 39
dd 18 antennal segments; length 2 mm; dorsal plate very deeply emarginate; harpes subtriangular; reared from whitish cocoon on poplar......populi Felt, C. 78x, a322, a1126

cc Stem of the fifth antennal segment one-half the length of the basal enlargement

d Length 2.5 mm; harpes rounded distally.................. absobrina Felt, C. 40

ccc Stem of the fifth antennal segment with a length three-quarters that of the basal enlargement

d Length 2.5 mm; ventral plate long, narrowly and deeply incised; reared from gouty gall on willow twig.......... batatas Walsh, a686, a1102, a1108

dd Length 2 mm; ventral plate long, deeply and roundly emarginate; reared from slender willow twigs.......... caulicola Felt, C. a1822

ddd Length 2 mm; ventral plate broad, deeply and roundly emarginate; reared in jar containing Schizomyia pomum galls on grape............................ hirticornis Felt, a1940, a1941

cccc Stem of the fifth antennal segment as long as the basal enlargement

d Length 1.5 mm; ventral plate long and broadly rounded distally; reared from pouch fold gall on Spiraea leaf.... salicifolia Felt, a1505

aaaa 21 or more antennal segments

b Females, segments sessile or subsessile

c Length 4 mm; 22 to 23 antennal segments, the fifth with a length twice its diameter; abdomen dark reddish brown; reared from inconspicuous swellings on willow twigs........ podagrae Felt, a1399, a1076y[1]

cc Length 5 mm; 26–29 antennal segments. Reared from clustered rosette gall on dwarf willow............................ rhodoides Walsh, C. 1247, 775–77

ccc 25 to 26 antennal segments; lateral whitish tufts on abdomen usually well marked; lobes of ovipositor oval with a length twice their breadth; reared from pine cone gall on willow.... strobiloides Walsh

cccc 24 antennal segments; the lateral tufts on abdomen not well marked; lobes of ovipositor long, narrowly oval, with a length two and one-half times the width; reared from leafy rosette gall on willow....................brassicoides Walsh

bb Males, antennal segments stemmed

c Stem of the fifth antennal segment with a length three-quarters that of the basal enlargement, males

d 23 antennal segments; the fourth palpal segment one-half longer than the third; apical processes on harpes short, broadly rounded; length 4 mm; lateral tufts on abdomen well marked; reared from pine cone gall on willow...... strobiloides Walsh, a1173, a1340, a1442, C. 1248

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[1] We have placed Rhabdophaga cornuta Walsh here provisionally owing to the similarity of the galls.

dd 22 antennal segments; fourth palpal segment as long as the third; the apical chitinous processes on the harpes long, subquadrate; length 3.5 mm; lateral tufts on abdomen not well marked; reared from leafy rosette gall on willow............brassicoides Walsh, a1433, a1467

ddd 23 to 25 antennal segments; harpes broadly truncate; length 4 mm; reared from large loose apical leaf gall on willow ? rhodoides Walsh, C. 775-77, 1247

dddd 21 to 23 antennal segments; length 3 mm; reared from slightly swollen willow twigs.............................. podagrae Felt, a1399, a1076y

Rhabdophaga sodalitatis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 351

The reddish brown female described below was reared at Albany, N. Y. April 13, 1906, from what appeared to be a typical Phytophaga rigidae gall on willow, Salix.

Female. Length 3 mm. Antennae extending to the second abdominal segment, sparsely haired, dark brown; 14 segments, the fifth with a length two and one-half times its diameter; terminal segment produced, with a length four times its diameter, subacute apically. Palpi; first segment long, expanded distally, the second as long as the first, rectangular, the third a little longer than the second, more slender, the fourth one-fourth longer than the third, slender. Mesonotum dark brown. Scutellum reddish brown. Abdomen dark brown. Wings hyaline, costa dark red, subcosta uniting therewith at the basal third. Halteres yellowish brown. Legs brownish yellow, the tarsi darker; claws slender, strongly curved, the pulvilli as long as the claws. Ovipositor nearly as long as the abdomen, the terminal lobes with a length nearly five times the width, tapering, narrowly rounded. Type Cecid. a1074b.

Rhabdophaga triticoides Walsh

1864 **Walsh, B. D.** Ent. Soc. Phila. Proc., 3:598 (Cecidomyia); p. 599 (C. hordeoides)

1867 ———— Ent. Soc. Phila. Proc., 6:225 (Cecidomyia)

1906 **Felt, E. P.** Ins. Affect. Prk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:745 (Cecidomyia and C. hordeoides)

1908 ———— N. Y. State Mus. Bul. 124, p. 351, 353

1908 **Jarvis, T. D.** Ent. Soc. Ont. 38th Rep't, p. 87-88

1909 ———— Ent. Soc. Ont. 39th Rep't, p. 92

1912 **Cosens, A.** Canad. Inst. Trans., 9:322-23 (Cecidomyia)

The gall of this species was recorded by Walsh as being very rare on Salix cordata near Rock Island, Ill. What we take to be a modified form of this gall was also described under the name of C. hordeoides. This gall is rather common in the vicinity of Albany, N. Y., has been taken by Miss Cora H. Clarke at Magnolia, Mass., is listed from Ontario, Canada, by Jarvis and is presumably widely distributed.

In early August the yellowish larvae may be found in cylindric, brown, hard cells 4 to 5 mm long and 1.5 mm in diameter. These cells are evidently in or near the center of a leaf bud and are surrounded by softer, green tissue from which they may frequently be drawn in part at least. The infestation by this midge results in dwarfing the buds and surrounding tissues, thus producing the characteristic "wheat-ear" deformity. The developing gall may be readily detected by the thick cluster of small leaves. The insect winters in the gall, the midges appearing in early spring. Several parasites have been reared from this deformity, Eupelmus dryorhizoxeni Ashm., Platygaster obscuripennis Ashm., Polynema striaticornis Girault and species of Polygnotus and Torymus.

Gall. The gall of this species is an irregular enlargement 1 to nearly 3 cm long and about 6 mm in diameter. It is evidently caused by the dwarfing of a number of adjacent buds and presents a remote resemblance to a head of wheat. See plates 13, 14.

Larva. Length 2 mm, stout, whitish or yellowish white; breastbone bidentate, the shaft obscure.

Male. Length 2 mm. Antennae two-thirds the length of the body, light brown; 17 segments, the fifth with a stem about ⅔ the length of the enlargement. Palpi; the first segment short, stout, second broader, almost oval, the third more slender, the fourth one-fourth longer. Head dark brown. Mesonotum dark brown, sublateral lines ornamented with yellowish white hairs. Scutellum, postscutellum and abdomen dark brown, the latter rather thickly clothed with yellowish hairs and with silvery reflections laterally. Wings hyaline, tinged with reddish about the base; costa dark brown; halteres yellowish transparent at base, fuscous apically. Legs light brown, silvery ventrally, tarsi darker; claws slender. Genitalia; basal clasp segment stout, terminal clasp segment broad at base. Dorsal plate broad, deeply emarginate; ventral plate broad, broadly emarginate. Harpes stout, with a stout, quadrate and a subconical tooth distally.

Female. Length 2.5 mm. Antennae about one-half the length of the body, light brown; 17 segments, the fifth nearly cylindric, sessile. Palpi; first segment slightly elongate, expanded distally, second suboval, third slightly fusiform and a little longer, fourth more slender and one-fourth longer. Head dark brown. Mesonotum dark brown, submedian lines ornamented with yellowish white hairs. Scutellum reddish brown, postscutellum lighter. Ovipositor long, acutely rounded. Cecid. a1101.

Rhabdophaga persimilis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 351

This moderate sized, reddish or dark brown species was apparently reared at Albany, N. Y., April 11, 1908 from a rather typical though slender R. strobiloides Walsh gall. It is possible that this species came from an unrecognized twig gall. Polygnotus species was also obtained.

Female. Length 3 mm. Antennae extending to the second abdominal segment, reddish brown; 16 sessile segments, the fifth tapering distally, with a length fully twice its diameter; terminal segment produced, evidently composed of two closely fused, subacute. Palpi; first segment short, stout, the second stout, with a length three times its width, the third a little longer, more slender, the fourth one-half longer than the third. Mesonotum dark brown, the submedian lines indistinct. Scutellum and postscutellum reddish brown. Abdomen dark brown. Wings hyaline, costa dark brown. Halteres probably yellowish brown. Legs dark brown, the tarsi almost black; claws stout, strongly curved, the pulvilli as long as the claws. Ovipositor about one-half the length of the abdomen, the terminal lobes with a length three times the width, narrowly rounded. Type Cecid. a1811a.

Rhabdophaga elymi Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:289

This reddish brown female was reared January 19, 1891 from Elymus americanus collected at Alameda, Cal.

Female. Length 2 mm. Antennae extending to the second abdominal segment, light brown; 16 segments, the fifth with a length at least three times its diameter; terminal segment produced, with a length two and one-half times its diameter and occasionally partially fused with the preceding. Palpi; first segment short, stout, the second narrowly oval, the third one-half longer than the second, slender, the fourth a little longer and more slender than the third. Mesonotum dark brown, the submedian lines fuscous yellowish. Scutellum reddish brown, postscutellum fuscous yellowish. Abdomen light reddish brown. Wings hyaline, costa pale straw. Halteres pale yellowish basally, reddish brown apically. Legs mostly a dull yellowish brown; claws slender, evenly curved, the basal tooth slender, pulvilli longer than the claws. Ovipositor stout, about one-quarter the length of the abdomen, the lobes broadly oval. Type Cecid. 1044.

Rhabdophaga nodula Walsh

1864 **Walsh, B. D.** Ent. Soc. Phil. Proc., 3:599 (Cecidomyia)
1906 **Felt, E. P.** Ins. Affect. Prk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:745
1908 ———— N. Y. State Mus. Bul. 124, p. 351, 352
1908 **Jarvis, T. D.** Ent. Soc. Ont. 38th Rep't, p. 87
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 92

This gall was recorded by Walsh as being rare on Salix longifolia near Rock Island, Ill. It is somewhat common in the vicinity of New York City, though it does not appear to be abundant around Albany. The insects winter in the gall, appearing in early spring. A circular gallery is first excavated nearly to the surface, leaving only a thin piece of bark attached by a few fibers here and there, which is readily pushed aside by the pupa as it emerges, the empty exuvium being left partly extruded. Platygaster obscuripennis Ashm. and Polygnotus species have been reared from this gall.

Gall. The gall of this species is a small, nodular swelling, usually encircling the base of the smaller branches. See plate 8, figure 1 and plate 12.

Male. Length 2.5 mm. Antennae extending to the fourth abdominal segment, fuscous brown; 16 segments, the fifth with a stem three-fourths the length of the subcylindric basal enlargement, which latter tapers slightly at each extremity; terminal segment prolonged, narrowly oval, irregularly rounded apically. Palpi; the first segment long, slightly swollen distally, the second shorter than the first, stout, irregularly subquadrate, the third a little longer than the second, more slender, slightly swollen distally, the fourth as long as the third, flattened, broader; face and mouth parts fuscous. Mesonotum dark brown, submedian lines thickly clothed with rather long, fuscous setae. Scutellum dark brown with numerous apical setae, postscutellum orange. Abdomen dark brown, the segments rather thickly margined posteriorly with long, fuscous hairs; genitalia dark brown. Wings hyaline, costa with the basal half black, the distal portion reddish. Halteres yellowish basally, fuscous apically. Legs a nearly uniform dark brown; claws long, slender, slightly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment short, stout; terminal clasp segment stout at base, obtuse; dorsal plate broad, long, deeply and triangularly incised; ventral plate broad, deeply and triangularly incised. Harpes broad, tapering, broadly rounded or subtruncate.

Female. Length 3.5 mm. Antennae extending to the second abdominal segment, sparsely haired, dusky yellowish, apical segments reddish; 15 segments, subsessile, tapering; the fifth with a length fully twice the diameter; face fuscous. Mesonotum reddish brown, the submedian lines distinct, rather thickly clothed with fuscous setae. Scutellum dark red, with a few apical setae, postscutellum and basal abdominal segment yellowish, the other abdominal segments dark red with a yellowish cast apically, each margined posteriorly with a rather thick conspicuous row of black setae; ovipositor orange. Wings, costa dark brown. Halteres fuscous yellowish basally, fuscous apically. Claws shorter than the pulvilli. Ovipositor probably one-half the length of the body, the terminal lobe short, broad, with a length about one-half greater than its diameter. Cecid. a1412.

Rhabdophaga ramuscula Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 351

This species was reared April 22, 1907 from a willow, Salix twig gall having every appearance of that of R. b a t a t a s taken on Staten Island.

Gall. Apparently identical in appearance with that of R h a b d o- p h a g a b a t a t a s Walsh.

Male. Length 1.75 mm. Antennae nearly as long as the body, dark brown; 16 or 17 segments, the fifth with a stem about three-fourths the length of the subcylindric basal enlargement; terminal segment narrowly oval. Palpi; first segment short, subrectangular, slightly swollen distally, the second a little longer, rounded at the extremities, the third as long as the second, more slender, the fourth one-half longer and slightly stouter than the third. Mesonotum dark brown, submedian lines rather thickly clothed with fine, yellowish hairs. Scutellum reddish brown, with a few long, yellowish setae apically, postscutellum dark brown. Abdomen dark brown, the segments posteriorly sparsely clothed with fine hairs, the genitalia and venter rather thickly so. Wings hyaline, costa dark brown. Halteres pale orange basally, fuscous apically. Legs reddish brown, the tarsi darker; claws long, slender, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment enlarged basally; dorsal plate broad, broadly and triangularly emarginate; ventral plate long, deeply and triangularly incised. Harpes short, stout, distally two or three long, diverging processes, each with a length two or three times its diameter.

Female. Length 2mm. Antennae about two-thirds the length of the body, dark brown; 16 segments, the fifth subsessile, cylindric; with a length nearly twice the diameter; terminal segment slightly prolonged, acute distally. Ovipositor nearly one-half the length of the abdomen, terminal lobes long, broad, broadly rounded. Otherwise as in the male. Type Cecid. a1449a.

Rhabdophaga plicata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 352

This species was reared from closely rolled leaves of willow May 21, 1886, presumably by Mr Pergande. The same National Museum note refers also to L u p i n u s a r b o r e a and there is a bare possibility that the two plants may have been confused.

Gall. The gall from which this insect was bred appears like several closely rolled terminal leaves.

Female. Length 1 mm. Antennae probably extending to the second abdominal segment, sparsely haired, dark brown; 15 segments, the fifth with a length one-half greater than its diameter, the terminal segment produced, with a length about three times its diameter. Palpi; first segment rather long, subquadrate, the second broadly oval, the third more slender, one-half longer, the fourth one-half longer than the third. Mesonotum dark brown, the submedian lines thickly haired. Scutellum yellowish brown, postscutellum darker. Abdomen reddish brown, sparsely haired. Wings hyaline, costa reddish brown. Halteres yellowish transparent. Legs a variable reddish brown, tarsi slightly darker; claws very strongly curved, the pulvilli about as long as the claws. Ovipositor about one-half the length of the abdomen, the terminal lobes long, slender, narrowly rounded. Type Cecid. 1037.

Rhabdophaga aceris Shim.

1868 **Shimer, Henry.** Amer. Ent. Soc. Trans., 1:281–83 (Cecidomyia)
1905 **Washburn, F. L.** Minn. Agric. Exp't Sta. Bul. 93, p. 65 (Cecidomyia)
1906 **Felt, E. P.** N. Y. State Mus. Mem. 8, 2:728 (Cecidomyia)
1911 ———— Econ. Ent. Jour., 4:452 (Cecidomyia)
1912 ———— N. Y. Ent. Soc. Jour., 20:239–40

The midge was reared by Doctor Shimer in midsummer from pale or whitish larvae on the surface of white or silver maple leaves, A c e r s a c c h a r i n u m. Doctor Shimer states that this species produces whitish cocoons upon the leaves, the midges emerging therefrom a week or two later. We have referred midges (a2344) reared by J. S. Houser of the Agricultural Experiment Station, Wooster, Ohio, August 9 and 26, 1912 to this species, and, in order to establish its identity more fully, published descriptions of both sexes. This form is closely related to R. r i l e y a n a Felt, the later being most easily distinguished by the long fourth palpal segment, it having a length twice that of the third. A study of a large series may show R. r i l e y a n a to be only a variety of Shimer's species.

Rhabdophaga rileyana Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:289

This species was reared by C. V. Riley June 15 and July 3, 1877 from a crumpled soft maple leaf having a portion badly folded, the folds being very irregular, thickened and somewhat shriveled.

Female. Length 1.25 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 15 segments, the fifth with a length twice its diameter, terminal segment slightly reduced, tapering from the distal fourth and slightly fused with the preceding. Palpi; first segment short, stout, subquadrate, the second narrowly oval, the third a little longer, more slender, the fourth twice the length of the third, slender. Mesonotum shining dark brown. Scutellum and postscutellum fuscous yellowish. Abdomen yellowish brown; ovipositor yellowish. Wings hyaline, costa light brown. Halteres yellowish transparent. Legs yellowish brown, the tarsi somewhat darker; claws long, slightly curved, the pulvilli as long as the claws. Ovipositor about one-half the length of the abdomen. Type Cecid. 1041.

Rhabdophaga racemi Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 352, 353

This reddish brown species was reared May 11, 1906 by Mr Norman Criddle of Aweme, Manitoba, from small, clustered galls arising from adjacent willow buds.

Gall. This is a small, clustered, rosette deformity arising from the closely set buds, the tip of the twig apparently becoming stunted on account of the infestation. The individual galls are about 2 cm long, 1 cm in diameter and composed of numerous closely set, aborted leaves, the central ones somewhat longer than the others and variously curled.

Male. Length 1.5 mm. Antennae as long as the body, rather thickly haired, yellowish brown; 16 segments, the fifth with a stem three-fourths the length of the basal enlargement, which latter has a length one-half greater than its diameter; terminal segment slightly reduced, narrowly oval. Palpi; first segment short, stout, the second broadly oval, the third stout, with a length four times its width, the fourth a little longer, more slender. Mesonotum dark brown, the yellowish submedian lines sparsely haired. Scutellum fuscous yellowish, postscutellum darker. Abdomen reddish brown. Wings hyaline, costa reddish brown. Halteres yellowish transparent. Coxae and femora basally yellowish, the distal portion of femora and tibiae reddish brown, the tarsi mostly dark brown; claws strongly curved, the pulvilli longer than the claws. Genitalia; basal clasp segment stout; terminal clasp segment stout; dorsal plate broad, deeply and triangularly incised, ventral plate long, slender, deeply and roundly emarginate. Harpes stout, irregular apically; style stout.

Female. Length 1.25 mm. Antennae extending to the third abdominal segment, thickly haired, dark brown; 15 segments, the fifth with a length one-half greater than its diameter, the terminal segment greatly produced, with a length four times its diameter, broadly rounded apically. Ovipositor about as long as the abdomen, the lobes slender, with a length four times the width, narrowly rounded. Type Cecid. 1245.

Rhabdophaga marginata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 352

This brown female was taken on choke cherry, Prunus virginiana, at Albany, N. Y., May 23, 1906

Female. Length 2.5 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 17 segments, the fifth sub-

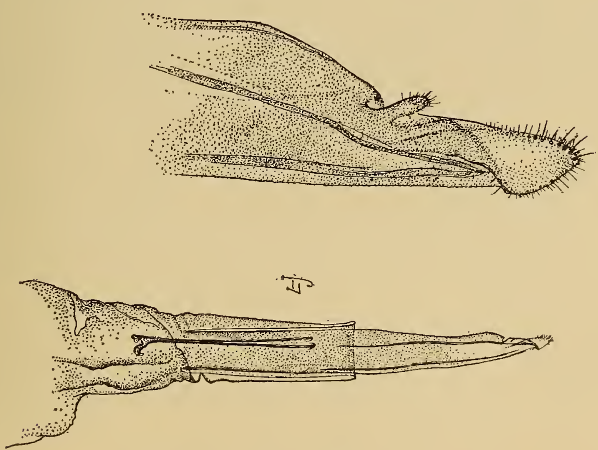

Fig. 15 Rhabdophaga marginata, ovipositor enlarged, the tip more enlarged (original)

sessile, subcylindric; terminal segment much prolonged, nearly twice the length of the preceding. Palpi; the first segment subquadrate, slightly swollen distally, the second one-half longer, suboval, the third one-fourth longer than the second, slender, slightly swollen distally, the fourth nearly twice the length of the third, slender. Mesonotum brown with apparently three rows of long hairs coalescing at the scutellum, which latter is covered with the same. Scutellum and postscutellum dark brown. Abdomen brown, the segments margined posteriorly with pale hairs. Wings hyaline, costa light brown. Legs pale, claws slender, strongly curved. Ovipositor nearly as long as the body; distal lobes long, slender, tapering. Type Cecid. 81.

Rhabdophaga salicis Schrk.

European willow gall midge

1803 **Schrank, F. v. P.** Fauna Boica III, 69, 2310 (Tipula)
1902 **Felt, E. P.** Inj. & Other Ins. N. Y. 17th Rep't p. 741–44
1906 ——— Ins. Affect. Pk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 1:299–302
1906 ——— Ins. Affect. Pk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:620
1908 ——— N. Y. State Mus. Bul. 124, p. 353

This European gall midge has evidently become well established in this country. It was first brought to our attention in 1898 by the reception of some European willow twigs kindly sent by Mr H. C. Peck of Rochester. The insects were reared therefrom, but the species was not determined beyond question till living material was submitted, in 1902, to Prof. J. J. Kiefer, the recognized European authority upon this group. This midge was doubtless introduced with imported nursery stock. Some infested willows were probably used around bundles of imported trees. The flies escaping therefrom made their way to willows growing in the vicinity of the packing grounds. This species attracted notice in the vicinity of Rochester because of the irregular, usually fusiform enlargements on young willow canes. These abnormal growths made the willows brittle and consequently unfitted them for binding bundles of nursery stock, for which they are extensively employed by many nurserymen. This species may eventually prove a serious pest to growers of willows for basket purposes.

Life history. Adults were reared from infested galls from May 22d onward. Other specimens, received directly from the field June 3d, were disclosing flies, showing that in nature the adults issue at this time. The pupae, like those of many Itonididae, wriggle partly out of the gall before disclosing the adult, and so many may emerge from one that it presents a somewhat peculiar appearance after the flies have escaped on account of the numerous white projecting pupal cases.

The reddish, oval eggs were deposited by captive flies on the leaves in irregular clusters or groups of three to six or more. The duration of the egg stage and of the larval existence was not determined. It seems very probable that there is but one generation annually.

Rhabdophaga rosacea Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 354

The male of this species was received May 15, 1906 from Mr Norman Criddle, Awema, Manitoba. The gall of presumably the same species (C. 1268) was found September 30, 1907 by Mr L. H. Weld, on a wild rose, Rosa, growing on low sand dunes at Beach, Ill., near Waukegan.

Gall. An apical loose bud gall some 2 to 2.5 cm in diameter and 3 to 3.5 cm long, the component leaflets rather loose, the general appearance being somewhat similar to that of the pine cone gall on willow, plate 11. There is an elongate central cell containing the pinkish larva.

Larva. Length 3 mm, stout, pale orange. Head small; antennae short, tapering; breastbone obsolescent. Skin coarsely shagreened; posterior extremity slightly lobed. Larva from Illinois specimens and tentatively referred to this species.

Male. Length 2.5 mm. Antennae extending to the third abdominal segment, yellowish brown; 16 segments, the fifth with a stem one-fourth the length of the basal enlargement, which latter has a length twice its diameter; terminal segment reduced, narrowly oval and sometimes fused with the preceding. Palpi; first segment produced, expanded distally, second with a length three times its width, the third a little longer, more slender, the fourth a little shorter than the third, dilated. Body probably reddish brown. Wings hyaline, costa dark brown. Halteres probably yellowish and fuscous. Legs presumably fuscous yellowish, the tarsal segments darker; claws rather slender, strongly curved, the pulvilli longer than the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment short, greatly swollen basally; dorsal plate deeply and triangularly emarginate; ventral plate rather short, deeply and triangularly emarginate. Harpes rather broad, truncate, dentate. Type Cecid. 1244.

Rhabdophaga latebrosa Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:290

This species was reared at Albany, N. Y., May 7, 1909, presumably from apparently normal willow buds, though the one bud showing an exit hole did not appear as though it has been recently deserted by a fly. This species was taken at Albany, N. Y.

Male. Length 1.5 mm. Antennae as long as the body, fuscous yellowish; 17 segments, the fifth with a stem three-fourths the length of the basal enlargement, which latter has a length two and one-half times its diameter; terminal segment reduced, narrowly oval. Palpi; first segment irregular, rectangular, the second with a length three times its diameter, the third a little shorter than the second and the fourth one-half longer and more slender than the third. Mesonotum reddish brown, the submedian lines sparsely haired. Scutellum and postscutellum dark brown, the latter orange mesially. Abdomen sparsely haired, yellowish brown; genitalia fuscous. Wings broad, hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Coxae and femora basally fuscous yellowish, the femora distally, tibiae and tarsi mostly dark brown; claws strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment slightly swollen basally; dorsal plate broad, deeply and triangularly emarginate; ventral plate broad, broadly and triangularly emarginate. Harpes stout, irregularly tuberculate. Type Cecid. a1958.

Rhabdophaga californica Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 353

The dark, reddish brown male described below was taken in Santa Clara county, California, in June. Nothing is known concerning its life history.

Male. Length 1.5 mm. Antennae about as long as the body, light brown; 17 segments, the fifth with a stem about three-fourths the length of the basal enlargement, which latter has a length about twice its diameter and tapers at both extremities; terminal segment short, stout, broadly oval. Palpi; the first segment rather slender, narrowly oval, the second a little longer, subrectangular, stouter, the third one-half longer and more slender than the second, the fourth one-half longer and much more slender than the third. Mesonotum dark brown, shining, the submedian lines sparsely haired. Scutellum light reddish brown, postscutellum a little darker. Abdomen dark reddish brown, rather sparsely haired. Wings hyaline, costa light brown. Halteres yellowish transparent. Legs a nearly uniform light reddish brown, the distal tarsal segments somewhat darker; claws long, rather slender, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment short, stout; terminal clasp segment short, stout at base; dorsal plate short, deeply and triangularly incised; ventral plate long, broad, deeply and roundly emarginate. Harpes long, broad, tapering, distally a group of five or six long, slender, chitinous processes. Type Cecid. 1012.

Rhabdophaga occidentalis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 353

This male was taken in Santa Clara county, California, in June.

Male. Length 2 mm. Antennae nearly as long as the body, dark brown; 18 segments, the fifth with a stem about three-fourths the length of the cylindric basal enlargement, which latter has a length three times its diameter; terminal segment greatly reduced, broadly fusiform. Palpi; first segment stout, with a length three times its diameter, the second broadly oval, a little shorter, the third one-half longer than the second, slender, the fourth one-half longer than the third. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum dark brown, with numerous coarse setae apically, postscutellum reddish brown. Abdomen dark reddish brown; genitalia slightly lighter. Wings hyaline, costa pale straw. Halteres pale yellowish. Legs a nearly uniform light yellowish brown; claws long, slender, strongly curved, minutely unidentate, the pulvilli longer than the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment long, stout; dorsal plate long, deeply and triangularly emarginate; ventral plate long, broad, very deeply and roundly emarginate. Harpes long, narrowly rounded.

Female. Length 2.5 mm. Antennae extending to the second abdominal segment, probably brown; 17 subsessile segments, the fifth with a length three and one-half times its diameter; terminal segment greatly produced, composed of two closely fused segments, narrowly rounded apically. Ovipositor about one-half the length of the body, the terminal lobes broad, with a length one-half greater than their width, broadly rounded. Other characters nearly as in the male. Type Cecid. 1073.

Rhabdophaga pratensis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 353

The dark brown male described below was taken on red clover, Trifolium pratense, at Albany, N. Y., June 4, 1906.

Male. Length 3 mm. Antennae probably extending beyond the base of the abdomen, dark brown; at least 12, probably 16 segments, the fifth with a stem about two-thirds the length of the subcylindric basal portion. Palpi; the first and second segments subequal, broadly oval, the third a little more prolonged, slender, the fourth over twice the length of the preceding, much more slender. Mesonotum, scutellum and postscutellum very dark brown. Abdomen dark brown. Wings hyaline, costa reddish brown. Halteres pale. Legs pale brown or reddish, tarsi a little darker; claws stout, strongly curved at the distal third. Genitalia; basal clasp segment stout; terminal clasp segment stout, obtuse; dorsal plate broad, deeply and triangularly incised; ventral plate broad, deeply and roundly emarginate. Harpes stout, subtriangular, the broadly rounded apex bearing three long, subquadrate processes. Type Cecid. 141.

Rhabdophaga acerifolia Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 112. Sep. p. 16

1908 ———— N. Y. State Mus. Bul. 124, p. 354

This dark brown male was taken on a hedgerow composed of maple, elm and various bushes at Albany, N. Y., May 17, 1906.

Male. Length 1.5 mm. Antennae about two-thirds the length of the body, dark brown; 15 segments, the fifth with a stem two-thirds the length of the slightly swollen basal enlargement; terminal segment prolonged, rounded at base, obtuse apically. Palpi; the first segment short, swollen distally, the second nearly twice the length of the first, elliptical, the third a little longer, more slender than the second, and the fourth a little longer than the third. Mesonotum dark brown. Scutellum reddish brown, postscutellum dark brown and orange, basal abdominal segment dark brown, the others light brown, all sparsely clothed with whitish hairs, genitalia drak brown. Wing, pl.5, fig. 2. Costa dark brown. Halteres yellowish transparent, somewhat fuscous apically. Legs variable brownish, tarsi darker; claws rather stout, strongly curved. Genitalia; basal clasp segment stout; terminal clasp segment broad at base, tapering; dorsal plate broad, deeply emarginate; ventral plate slender, deeply emarginate. Harpes stout, tapering, irregularly rounded, subacute. Type Cecid. 36.

Rhabdophaga globosa Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 354

This species was reared at Albany, N. Y., May 7, 1906 from willow, Salix, twigs bearing small, rounded galls, a portion of the surface showing a discolored dead area.

Male. Length 2 mm. Antennae two-thirds the length of the body, light brown; 15 segments, the fifth with a stem about two-thirds the length of the enlargement. Palpi; the first segment short, slightly swollen distally, the second and third subequal, rather slender, the fourth more slender and about one-half longer than the third. Head fuscous. Mesonotum dark brown with the sublateral lines marked by yellowish white hairs. Scutellum reddish brown. Abdomen dark brown, rather sparsely clothed with yellowish white hairs and with silvery white reflections laterally. Wings hyaline, costa dark brown. Halteres yellowish transparent basally, reddish brown apically. Legs dark brown, silvery ventrally; tarsi blackish. Genitalia; basal and terminal clasp segments stout; dorsal plate broad, deeply excavated; ventral plate narrow, deeply emarginate. Harpes thick, convolute, a bidentate quadrate tooth distally. Type Cecid. a1084a.

Rhabdophaga gemmae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 354

This male was reared at Albany, N. Y., from a peculiar, stunted, elongate willow, Salix, tip in the middle of June 1906.

Gall. This appears much like a thickened bud, the scales being closely set beside each other, the deformity being approximately an inch long, with a rounded, somewhat loose tip. The cocoons were found lying between the imbricated bud scales.

Male. Length 1 mm. Antennae longer than the body, light brown; 16 segments, the fifth with a stem one-fourth longer than the basal enlargement; terminal segment slightly prolonged, suboval. Palpi; the first segment subquadrate, somewhat dilated distally, the second a little stouter and longer than the first, the third one-half longer than the second, more slender, the fourth nearly twice the length of the third, more slender. Mesonotum dark brown, submedian lines sparsely ornamented with light setae. Scutellum light brown with sparse apical setae. Abdomen nearly uniform dull brown. Wings hyaline, costa dark brown; halteres whitish transparent. Legs light brown; claws stout, uniformly curved. Genitalia; basal clasp segment long, stout; terminal clasp segment stout at base. Dorsal plate broad, deeply and triangularly incised; ventral plate stout, broad, deeply and narrowly incised. Harpes stout, subtriangular.

Female. Length 1.5 mm. Antennae nearly as long as the body, light brown; 14 segments, the fifth sessile; terminal segment slightly prolonged, narrowly oval. Palpi; the first segment subquadrate, swollen distally, the second longer than the first, subrectangular, the third a little longer, more slender, the fourth longer than the third. Ovipositor nearly as long as the body, terminal lobes long, slender, narrowly rounded. Type Cecid. 254.

Rhabdophaga porrecta n. sp.

This remarkable form was taken April 5, 1908 by C. P. Alexander at Gloversville, N. Y. It is anomalous in that the antennal characters are most suggestive of the Epidosariae, while the wing, tarsal and genitalic characters indicate strong affinities with this genus.

Male. Length 2 mm. Antennae probably three or four times the length of the body, dark brown, with at least 9 and probably 16 segments, the fifth having a stem with a length about three times that of the basal enlargement, which latter has a length twice its diameter. Palpi; first segment short, stout, narrowly oval, the second one-half longer and a little stouter, the third nearly twice the length of the preceding, the fourth one-half longer than the third, more slender. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum dark reddish brown, postscutellum dark brown. Abdomen dull reddish brown, the pleurae dark brown, genitalia fuscous yellowish. Wings narrow, hyaline, costa light brown. Halteres pale yellowish. Coxae dark brown, femora dull brown, tibiae and three basal tarsal segments fuscous yellowish, the distal tarsal segment variably tinged with reddish and reddish brown; claws long, slender, evenly curved, pulvilli as long as the claws. Genitalia; basal clasp segment stout, with a conspicuous apical lobe internally; terminal clasp segment long, stout; dorsal plate long, broad, broadly and triangularly incised; ventral plate long, broad, broadly and roundly emarginate. Harpes stout, acute apically. Type Cecid. 1301.

Rhabdophaga populi Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 112. Sep. p. 16
1908 ———— N. Y. State Mus. Bul. 124, p. 354, 355

This dark brown species was reared at Albany, N. Y., May 25, 1909 from cocoons taken at the base of poplar, Populus tremuloides, buds collected at Karner, N. Y. The midge winters in the cocoon, appearing in early spring. A species of Polygnotus was reared from this gall.

Cocoon. Oval, whitish, about 2 mm long.

Male. Length 2 mm. Antennae extending nearly to the tip of the abdomen, sooty yellowish; 18 segments, the fifth with a stem one-third the length of the basal enlargement; terminal segment reduced, suboval. Palpi; first segment broad, subrectangular, second a little more slender, longer, the third one-half longer than the second, more slender, the fourth one-fourth longer than the third, fusiform and more slender; face dark brown, narrowly margined with silvery white; mesonotum dark brown, with submedian lines of silvery white hairs and groups of the same at the base of the wing. Scutellum dark brown, postscutellum reddish brown. Abdomen dark brown, thinly clothed dorsally and thickly so laterally with silvery hairs. Wings hyaline, costa and subcosta light brown, tinged with reddish near the apex. Halteres reddish transparent at base, yellowish red apically. Legs nearly uniform brown dorsally, silvery ventrally; tarsi possibly a little darker; claws stout, uniformly curved. Genitalia; basal clasp segment stout; terminal clasp segment swollen at the basal fourth; dorsal plate broad, deeply emarginate; ventral plate broad, deeply incised. Harpes subtriangular, tapering, obtuse, with a minor chitinous lobe bearing a long, slender, obtuse tooth. See plate 5, figure 1 and plate 7, figure 2, for illustrations of the wing and genitalia respectively.

Female. Length 2.5 mm. Antennae extending to the base of the abdomen, yellowish brown; 18 segments, the fifth subsessile, the enlargement having a length one-half greater than its diameter; terminal segment reduced, subovoid. Palpi; first segment stout, subquadrate, second one-half longer, subrectrangular, the third more slender and one-fourth longer than the preceding, the fourth one-half longer than the third, more slender; face yellowish brown, margined posteriorly with silvery gray hairs. Abdomen dark brown, incisures dark reddish, the segments fringed posteriorly with silvery hairs and the sides rather thickly clothed with the same. Ovipositor about one-third the length of the abdomen, the terminal lobes long, narrowly rounded. Type Cecid. a322.

Rhabdophaga normaniana Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 354

This species was reared May 17, 1906 from a small apical gall on willow, Salix, received from Mr Norman Criddle, Aweme, Manitoba.

Gall. A small, oval terminal bud gall resembling an aborted Rhabdophaga brassicoides gall.

Female. Length 3.5 mm. Antennae extending to the second abdominal segment, dark brown; 18 segments, the fifth with a length about twice its diameter; terminal segment produced, with a length two and one-half times its diameter. Palpi; first segment subtriangular, second rectangular, with a length three times its width, the third a little longer, more slender, the fourth longer and more slender than the third. Mesonotum shining black, sparsely haired. Scutellum and postscutellum shining black. Abdomen sparsely haired, dark reddish brown. Wings hyaline, costa fuscous yellowish. Halteres whitish fuscous subapically. Legs mostly fuscous yellowish, the distal tarsal segments darker; claws stout, strongly curved, the pulvilli as long as the claws. Ovipositor about half the length of the body, the lobes with a length two and one-half times the width, narrowly rounded.

Male. Length 3 mm. Antennae nearly as long as the body, dark brown; 22 segments, the fifth with a stem one-half the length of the basal enlargement, which latter has a length one-half greater than its diameter; terminal segment reduced, narrowly oval. Palpi; first segment with a length twice its diameter, the second a little longer, more slender, the third longer and more slender than the second, the fourth as long as the third, slender. Genitalia; basal clasp segment long, terminal clasp segment long, stout; dorsal plate deeply and triangularly incised; ventral plate deeply and roundly emarginate. Harpes long, stout, truncate, with a large, quadrate tooth. Type Cecid. 1246.

Rhabdophaga caulicola Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:290

This reddish brown species was reared in April 1908 from slender willow twigs similar to those producing Sackenomyia packardi Felt and collected by Mr L. H. Weld at Evanston, Ill. Eurytoma and Decatoma species were reared, presumably from this midge.

Gall. This species was reared from long, slender, hardly swollen willow, Salix, twigs similar to those producing Sackenomyia packardi.

Larva. Length 3 mm, dark orange, moderately stout. Head small; antennae short; breastbone bidentate, the anterior lateral angles greatly produced though not dentate as in Sackenomyia, the shaft slender, strongly chitinized. Skin coarsely shagreened; posterior extremity broadly rounded.

Male. Length 2 mm. Antennae extending to the fourth abdominal segment, dark brown; 18 or 19 segments, the fifth with a stem about three-fourths the length of the basal enlargement, which latter has a length about twice its diameter, terminal segment somewhat produced, cylindric, with a length about three times its diameter and distally tapering irregularly to a subacute apex. Palpi; the first segment irregular, stout, with a length over twice its diameter, the second a little shorter, subrectangular, the third one-half longer than the second, more slender, the fourth about as long as the third. Mesonotum dark brown, the submedian lines thickly haired. Scutellum dark brown, postscutellum fuscous yellowish. Abdomen dark reddish brown, sparsely haired; genitalia dark brown. Wings hyaline, costa yellowish, subcosta uniting with the anterior margin before the basal half. Halteres fuscous, reddish apically. Legs tinged with reddish and thickly clothed with silvery scales; claws long, slender, evenly curved, the pulvilli a little longer than the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment rather short, stout; dorsal plate long, broad, deeply and triangularly emarginate; ventral plate long, broad, deeply and roundly emarginate. Harpes long, stout, tapering, irregularly truncate, with several subquadrate chitinous spurs.

Female. Length 3.25 mm. Antennae extending to the second abdominal segment, light brown, the basal segments fuscous yellowish; 18 segments, subsessile, the fifth with a length about two and one-half times its diameter; terminal segment slightly produced, with a length over twice its diameter and tapering to an acute apex. Palpi; the first segment short, stout, subquadrate, the second with a length about two and one-half times its diameter, subrectangular, the third about as long as the second, more slender, the fourth a little longer and more slender than the third; face fuscous yellowish. Mesonotum reddish brown, the submedian lines thickly haired. Scutellum reddish orange, postscutellum orange. Abdomen reddish brown, membrane and pleurae deep orange; ovipositor fuscous yellowish. Wings hyaline, costa dark brown. Halteres light fuscous yellowish. Coxae and base of femora fuscous yellowish, the femora distally, tibiae and tarsi dark brown, the latter almost black; the pulvilli as long as the claws. Ovipositor about as long as the abdomen, the terminal lobes with a length nearly four times their width, tapering, narrowly rounded. Type Cecid. a1822.

Rhabdophaga cephalanthi Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 355

This yellowish brown form was reared at the division of entomology, United States Department of Agriculture, from twigs of button ball, Cephalanthus occidentalis, collected by Rev. J. L. Zabriskie at Nyack, N. Y., January 7, 1884.

Male. Length 1.5 mm. Antennae probably nearly as long as the body, fuscous yellowish; presumably 18 segments, the fifth with a stem about three-quarters the length of the subcylindric basal enlargement, which latter has a length fully twice its diameter. Mesonotum reddish brown. Scutellum yellowish brown, postscutellum a little darker. Abdomen a dark yellowish brown, somewhat darker basally and apically. Wings hyaline, costa fuscous yellowish. Halteres probably pale yellowish. Legs a nearly uniform yellowish straw. Genitalia; basal clasp segment long, stout; terminal clasp segment stout; dorsal plate broad, deeply and triangularly emarginate; ventral plate long, broad, deeply and roundly emarginate. Harpes long, stout, obliquely truncate, with chitinous tubercles at the external angles.

Female. Length 1.5 mm. Antennae extending to the second abdominal segment, fuscous yellowish; 18 segments, the fifth with a length twice its diameter, tapering distally; terminal segment reduced, narrowly oval. Palpi; first segment short, stout, subquadrate, the second suboval, the third one-half longer, more slender, the fourth as long as the third. Mesonotum reddish brown. Scutellum and postscutellum fuscous yellowish. Abdomen reddish brown, sparsely clothed with fuscous scales, the posterior segments thinly clothed with long, yellowish setae; ovipositor pale yellowish. Halteres yellowish basally, fuscous apically. Legs mostly dark reddish brown; claws stout, strongly curved, the basal tooth heavy, the pulvilli as long as the claws. Ovipositor two-thirds the length of the abdomen, the terminal lobes slender, with a length four times their width, narrowly rounded. Type Cecid. 1048.

Rhabdophaga batatas Walsh

Willow potato gall

1864 **Walsh, B. D.** Ent. Soc. Phila. Proc., 3:601–6 (Cecidomyia)

1870 ———— Amer. Ent., 2:299, 301 (Eurytoma studiosa Say and Decatoma nubilistigma, parasites, Cecidomyia)

1890 **Cockerell, T. D. A.** Ent., p. 279–80

1892 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Bul. 4, p. 268 (Cecidomyia)

1896 **Marlatt, C. L.** U. S. Dep't Agric., Div. of Ent., Tech. Ser. 3, p. 22 (Nematus fur ? = Amauronematus luteotergum reared from gall)

1900 **Smith, J. B.** List Ins. N. J., p. 620

1904 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Guide Leaflet 16, p. 29

1906 **Felt, E. P.** Injur. & Other Ins. N. Y., 21st Rep't, p. 119–22

1906 ———— Ins. Affect. Prk. & Wdld. Trees. N. Y. State Mus. Mem. 8, 2:745

1908 **Jarvis, T. D.** Ent. Soc. Ont. 38th Rep't, p. 86

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 355

1909 **Jarvis, T. D.** Ent. Soc. Ont. Bul. 39th Rep't, p. 92

1912 **Cosens, A.** Canad. Inst. Trans., 9:324–25

This somewhat characteristic gall is rather common upon willow, Salix, twigs in the vicinity of Albany, N. Y. and in the neighborhood of New York City. Illinois specimens in the Museum of Comparative Zoology at Cambridge, Mass., are smaller than those commonly occurring in this State. Apparently the same gall has been received from Prof. T. D. A. Cockerell, Colorado. The adults winter in the gall, appearing in early spring. The wing and genitalia are illustrated on plate 5, figure 4 and plate 7, figure 3 respectively.

The gall is a very irregular, polythalamous enlargement occurring on the shoots of the low swamp willow, Salix humilis. It varies greatly in size and somewhat in form. See plate 9, figure 1. Polygnotus species was reared from this gall.

Rhabdophaga salicifolia Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 12–13
1908 ———— N. Y. State Mus. Bul. 124, p. 293–94, 355

This characteristic gall is somewhat common on meadowsweet, Spiraea salicifolia, in the vicinity of Albany, N. Y., and is quite abundant in some sections of eastern Massachusetts. It was taken by Miss Cora H. Clarke in the vicinity of Magnolia, Mass. The midges were reared in July 1907 from galls taken near Albany, N. Y. Torymus ostensackenii D. T. was also reared from this gall.

Gall. This is a thickened, greenish fold of the midrib 1 to 1.5 cm long and about 6 mm in diameter, plate 4, figure 12. It is inhabited by several pale yellowish larvae.

Male. Length 1.5 mm. Antennae probably a little longer than the body, dark brown; at least 12 and probably 20 segments, the fifth with a stem about as long as the basal enlargement, which latter has a length nearly twice its diameter. Palpi; first segment short, stout, irregularly subquadrate, the second stout, rounded at the extremity, subrectangular, with a length fully twice the diameter, the third one-half longer and more slender than the second, the fourth a little longer and more slender than the third; face fuscous. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum a deep reddish brown, postscutellum dark fuscous. Abdomen dark brown, sparsely clothed with fine hairs. Wings hyaline, costa light brown. Halteres fuscous basally, fuscous yellowish apically. Legs a somewhat variable fuscous yellowish, the femora basally light yellowish; claws long, slender, strongly curved, the pulvilli a little longer than the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment short, stout; dorsal plate short, broadly and triangularly incised; ventral plate long, broad, broadly and roundly emarginate. Harpes short, stout, scarcely tapering, irregularly truncate and with several chitinous spurs.

Female. Length 2.5 mm. Antennae extending to the fourth abdominal segment; fuscous yellowish; 20 sessile segments, the fifth with a length fully two and one-half times its diameter; terminal segment greatly produced, narrowly rounded distally. Abdomen very sparsely clothed with fine hairs, brown, the incisures and pleurae deep orange, the ovipositor pale yellowish, ventral sclerites dark brown. Ovipositor probably one-half the length of the abdomen, the terminal lobes long, narrowly oval. Type Cecid. a1505.

The following references apply with little question to the species described above. It may be noted that this gall occurs on Spiraea salicifolia, S. tomentosa and S. betulaefolia.

1867 **Osten Sacken, C. R.** Ent. Soc. Phila. Proc., 6:220
1907 **Jarvis, T. D.** 37th Rep't Ent. Soc. Ont., p. 68
1907 **Cook, M. T.** Acad. Sci. Proc., Sep. p. 8
1908 **Jarvis, T. D.** Ent. Soc. Ont., 38th Rep't, p. 88
1909 ———— Ent. Soc. Ont., 39th Rep't, p. 90
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 35

Rhabdophaga consobrina Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 113, Sep. p. 17
1908 ———— N. Y. State Mus. Bul. 124, p. 355

This dark brown male was taken May 17, 1906 at Albany, N. Y., in the vicinity of maple, elm and various bushes.

Male. Length 3 mm. Antennae shorter than the body, dark brown; 19 segments, the fifth with a stem about one-third the length of the basal enlargement; terminal segment greatly prolonged, broadly rounded apically, slightly constricted at the distal third. Mesonotum dark brown, submedian lines rather thickly dark haired. Palpi; first segment subquadrate, the second one-half longer than the first, a little stouter, the third a little longer than the second, more slender and the fourth one-half longer than the third. Scutellum dark brown, thickly clothed with yellowish white hairs, postscutellum reddish anteriorly, dark brown posteriorly. Abdomen dark brown, sparsely clothed with whitish hairs. Wings subhyaline, costa dark brown. Halteres yellowish transparent at base, fuscous apically. Legs dark brown, lighter ventrally; tarsi darker; claws stout, strongly curved. Genitalia; basal clasp segment stout; terminal clasp segment swollen basally; dorsal plate deeply incised; ventral plate narrow at base, dilating distally, deeply and triangularly emarginate. Harpes convolute, broadly truncate and with a subquadrate, chitinous process apically. Type Cecid. 39. See plate 5, figure 3 and plate 7, figure 4 for illustrations of the wing and genitalia respectively.

Rhabdophaga absobrina Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 113. Sep. p. 16–17
1908 ———— N. Y. State Mus. Bul. 124, p. 355

This dark brown male was taken May 17, 1906 at Albany, N. Y., in the vicinity of maple, elm and various bushes.

Male. Length 2.5 mm. Antennae extending to the base of the abdomen, dark brown; 19 segments, the fifth with a stem about one-half the length of the basal enlargement; terminal segment prolonged, broadly rounded. Palpi; first segment subquadrate, the second and third one-half longer than the first, a little more slender, the fourth one-quarter longer than the third; face dark brown. Mesonotum dark brown with distinct sublateral and submedian rows of golden yellow hairs. Scutellum and postscutellum reddish brown. Abdomen dark brown, rather thickly clothed laterally with silvery white hairs in patches. Wings hyaline, costa dark brown. Halteres yellowish transparent basally, fuscous apically. Legs a variable brown, lighter ventrally; tarsi dark brown; claws slender, strongly curved. Genitalia; basal clasp segment stout; terminal clasp segment swollen at base, obtuse; dorsal plate deeply incised, almost divided; ventral plate broad at base, deeply incised. Harpes stout, strongly chitinized internally, slightly convolute, broadly rounded and with two apposed subquadrate chitinous processes. Type Cecid. 40.

Rhabdophaga hirticornis Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:290

This species was reared at Albany, N. Y., September 20, 1908 and April 1909 from jars containing various Cecidomyiid galls, notably those of Caryomyia persicoides and Schizomyia pomum. It is probable that the association of this insect with these two species was accidental.

Male. Length 2 mm. Antennae nearly as long as the body, 18 segments, the fifth with a stem three-quarters the length of the cylindric basal enlargement, which latter has a length one-quarter greater than its diameter; terminal segment reduced, narrowly oval. Palpi fuscous yellowish; first segment irregularly subquadrate, the second with a length five times its diameter, the third a little longer, dilated, the fourth as long as the third, slender. Mesonotum reddish brown, the submedian lines and anterior and lateral margins thickly white-haired. Scutellum and postscutellum reddish brown. Abdomen dark brown, the segments sparsely margined posteriorly with whitish hairs; pleurae yellowish white, venter pale yellowish; genitalia fuscous yellowish. Wings hyaline, costa dark brown. Halteres yellowish transparent. Coxae and femora basally yellowish, the distal portion of femora and tibiae fuscous yellowish, the tarsi mostly dark brown; claws large, slender, curved, unidentate, the pulvilli longer than the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment long, stout; dorsal plate rather long, broad, deeply and narrowly incised; ventral plate long, deeply and broadly emarginate. Harpes rather long, broad.

Female. Length 2.25 mm. Antennae extending to the second abdominal segment, dark brown; 19 subsessile segments, the fifth cylindric, with a length one-half greater than its diameter; terminal segment somewhat produced, narrowly oval. Palpi fuscous yellowish, the first segment presumably subquadrate, the second stout, with a length about three times its diameter, the third as long as the second and the fourth a little longer than the third. Mesonotum dull black, the submedian lines and sublateral areas thickly clothed with pale yellow hairs. Scutellum reddish brown, postscutellum darker. Abdomen dark brown, the segments sparsely margined posteriorly with yellowish hairs, incisures and pleurae deep reddish; ovipositor fuscous yellowish. Wings as in the opposite sex. Halteres pale orange basally, yellowish apically; coxae dark brown; femora and tibiae mosty fuscous yellowish, tarsi dark brown; claws and pulvilli as in the male. Ovipositor about half the length of the abdomen; terminal lobes with a length about five times their width. Type Cecid. a1941.

Rhabdophaga podagrae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 355

This species produces rather long inconspicuous swellings in willow, Salix, twigs, the dark brown midges appearing in early spring. This gall was taken at East Schodack, N. Y. Polygnotus and Eurytoma species were reared from shoots infested with larvae of this midge and those of Sackenomyia packardi Felt. The same insect appears to produce a fusiform gall 4 by .6 cm on Salix cordata, since specimens were received from Dr A. Cosens, Toronto, Can., Sept. 2, 1913.

Fig. 16 Rhabdophaga podagrae, gall (natural size, original)

Gall. A uniform swelling of the twig some 5 to 7 cm in length and about 1 cm in diameter, irregularly channeled by orange larvae. See plate 8, figure 2.

Male. Length 3 mm. Antennae nearly as long as the body, dark brown; 21 segments, the fifth with a stem about three-quarters the length of the subcylindric basal enlargement, which latter has a length about one-third greater than its diameter; terminal segment reduced, broadly fusiform, obtuse apically. Palpi; first segment subrectangular, slightly swollen distally, the second one-half longer, more slender, the third one-quarter longer and more slender than the second, and the fourth a little longer than the third; face fuscous, sparsely clothed with light hairs, narrowly margined posteriorly with white. Mesonotum dark brown, sparsely bordered laterally with yellowish hairs, the submedian lines thickly clothed with diverging yellowish hairs. Scutellum dark brown with a few yellowish setae apically; postscutellum dark brown. Abdomen dark brown, sparsely clothed with fine hairs, the segments margined posteriorly with longer setae; venter sparsely clothed with short, yellowish setae. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs rather variable brown, tarsi dark brown; claws long, slender, strongly curved, the pulvilli longer than the claws. Genitalia; basal clasp segment stout; terminal clasp segment slender, tapering; dorsal plate long, broad, deeply and narrowly incised; ventral plate broad, tapering, broadly and deeply incised, the lobes long, narrow, tapering, obtuse. Harpes broad at base, tapering, obtuse, entire surface evenly covered with short, stout setae; style short, stout, broadly rounded.

Female. Length 4 mm. Antennae extending to the third abdominal segment, dark brown, the basal segment thickly clothed ventrally with silvery scales; 22 or 23 segments, the fifth subsessile, subcylindric, with a length about twice the diameter; the distal two or three segments in the specimen described are fused into a spiral compound mass, the apex obtuse. Abdomen dark reddish brown, the segments sparsely margined posteriorly with pale yellowish hairs, the incisures deep red, the ovipositor pale fuscous yellowish, the venter dull reddish brown, the median sclerites a dark brown and sparsely clothed with short, silvery hairs. Wings hyaline, costa dark brown; the ovipositor at least one-half the length of the abdomen; terminal lobe long, broad, acute. Otherwise nearly as in the male. Type Cecid. a1399.

Rhabdophaga cornuta Walsh

1864 **Walsh, B. D.** Ent. Soc. Phila. Proc., 3:624–26 (Cecidomyia)

1870 ———— Amer. Ent., 2:299 (Eurytoma studiosa Say, reared, Cecidomyia)

1906 **Felt, E. P.** Ins. Affect. Prk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:735

This species appears to inhabit willow stems in very much the same way as the preceding midge. It is possible that they are closely related. The larva, according to Walsh, bores cylindric holes into the solid wood of the largest willow, Salix, stems. They generally work rather close to the point from which galls of R. brassicoides arise and usually where the growth of a good sized willow stem has been arrested. These midge larvae produce elongate, oval swellings. The interior of the galleries is always much blackened and discolored. The first sign of infestation is usually the circular exit hole. It is recorded as very rare near Rock Island, Ill. We have observed a very similar gall rather commonly on willow at West Nyack, N. Y., though we have been unable to rear a midge therefrom. Eurytoma studiosa Say was reared from the gall of this species.

Rhabdophaga rhodoides Walsh

1864 **Walsh, B. D.** Ent. Soc. Phila. Proc., 5:586–88

1867 ——— Ent. Soc. Phila. Proc., 6:224

1896 **Marlatt, C. L.** U. S. Dep't Agric., Div. Ent., Tech. Ser. 3, p. 22 (Nematus inquilinus reared from gall)

1906 **Felt, E. P.** Ins. Affect. Prk & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:745

This rather large, loose gall on willow, Salix, appears to be the work of a western or central species, since we have it only from Illinois and Aweme, Manitoba.

Gall. The midges undoubtedly winter in the gall. Specimens of this gall in the Museum of Comparative Zoology at Cambridge, Mass., show that the head is much looser than is the case with the gall produced by R. strobiloides and that the distal third of the central leaves is free, while most of the basal leaves are entirely so. The gall is smaller and the aborted leaves shorter and more compact than they are in the deformity produced by Rhabdophaga coryloides.

Male. Length 3.5 mm. Antennae about as long as the body, reddish brown; 25 segments, the fifth with a stem about one-half the length of the basal enlargement, which latter has a length twice its diameter; terminal segment fused with the preceding. Palpi; first segment with a length about three times its diameter, the second twice the length of the first, the third a little longer than the second, more slender, the fourth about as long as the second, slender. Mesonotum dark brown, submedian lines sparsely haired. Scutellum reddish brown, postscutellum yellowish brown. Abdomen rather thickly haired, dark reddish brown. Wings hyaline, costa dark brown. Halteres brownish basally, yellowish white apically. Coxae dark brown; femora, tibiae and tarsi yellowish brown, the distal segments somewhat darker; claws stout, strongly curved, the pulvilli longer than the claws. Genitalia; basal clasp segment long, slender, terminal clasp segment long; dorsal plate long, deeply and triangularly incised; ventral plate long, deeply and triangularly emarginate. Harpes long, broadly rounded.

Female. Length 5 mm. Antennae extending to the second abdominal segment, reddish brown; 29 sessile segments, the fifth with a length about twice its diameter; terminal segment tapering distally and slightly fused with the preceding. Palpi; first segment with a length about two and one-half times its diameter, the second a little longer, the third one-half longer than the second, more slender, the fourth about as long as the third, slightly dilated. Ovipositor about one-quarter the length of the abdomen, terminal lobes with a length about two and one-half times the diameter, narrowly rounded. Cecid. 1247.

Rhabdophaga strobiloides Walsh

1862 **Osten Sacken, C. R.** Mon. Dipt. N. A., 1:203 (Cecidomyia)
1864 **Walsh, B. D.** Ent. Soc. Phila. Proc., 3:580–82 (Cecidomyia)
1867 ———— Ent. Soc. Phila. Proc., 6:269 (Apion lanuginosum (walshii) reared, Cecidomyia)
1869 **Riley, C. V. & Walsh, B. D.** Am. Ent., 1:105 (Cecidomyia)
1869 **Packard, A. S.** Guide to the Study of Insects, p. 377 (Cecidomyia)
1870 **Walsh, B. D.** Am. Ent., 2:299 (Eurytoma studiosa Say reared, Cecidomyia)
1874 **Glover, Townend.** MS. Notes from My Journal, pl. II, fig. 15 (Cecidomyia)
1884 **Smith, J. B.** Am. Ent. Soc. Trans., 11:57–58 (Apion walshii Smith reared, Cecidomyia)
1890 **Riley, C. V. & Howard, L. O.** Ins. Life, 2:353 (Chelonus parvus Say reared, Cecidomyia)
1892 **Beutenmueller, William.** Am. Mus. Nat. Hist. Bul. 4, p. 267–68 (Cecidomyia)
1894 **Comstock, J. H.** Man. for the Study of Insects, p. 455 (Fig.)
1896 **Marlatt, C. L.** U. S. Dep't Agric. Div. Ent., Tech. Ser. 3, p. 22 (Nematus pomum reared, Cecidomyia)
1900 **Smith, J. B.** List Ins. N. J., p. 620 (Cecidomyia)
1904 **Beutenmueller, William.** Am. Mus. Nat. Hist. Guide Leaflet 16, p. 28 (Cecidomyia)
1904 **Cook, M. T.** Dep't Geol. Nat. Res. Ind. 29 Rep't, p. 840 (Cecidomyia)
1906 **Felt, E. P.** Ins. Affect. Prk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:639, 746
1907 **Jarvis, T. D.** Ent. Soc. Ont. 37th Rep't, p. 66
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 355, 356
1909 ———— Ent. Soc. Ont. Rep't, p. 92 (Cecidomyia)
1909 **Brodie, William.** Can. Ent., 41:249–51
1910 **Cook, M. T.** Mich. Geol. & Biol. Surv. Pub. 1, Biol. Ser. 1, p. 31 (Cecidomyia)
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 11
1912 **Cosens, A.** Canad. Inst. Trans., 9:325

This gall is a somewhat common one in New York State and New England. The dark brown adults pass the winter as larvae in the gall, appearing in early spring. Polygnotus species was reared from this gall.

Gall. This is a loose, cabbagelike apical deformity some 2 to 2½ cm in diameter and about 3 to 4 cm long. The bracts give shelter to the larvae of several inquilines.

Male. Length 4 mm. Antennae about two-thirds the length of the body, dark brown; 23 segments, the fifth with a stem about three-quarters the length of the basal enlargement; terminal segment somewhat prolonged. Palpi; first segment irregularly subquadrate, slightly swollen distally, the second longer, a little stouter, the third a little shorter and more slender than the second, the fourth about one-third longer than the third, more slender; face fuscous. Mesonotum dark brown, the submedian lines thickly clothed with long, gray setae. Scutellum dark brown or black with numerous long, gray setae apically, postscutellum dark brown. Abdomen dark brown, incisures dull red, the segments margined posteriorly, especially laterally, with long, grayish white setae; venter rather thickly clothed with short, silvery setae. Wings hyaline, costa dark brown. Halteres a dull salmon, fuscous subapically. Legs a variable gray, the femora and tibiae with sparse, irregular dark brown markings; tarsi dark brown or black; claws rather short, stout, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment swollen at the base; dorsal plate broad, deeply and triangularly incised; ventral plate long, stout, deeply and rather broadly emarginate. Harpes long, stout, convolute, obliquely truncate.

Female. Length 4 to 5 mm. Antennae extending to the third abdominal segment, dark brown; 25–26 subsessile subcylindric segments, the two terminal ones usually fused, subobtuse distally. Ovipositor reddish brown; venter with the median sclerites dark brown, sparsely clothed with short, silvery hairs, the sublateral areas suffused with the same. Legs somewhat variable yellowish or reddish brown, the femoral and tibial articulations deep red; tarsi normally dark brown. Ovipositor about one-half the length of the abdomen, the terminal lobe broad, tapering, narrowly rounded. Otherwise nearly as in the male. Cecid. a1442.

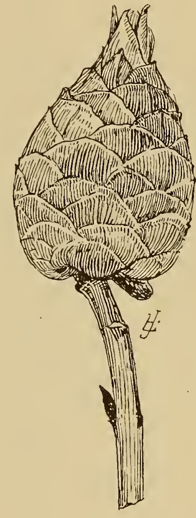

Fig. 17 Rhabdophaga strobiloides, typical gall (natural size, original)

Rhabdophaga brassicoides Walsh

Willow cabbage gall

1864 **Walsh, B. D.** Ent. Soc. Phila. Proc., 3:577–80 (Cecidomyia)

1869 **Packard, A. S.** Guide to Study of Ins., p. 377 (Cecidomyia)

1870 **Walsh, B. D.** Amer. Ent., 2:299 (Eurytoma studiosa Say, reared, Cecidomyia)

1890 **Cockerell, T. D. A.** Entomologist, p. 280 (Cecidomyia)

1892 **Beutenmueller, William.** Am. Mus. Nat. Hist. Bul. 4, p. 268 (Cecidomyia)

1895 **Townsend, C. H. T.** Can. Ent., 27:205–7 (Cecidomyia)

1896 **Marlatt, C. L.** U. S. Dep't Agric., Tech. Ser. 3, p. 22 (Pteronus mendicus, reared, Cecidomyia)

1900 **Smith, J. B.** List Ins. N. J., p. 620 (Cecidomyia)

1906 **Felt, E. P.** Ins. Affect. Pk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:563, 567, 745, 746 (Cecidomyia)

1908 **Jarvis, T. D.** Ent. Soc. Ont., 38th Rep't, p. 87
1909 ———— Ent. Soc. Ont., 39th Rep't, p. 91
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 11

This small, close apical gall on willow is very common in New York State. The larvae inhabit a large central cell and transform to adults in early spring. The male has 23 antennal segments, the fifth with a stem three-quarters the length of the basal enlargement. The female has 24 antennal segments, the fifth with a length about one-quarter greater than its diameter.

Gall. Length and diameter approximately 1 to 2 cm. This is a close, apical gall and is composed of a series of broad, appressed rudimentary leaves.

Male. Length 3.5 mm. Antennae nearly as long as the body, light brown fuscous basally, 23 segments, the fifth with a stem about three-fourths the length of the basal enlargement, which latter has a length slightly greater than its diameter; terminal segment frequently somewhat reduced and partially fused with the preceding. Palpi; first segment rather short, slightly swollen distally, with a length fully twice its diameter, the second cylindric, one-half longer than the first, the third as long as the second, and the fourth a little longer than the third, all nearly equal in size, thickly clothed with narrow scales and sparsely so with stout setae; face fuscous, sparsely clothed with yellowish setae, obscurely margined posteriorly with fine, yellowish hairs. Mesonotum dark brown, the submedian lines and lateral margins thickly clothed with rather long, spreading yellowish setae. Scutellum a deep red with numerous yellowish setae apically, postcutellum darker. Abdomen dark brown, rather thickly and uniformly clothed with yellowish setae. Genitalia slightly darker. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous yellowish apically, dark brown subapically. Legs a fuscous yellowish basally, the tarsi mostly dark brown; claws long, stout, strongly curved, the puvilli longer than the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment long, slender; dorsal plate broad, deeply and rather broadly incised; ventral plate long, broad, deeply and triangularly emarginate. Harpes long, narrow, obtuse, apically a heavy, broad, subquadrate, chitinous process.

Female. Length 4 mm. Antennae extending to the third abdominal segment, dark brown; 24 segments, the fifth cylindric, subsessile, with a length about one-fourth greater than its diameter, the last segment prolonged. Scutellum dark brown with numerous pale yellowish setae apically, postscutellum a reddish brown. Abdomen dark brown, the segments margined posteriorly with rather long, whitish hairs, most abundant laterally, incisures deep red, venter sparsely suffused with silvery white scales, yellowish red, the median sclerites dark brown. Ovipositor about one-half the length of the abdomen, the terminal lobes long, stout, broadly rounded. Otherwise nearly as in the male. Cecid. a1433.

DASYNEURA Rond.

Perrisia Rond.

Dichelomyia Rubs. in part.

Neocerata Coq.

1846 **Rondani, Camillo.** Nouv. Ann. Sci. Nat. Bologna, S. 2, 6:371 (p. 371, footnote Perrisia proposed, type C. urticae)
1850 **Loew, H.** Dipt. Beitr., 4:20 (Cecidomyia)
1861 **Rondani, Camillo.** Atti Soc. Ital. Sci. Milano 2:2
1862 **Osten Sacken, C. R.** Dipt. N. Am. Mon., 1:175 (Cecidomyia)
1864 **Schiner, J. R.** Fauna Austrica Dipt., 2:369 (Cecidomyia)
1876 **Bergenstamm, J. E. & Low, Paul.** Syn. Cecidomyidarum, p. 23
1877 **Karsch, F. A. F.** Revis. Gallmucken, p. 15
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:37, 38, 42, 43, 60, 61 (Cecidomyia)
1892 **Rubsaamen, E. H.** Berl. Ent. Zeit., 37:346 (Dichelomyia in part)
1892 **Theobald, F. V.** Acct. Brit. Flies, p. 50, 52 (Cecidomyia)
1895 **Kieffer, J. J.** Wien. Ent. Zeit., 15:86
1896 ——— Soc. Ent. Fr. Bul., 65:189 (Bertieria)
1897 ——— Syn. Cecid Eur. & Alg., p. 6 (Perrisia)
1900 **Coquillett, D. W.** U. S. Dep't Agr., Bur. Ent. Bul. 22, n. s., p. 44 (Neocerata)
1900 **Kieffer, J. J.** Soc. Ent. Fr. Ann., 69: 440
1901 ——— Suite Syn. Cecid. Eur. & Alg., p. 16 (Neocerata)
1904 ——— Soc. Sci. Brux. Ann., 38: 13 (Perrisia)
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 340–42
1910 **Rubsaamen, E. H.** Zeitsch. Wissenschaft. Insektenbiol., 15:337
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:43

This genus comprises a large number of medium and rather small, usually dark brown insects which breed by preference in leafy tissues. The group intergrades with Rhabdophaga and the more typical forms may be distinguished therefrom by the heavy, nearly uniform third vein uniting with the margin well before the apex of the wing. The type is Dasineura luteofusca Rond.

There has been in earlier years a most unfortunate disagreement as to the concept represented by the genus Cecidomyia. A number of the earlier authors have insisted on applying this generic designation to a series of species which we have referred to this genus and its allied forms. Contemporaries of some of these earlier writers have insisted, and we believe rightfully, that Cecidomyia could be applied only to a series of insects represented by the Cecidomyia pini of DeGeer and have used the term Dasyneura for species referable to this group. The consequence has been that some writers have employed the designation of Cecidomyia to represent a certain group of insects, while others have used it in a totally different sense. The type of the genus D. sisymbrii Schrnk. is a well-known species, and a study of its structures should forever obviate any further danger of confusion

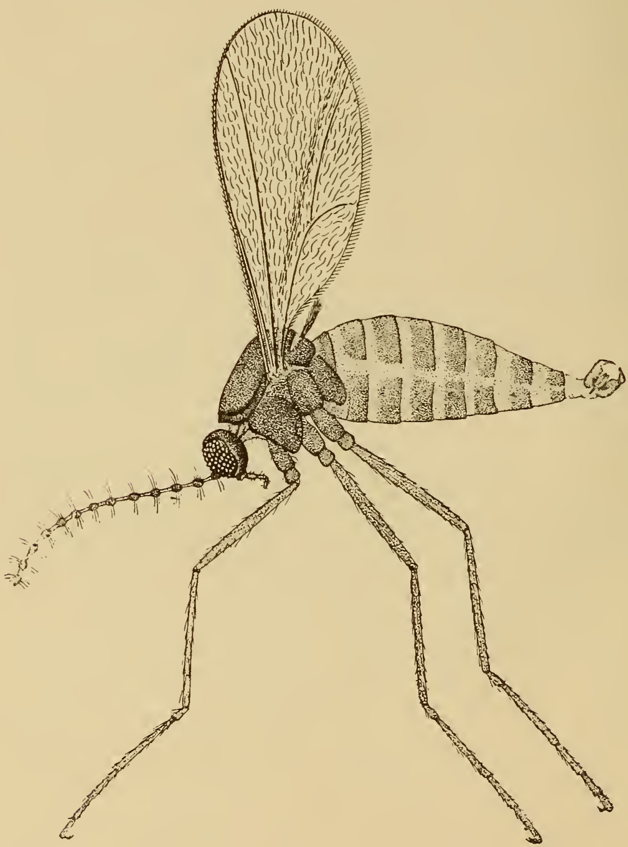

Fig. 18 Dasyneura gibsoni, showing the general characteristics of the genus (much enlarged, original)

with the more typical Cecidomyia. The generic term Perrisia, proposed by Rondani in 1846 for D. urticae Perris, agrees so closely with D. sisymbrii Schrnk. that we are unwilling to accord it generic rank, despite the fact that there are certain well-marked antennal differences between the two.

Key to species

a Third vein distinctly curved anteriorly

b 9 antennal segments; abdomen yellowish. Reared from rose.. rhodophaga Coq., C. a1390

bb 10 antennal segments, females

c Abdomen pale yellowish; scutellum reddish brown; antennal segments sessile, the fifth with a length twice its diameter, the terminal one with a length four times its diameter; ovipositor lobes short, stout............. maculosa Felt, C. 288

bbb 12 antennal segments, sessile or subsessile

c Abdomen and scutellum deep carmine; the fifth antennal segment with a length twice its diameter, the terminal one with a length six times its diameter; lobes of the ovipositor with a length three times their width, female. Reared from solidago......carbonaria Felt, C. 713

cc Abdomen and scutellum dark reddish brown, the fifth antennal segment with a length one-half greater than its diameter, the terminal one with a length five times its diameter; lobes of the ovipositor with a length four times their width, female. Taken on New Jersey tea... vernalis Felt, C. 262

ccc Abdomen dark reddish salmon; scutellum red; fifth antennal segment with a length two and one-half times its diameter, the terminal segment not produced, male ....bidentata Felt, C. 345

bbbb 13 antennal segments, sessile or subsessile, females

c Abdomen fuscous yellowish, unicolorous; scutellum light reddish brown; fifth antennal segment with a length one-half greater than its diameter; ovipositor as long as the abdomen, the lobes with a length four times their width. Reared from ash............................ fraxinifolia Felt, C. a1648a

cc Abdomen fuscous yellowish basally, yellowish apically; scutellum fuscous yellowish; fifth antennal segment with a length twice its diameter, the terminal one greatly produced; ovipositor one-half the length of abdomen, the oval lobes with a length thrice their width. Reared from tumid gall on grape.............. vitis Felt, C. a1165b

ccc Abdomen yellow, thorax tinged with red. Reared from root gall on Rhus..........................rhois Coq.

cccc Abdomen dark red; scutellum reddish brown; fifth antennal segment with a length three times its diameter; the terminal segment produced, the ovipositor nearly as long as the abdomen......karnerensis Felt, C. 128

ccccc Abdomen and scutellum reddish brown; fifth antennal segment with a length two and one-half times its diameter, the terminal segment produced.................. spiraeina Felt, C. 133

cccccc Abdomen dark orange; scutellum dark brown; fifth antennal segment with a length two and one-half times its diameter, the terminal one with a length four times its diameter; ovipositing in June grass................ graminis Felt, C. 1209

bbbbb 14 antennal segments

c Females; antennal segments sessile; ovipositor long

d Abdomen yellowish or yellowish orange

e Abdomen light yellowish; scutellum pale yellowish; fifth antennal segment with a length one-half greater than its diameter; lobes of the ovipositor long, nearly oval, hardly tapering distally, the fourth palpal segment nearly twice the length of the third. Reared from loose bud gall on peppermint.......................... piperitae Felt, C. a1663a

ee Abdomen fuscous yellowish; scutellum light reddish brown; fifth antennal segment with a length one-half greater than its diameter, the fourth palpal segment one-half longer than the third; lobes of the ovipositor with a length four times their width. Reared from ash........... fraxinifolia Felt, C. a1648a

eee Abdomen light yellowish red; scutellum yellowish carmine; fifth antennal segment with a length one-half greater than its diameter, the third and fourth palpal segments subequal, the lobes of the ovipositor very long, with a length seven times their width......borealis Felt, C. 160

eeee Abdomen yellowish brown; scutellum reddish brown; fifth antennal segment with a length twice its diameter, terminal antennal segment much produced, the third and fourth palpal segments equal; terminal lobes of the ovipositor long, slender and narrowly oval. Reared from acorns................glandis Felt, C. 1030

dd Abdomen dark brown

e Scutellum fuscous red; fifth antennal segment with a length twice its diameter, tapering distally, the third and fourth palpal segments nearly equal.........aurihirta Felt, C. 509

ee Scutellum yellowish brown; fifth antennal segment with a length one-third greater than its diameter, the fourth palpal segment one-half longer than the third. Reared from blackberry blossoms..........rubiflorae Felt, C. 990

eee Scutellum fuscous yellowish; fifth antennal segment with a length twice its diameter, the fourth palpal segment one-half longer than the third. Reared from a loose bud gall on anemone...... anemone Felt, C. a1522 *cc* Males; antennal segments stemmed

d Fifth antennal segment with a stem one-third the length of the basal enlargement

e Abdomen dark brown; scutellum yellowish; terminal clasp segment of the male genitalia short, and relatively stout..........................
photophila Felt, C. 194

ee Abdomen yellowish brown; scutellum pale yellowish; terminal and basal clasp segments long and slender. Reared from Yucca.................
yuccae Felt, C. 1053

dd Fifth antennal segment with a stem three-fourths the length of the basal enlargement

e Abdomen fuscous yellowish, unicolorous; basal enlargement of the fifth antennal segment with a length one-half greater than its diameter, the fourth palpal segment three-fourths longer than the third, the dorsal plate deeply and triangularly incised..fraxinifolia Felt, C. a1648a

ee Abdomen fuscous yellowish basally and apically, the middle segment dark brown, the basal enlargement of the fifth antennal segment with a length twice its diameter, the fourth palpal segment one-third longer than the third, the dorsal plate narrowly incised........................
ampelophila Felt, C. 449

eee Abdomen light brown; scutellum yellowish brown; basal enlargement of the fifth antennal segment with a length one-fourth greater than its diameter, the fourth palpal segment one-half longer than the third, the dorsal plate deeply and triangularly incised. Reared from blackberry blossoms....rubiflorae Felt, C. 990

eeee Abdomen dark brown

f Basal enlargement of the fifth antennal segment with a length twice its diameter; terminal segment with a distinct process...
setosa Felt, C. 750

ff Basal enlargement of the fifth antennal segment with a length one-half greater than its diameter; terminal segment narrowly oval, with the apical process rudimentary or wanting; palpi rather slender; basal tooth of the claw very long

g Basal clasp segment stout, with a length three times its diameter, tapering distally
unguicula Felt, C. 1225, 712, 745, 749

gg Basal clasp segment slender, with a length four times its diameter, hardly tapering distally.......pudorosa Felt, C. 279

fff Basal enlargement of the fifth antennal segment with a length one-fourth greater than its diameter, palpi rather stout, the fourth segment one-fourth longer than the third, the tooth of the claw relatively short...... simulator Felt, C. 445, 627

ddd Fifth antennal segment with a stem as long as the basal enlargement

e Abdomen reddish brown; scutellum fuscous brown; fourth palpal segment one-fourth longer than the third. Reared from folded leaves of Lupinus............trifolii Loew, C. 1034

bbbbbb 15 antennal segments

c Females; segments sessile

d Abdomen dark brown; scutellum reddish brown; fifth antennal segment with a length two and one-half times its diameter; ovipositor not longer than the body, the lobes with a length about five times their width...............trifolii Loew, C. 456, 742

dd Abdomen dark brown; scutellum brownish red; fifth antennal segment with a length two and one-half times its diameter; ovipositor distinctly shorter than the body, the lobes with a length about three times their width. Reared from apical bud gall on blueberry...........cyanococci Felt, C. a1700

ddd Abdomen pale yellowish; scutellum pale orange; fifth antennal segment with a length one-half greater than its diameter; ovipositor longer than the body, the lobes with a length four times their width...... flavescens Felt, C. 601

cc Males; antennal segments stemmed

d Fifth antennal segment with a stem one-half the length of the basal enlargement

e Abdomen brownish black; genitalia yellow. Reared from a root gall on Rhus..rhois Coq.

dd Fifth antennal segment with a stem three-fourths the length of the basal enlargement

e Abdomen light fuscous yellowish; scutellum pale orange, the basal enlargement of the fifth antennal segment with a length twice its diameter; the fifteenth reduced. Reared from Clematis... clematidis Felt, C. a1659

ee Abdomen yellowish red; scutellum yellowish; the basal enlargement of the fifth antennal segment with a length one-fourth greater than its diameter, the fifteenth produced and with a length three times its diameter............... filicis Felt, C. 43

eee Abdomen dark brown, the basal enlargement of the fifth antennal segment with a length one-

half greater than its diameter, the fifteenth not produced, nearly oval. Reared from a loose apical bud gall on anemone....................
anemone Felt, C. a1522

ddd Fifth antennal segment with a stem as long as the basal enlargement

e Abdomen reddish brown; scutellum fuscous brown, the fourth palpal segment one-fourth longer than the third. Reared from folded leaves of white clover..........................
trifolii Loew, C. 1032

bbbbbbb 16 antennal segments

c Females; antennal segments sessile

d Abdomen dark brown; scutellum reddish orange; fifth antennal segment with a length one-half greater than its diameter. Reared from pouch gall on narrow-leaved Solidago...........................
flavicornis Felt, C. a1154

dd Abdomen dark brown; scutellum yellowish orange; fifth antennal segment with a length twice its diameter. Reared from rolled leaves of beach-pea......
maritima Felt, C. a1895

ddd Abdomen reddish or light brown

e Abdomen reddish brown; scutellum fuscous yellowish; fifth antennal segment with a length twice its diameter. Reared from leaf gall on cranberry...........vaccinii Smith, C. 957

ee Abdomen light brown; scutellum dark red; fifth antennal segment with a length one-half greater than its diameter.....modesta Felt, C. 1200

dddd Abdomen yellowish

e Abdomen and scutellum pale yellowish; fifth antennal segment with a length one-half greater than its diameter. Reared from ash..........
apicata Felt, C. a1712

ee Abdomen fuscous yellowish; scutellum light fuscous yellowish; fifth antennal segment with a length three-fourths greater than its diameter. Reared from Clematis...................
clematidis Felt, C. a1659

eee Abdomen yellowish or reddish orange; fifth antennal segment with a length twice its diameter; reared from rolled Smilax leaves..............
smilacifolia Felt, C. a2214

cc Antennal segments stemmed

d Fifth antennal segment with a stem one-quarter the length of the basal enlargement

e Abdomen and scutellum yellowish red; fifth antennal segment with a length two and one-half times its diameter; female....................
caricis Felt, C. 111

dd Fifth antennal segment with a stem three-fourths the length of the basal enlargement; males

e Abdomen dark brown; scutellum reddish brown; basal enlargement of the fifth antennal segment with a length one-half greater than its diameter quercina Felt, C. 47

ee Abdomen yellowish or reddish orange; basal enlargement of the fifth antennal segment with a length two and one-half times its diameter; reared from rolled smilax leaves............ smilacifolia Felt, C. a2214

eee Abdomen reddish brown; basal enlargement of the fifth antennal segment with a length one-half greater than its diameter; reared from a midrib gall on Virginia creeper............... parthenocissi Stebb. C. a2293

ddd Fifth antennal segment with a stem as long as the basal enlargement; males

e Abdomen reddish brown; scutellum fuscous yellowish; basal enlargement of the fifth antennal segment with a length two and one-half times its diameter, the third and fourth palpal segments equal. Reared from leaf gall on cranberry...............vaccinii Smith, C. 957

ee Abdomen reddish brown; scutellum fuscous brown; basal enlargement of the fifth antennal segment with a length one-half greater than its diameter, the fourth palpal segment one-quarter longer than the third. Reared from folded leaves of white clover..trifolii Loew

dddd Fifth antennal segment with a length one-quarter greater than the basal enlargement; males

e Abdomen yellowish brown; scutellum reddish brown; basal enlargement of the fifth antennal segment with a length two and one-quarter times its diameter......caricis Felt, C. 110

bbbbbbbb 17 antennal segments

c Females; antennal segments sessile

d Abdomen dark brown; scutellum yellowish orange; fifth antennal segment with a length twice its diameter. Reared from rolled leaves of beach-pea maritima Felt, C. a1895

dd Abdomen brown; fifth antennal segment with a length twice its diameter; reared from root gall on smilacina................smilacinae Bish., C. a2126

ddd Abdomen reddish brown; scutellum fuscous yellowish; fifth antennal segment with a length one-quarter greater than its diameter; ovipositor two-thirds the length of the abdomen, terminal lobes short and broad. Reared from Lepidium........ lepidii Felt, C. 1035

dddd Abdomen dark reddish brown; fifth antennal segment with a length one-quarter greater than its diameter; ovipositor as long as the body; reared from a midrib gall on Virginia creeper....................
parthenocissi Stebb. C a2293

cc Males; antennal segments stemmed

d Fifth antennal segment with a stem one-third the length of the basal enlargement, the latter with a length twice its diameter........................
smilacinae Bish., C. a2126

dd Fifth antennal segment with a stem one-half the length of the basal enlargement

e Abdomen pale yellowish; scutellum reddish brown; basal enlargement of the fifth antennal segment with a length twice its diameter. Reared presumably from the common tumid midrib gall on ash....
tumidosae Felt, C. a1532

ee Abdomen dark red, scutellum fuscous yellowish; basal enlargement of fifth antennal segment with a length one-half greater than its diameter; reared from western wild cherry fruit..................
pergandei Felt, C. 820p

bbbbbbbbb 18 antennal segments

c Females; antennal segments sessile

d Abdomen pale reddish brown; scutellum dull brown; fifth antennal segment with a length one-half greater than its diameter; ovipositor as long as the body..........multiannulata Felt, C. 261

dd Abdomen dark reddish brown; scutellum yellowish brown; ovipositor one-half the length of the body, stout, the terminal lobes very short and broad....
florida Felt, C. 1057

cc Males; fifth antennal segment with a stem three-quarters the length of the basal enlargement

d Abdomen light brown; scutellum yellowish, fuscous apically. Reared from rolled leaves of beach-pea
maritima Felt, C. a1895

bbbbbbbbbb 20 antennal segments

c Males; fifth antennal segment with a stem as long as the basal enlargement; abdomen yellowish. Reared from Eugenia.......................eugeniae Felt, a2258

aa Third vein straight or nearly so

b Antennal segments 11, sessile, the fifth with a length one-half greater than its diameter...aberrata Felt, C. 1200a

bb Antennal segments 12, sessile, the fifth with a length one-half greater than its diameter; abdomen fuscous yellowish; scutellum reddish brown; ovipositor as long as the body, remarkably stout................cirsioni Felt, C. 619

bbb 13 antennal segments
c Females; antennal segments sessile
d Antennal segments cylindric or nearly so
e Abdomen dark brown; scutellum black; fifth antennal segment with a length twice its diameter
scutata Felt, C. 507
ee Abdomen dark brown; scutellum reddish brown; fifth antennal segment with a length one-quarter greater than its diameter, the terminal segment long, tapering, the fourth palpal segment one-half longer than the third..........
acerifolia Felt, C. 66
eee Abdomen light brown; scutellum dark brown; fifth antennal segment with a length one-half greater than its diameter; terminal segment produced, the palpi stout, the fourth segment shorter than the third; the legs are shorter and stouter than in D. scutata................
albohirta Felt, C. 44
eeee Abdomen reddish brown; scutellum brown; fifth antennal segment with a length twice its diameter, the palpi slender, the fourth segment one-quarter longer than the third................
similis Felt, C. 596
dd Antennal segments more or less oval
e Abdomen dark brown; scutellum reddish brown; fifth antennal segment with a length one-half greater than its diameter, terminal one with a length four times its diameter, the fourth palpal segment twice the length of the short third..............antennata Felt, C. 213
ee Abdomen pale salmon; scutellum fuscous yellowish; fifth antennal segment with a length twice its diameter, the third and fourth palpal segments equal. Reared from spruce cones....
canadensis Felt, C. a1428
bbbb 14 antennal segments
c Antennal segments sessile females
d Abdomen dark brown; fifth antennal segment with a length one-quarter greater than its diameter
e Scutellum yellowish brown; fifth tarsal segment stout, with a length twice its diameter; lobes of the ovipositor stout, with a length about two and one-half times their width, tapering distally and narrowly rounded. Reared from leaves of honey locust, Gleditschia......................
gleditchiae O. S., C. 958
ee Scutellum dark brown; fifth tarsal segment with a length three times its diameter; lobes of the

ovipositor long, with a length about three times their width and tapering slightly. Reared from leaves of locust, Robinia......................
pseudacaciae Fitch, C. a1355

dd Abdomen reddish brown; fifth antennal segment cylindric, with a length one-half greater than its diameter; palpi quadriarticulate, the third and fourth segments equal; lobes of the ovipositor with a length thrice their width. Reared from bud gall on Salix.............californica Felt, C. 981

ddd Abdomen dark carmine; scutellum yellowish; fifth antennal segment oval, with a length about twice its diameter; wings very hairy, with peculiar obsolescent veins; claws minutely toothed; palpi short, stout, the segments subequal...................
denticulata Felt, C. 156

dddd Abdomen reddish orange; scutellum dark brown; fifth antennal segment with a length one-half greater than its diameter; palpi long, the fourth segment three-quarters longer than the third......
augusta Felt, C. 737

cc The flagellate antennal segments stemmed

d Fifth antennal segment with a stem one-quarter the length of the basal enlargement

e Abdomen dark brown; scutellum fuscous yellowish; basal enlargement of the fifth antennal segment with a length two and one-half times its diameter, lobe of the ovipositor narrowly lanceolate, with a length five times its width. Reared from rose...........................
? rosarum Hardy, C. a1491

dd Fifth antennal segment with a stem one-third the length of the basal enlargement; male

e Abdomen brown; scutellum dark brown; wing very short, broad, with a width three-quarters its length, the basal enlargement of the fifth antennal segment with a length one-quarter greater than its diameter...................
acerifolia Felt, C. 72

ddd Fifth antennal segment with a stem one-half the length of the basal enlargement; male

e Abdomen and scutellum dark brown; basal enlargement of the fifth antennal segment with a length twice its diameter, the fourth palpal segment a little longer than the third. Reared from locust, Robinia.......................
pseudacaciae Fitch, C. a1355

dddd Fifth antennal segment with a stem three-quarters the length of the basal enlargement, male

e Abdomen dark yellowish brown, the basal enlargement of the fifth antennal segment with a length twice its diameter, the fourth palpal segment a little longer than the third. Reared from seed pods of violet.....................
semenivora Beutm., C. a1830

bbbbb 15 antennal segments

c Antennal segments sessile; female

d Abdomen dark reddish

e Scutellum fuscous yellowish

f Fifth antennal segment with a length twice its diameter, the fourth palpal segment with a length one-quarter greater than the third. Reared from bedstraw, Galium............
americana Felt, C. a1678k

ff Fifth antennal segment with a length two and one-half times its diameter; the fourth palpal segment longer than the third. Reared from a rosette willow gall.................
albovittata Walsh, a1442a

ee Scutellum reddish, fifth antennal segment with a length two and one-half times its diameter; fourth palpal segment one-quarter longer than third. Reared from willow twigs..............
corticis Felt, C. a1966

dd Abdomen dark brown

e Scutellum yellowish and fuscous; fifth antennal segment with a length twice its diameter, the fourth palpal segment one-half longer than the third. Reared from willow, Salix............
salicifolia Felt, C. a1675

ee Scutellum fuscous yellowish; fifth antennal segment with a length one-half greater than its diameter. Reared from Canada thistle........
gibsoni Felt, C. a2221

ddd Abdomen dull orange yellow; scutellum dark red; fifth antennal segment with a length two and one-half times its diameter, the fourth palpal segment one-half longer than the third..fulva Felt, C. 257

cc Antennal segments stemmed; male

d Fifth antennal segment with a stem as long as the basal enlargement

e Abdomen dark brown. Reared from a rosette willow gall.....albovittata Walsh, a1442a

dd Fifth antennal segment with a length one-quarter greater than the basal enlargement

e Abdomen dark brown. Reared from heads of Canada thistle......gibsoni Felt, C. a2221 *bbbbbb* 16 antennal segments

c Antennal segments sessile; females

d Abdomen dark brown

e Scutellum fuscous yellowish; fifth antennal segment with a length one-half greater than its diameter, fourth palpal segment one-half longer than the third. Reared from bud gall on elm.....................u l m e a Felt, C. 880

ee Scutellum pale fuscous orange; fifth antennal segment with a length twice its diameter; ovipositor with a length one-half greater than the body. Reared from blossoms of Joe Pye weed.. p u r p u r e a Felt, C. a1693a

eee Scutellum yellowish brown

f Antennal segments cylindric

g Fifth antennal segment with a length about two and one-half times its diameter

h Ovipositor longer than the body, the lobes with a length about three and one-half times their width. Taken on clover........................ ? l e g u m i n i c o l a Lintn. C. 125, 114, 134, 740

hh Ovipositor as long as the body, the lobes with a length six times their width. Reared from small strobiloides bud gall on willow....... g e m m a e Felt, C. a1937a

hhh Ovipositor as long as the body, the lobes with a length three times the width. Reared from clusters of root leaves of solidago........... r a d i f o l i i Felt, C. a1911

hhhh Ovipositor as long as the body, the lobes with a length four times the width. Reared from a rosette willow gall......................... a l b o v i t t a t a Walsh a1442a

gg Fifth antennal segment with a length twice its diameter; ovipositor as long as the abdomen, the lobes with a length twice their width. Reared from distorted violet pods.................... s e m e n i v o r a Beutm., C. a1830

ggg Fifth antennal segment with a length three-fourths greater than its diameter; ovipositor as long as the body, the oval lobes with a length three and one-half times their width..................... c o m m u n i s Felt, C. a1133

ff Antennal segments slightly oval, the fifth with a length three-fourths greater than its diameter; ovipositor longer than the body, the lobes with a length four times their width ....
rufipedalis Felt, C. 127

dd Abdomen brown; scutellum dull red; fifth antennal segment with a length two and one-half times its diameter, ovipositor as long as the body. Reared from Lysimachia ....
lysimachiae Beutm., C. a1192

ddd Abdomen yellowish orange; scutellum yellowish white; fifth antennal segment with a length twice its diameter; ovipositor one-third longer than the body........flavoabdominalis Felt, C. 738

dddd Abdomen dark red, scutellum fuscous orange; fifth antennal segment with a length three-fourths longer than its diameter; ovipositor as long as the abdomen. Reared from Cercocarpus........................
cercocarpi Felt, C. a2359

cc Antennal segments stemmed; males

d Fifth antennal segment with a stem three-fourths the length of the basal enlargement

e Abdomen and scutellum dark brown, the basal enlargement of the fifth antennal segment with a length one-half greater than its diameter......
communis Felt, C. a1133

ee Abdomen reddish orange, scutellum fuscous yellowish; basal enlargement of the fifth antennal segment with a length twice its diameter. Reared from willow twigs...corticis Felt, C. a1966

dd Fifth antennal segment with a stem as long as the basal enlargement

e Abdomen dark brown

f Basal enlargement of the fifth antennal segment with a length one-fourth greater than its diameter. Reared from willow, Salix...
salicifolia Felt, C. a1675

ff Basal enlargement of the fifth antennal segment with a length three-fourths greater than its diameter. Reared from a rosette willow gall..albovittata Walsh, a1442a

ee Abdomen and scutellum reddish brown, basal enlargement of the fifth antennal segment with a length twice its diameter. Taken on clover....
? leguminicola Lintn., C. 125, 457

eee Abdomen brown; scutellum dull red; basal enlargement of the fifth antennal segment with a length one-half greater than its diameter. Reared from loose bud galls on Lysimachia....
lysimachiae Beutm., C. a1192, C. 1240

eeee Abdomen yellowish brown; scutellum fuscous yellowish, the basal enlargement of the fifth antennal segment with a length one-half greater than its diameter, the third and fourth palpal segments equal. Reared from mint............
aromaticae Felt, C. a1875

eeeee Abdomen yellowish red, scutellum reddish brown; the basal enlargement of the fifth antennal segment with a length one-half greater than its diameter; fourth palpal segment one-fourth longer than the third. Reared from Cercocarpus..........cercocarpi Felt, C. a2359

ddd Fifth antennal segment with a stem one-fourth longer than the basal enlargement

e Abdomen dark reddish orange; scutellum brown; basal enlargement of the fifth antennal segment with a length one-half greater than its diameter..........attenuata Felt, C. 1209b

bbbbbbb 17 antennal segments

c Antennal segments sessile; females

d Abdomen reddish brown; scutellum yellowish; fifth antennal segment with a length two and one-half times its diameter, the third and fourth palpal segments equal; ovipositor as long as the abdomen....
flavoscuta Felt, C. 553

dd Abdomen blood red; scutellum pale yellowish; fifth antennal segment with a length two and one-half times its diameter, the third and fourth palpal segments equal; ovipositor as long as the abdomen. Reared from Lysimachia........................
lysimachiae Beutm., C. 1240

ddd Abdomen fuscous orange; scutellum brownish orange; fifth antennal segment with a length twice its diameter, the fourth palpal segment one-half longer than the third; ovipositor two-thirds the length of the abdomen..........................
consobrina Felt, C. 215

cc Antennal segments stemmed; males

d Fifth antennal segment with a stem three-quarters the length of the basal enlargement

e Abdomen dark brown; scutellum reddish brown; basal enlargement of the fifth antennal segment with a length three-quarters greater than its diameter.........meliloti Felt, C. 744

ee Abdomen pale salmon; scutellum yellowish brown; basal enlargement of the fifth antennal segment with a length twice its diameter. Reared from spruce seeds.........................
canadensis Felt, C. a1428

dd Fifth antennal segment with a stem one-quarter longer than the basal enlargement, the latter with a length two and one-half times its diameter

e Abdomen dark brown; scutellum reddish brown, the ventral plate broadly and roundly emarginate..................pedalis Felt, C. 410

ee Abdomen dark brown; scutellum reddish brown, the ventral plate deeply and roundly emarginate. Reared from clusters of root leaves of solidago radifolii Felt, C. a1911

bbbbbbbb 18 antennal segments

c Antennal segments sessile; females

d Abdomen reddish brown. Reared from apical bud gall on alder..........serrulatae O. S., C. 876

cc Antennal segments stemmed; males

d Fifth antennal segment with a stem as long as the basal enlargement, the latter with a length twice its diameter; abdomen reddish brown. Reared from apical bud gall on alder.................... serrulatae O. S., C. 876

dd Fifth antennal segment with a length one-fourth greater than the basal enlargement, the latter with a length one-half greater than its diameter; abdomen dark brown. Reared from small strobiloides bud galls on willow..........gemmae Felt, C. a1937a

bbbbbbbbb 19 antennal segments

c Abdomen reddish; male, the fifth antennal segment with a stem one-quarter longer than the basal enlargement, the latter with a length twice its diameter; female, the fifth antennal segment with a length thrice its diameter. Reared from axillary galls on Hypericum mutilum..... toweri Felt, C. a1883

Dasyneura rhodophaga Coq.

1899 **Riley, C. V.** and **Howard, L. O.** Insect Life, 1:284. Injuries (as Cecidomyia)

1891 ———— Insect Life, 3:294-95. Injuries (as Cecidomyia)

1900 **Coquillett, D. W.** U. S. Dep't Agric., Div. Ent. Bul. 22 n. s., p. 44, 46, 47 (Neocerata)

1904 **Webster, F. M.** Ill. State Lab. Nat. Hist. Bul. 7, p. 15-25 (Neocerata)

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 349

1912 **Davis, J. J.** Ins. Ill. 27th Rept., p. 106-113 (Neocerata)

This species was first brought to notice on account of its injuring roses in association with Diplosis rosivora Coq., the attack for some reason being confined to Meteor, Wooten, La France, Madame Chatenay, Bride, Ivory and Golden Gate. The injury was most severe to the first named variety and more prevalent in older than in newer greenhouses. Later investigations show injury to other roses, especially to all "hybrid teas." The midges were so abundant at times as to destroy the entire crop of rose buds. Though the antennae depart somewhat from the Dasyneura type, we believe the species should be referred to this genus.

Male. Length 1 mm. Antennae short, 9 subsessile segments, the fifth with a length only a little greater than its diameter, the last segment greatly produced, with a length about four times its diameter. Palpi; the first segment short, the second broadly oval, the third one-half longer, dilated, the fourth as long as the third, slender. Head and thorax brown, the abdomen, in alcoholic specimens, yellowish. Wings hyaline, costa dark brown, third vein curving forward. Claws long, slender, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment slender; terminal clasp segment long, slightly swollen basally; dorsal plate broad, deeply and narrowly incised, ventral plate long, broadly and roundly emarginate. Harpes long, subtruncate and irregularly tuberculate.

Female. Length 1 to 1.25 mm. Antennae short; 9 subsessile segments, the fifth with a length nearly twice its diameter, the terminal segment greatly produced, with a length about five times its diameter. Ovipositor nearly as long as the abdomen, the terminal lobes narrowly oval, tapering. Other characters presumably as in the opposite sex.

The above descriptions were drafted from specimens received from Prof. S. A. Forbes, state entomologist of Illinois, in connection with the original descriptions by Mr Coquillett.

Life history. This species was closely studied by Professor Webster who failed to find it on wild roses even in the vicinity of infested rose houses. The damage is caused between May and October. The eggs are deposited under and near the base of the sepals and occasionally in the sutures separating the sepals. Not infrequently a female perishes with her ovipositor inextricably fixed in a bud. The young larvae are white, the older ones reddish. Twenty-five may be found in one blossom. Fumigation with .10 and .15 grams of potassium cyanide to each cubic foot of space for a period of 15 minutes killed only exposed larvae. The maggots desert the blossoms and undergo their final transformations in a nearly transparent cocoon in the soil. Cecid. a1390.

Dasyneura maculosa Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 341

This species was taken on a window at Nassau, N. Y., June 14, 1906.

Female. Length .75 mm. Antennae extending to the base of the abdomen, light brown; 10 segments, the fifth subsessile; terminal segment slightly prolonged, tapering to an obtusely rounded apex. Palpi; the first segment short, subquadrate, the second irregularly suboval, the third one-half longer than the second, narrowly oval, the fourth one-half longer than the third, a little more slender, the fifth one-half longer than the fourth, more slender. Mesonotum nearly uniform dark brown. Scutellum reddish brown. Abdomen pale yellowish, irregularly mottled with dark brown (the normal color is probably a nearly uniform dark brown), terminal segments pale orange. Wings subhyaline, costa dark brown; halteres pale reddish basally, whitish apically. Legs nearly uniform pale straw, except that the anterior tarsi appear to be dark brown; claws long, slender, rather strongly curved. Ovipositor nearly as long as the body, terminal lobes short, broadly rounded. Type Cecid. 288.

Dasyneura carbonaria Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 117 Separate, p. 21
1908 ———— N. Y. State Mus. Bul. 124, p. 341
1909 ———— Ottawa Nat., 22:248

This species was reared at Albany, N. Y., from the narrow-leaved Solidago, S. graminifolia July 27, 1906, probably from a loose apical gall though the plant was infested with the blister galls of Baldratia carbonifera Felt.

Female. Length 1.25 mm. Antennae extending to the base of the abdomen, dark brown; 12 segments fifth subsessile, with a length twice its diameter; terminal segment more than twice the length of the preceding, the basal four-fifths subcylindric, the distal part narrow, broadly rounded. Palpi; the first and second segments short, stout, the third one-half longer than the second, the fourth one-half longer than the third. Mesonotum dark brown, submedian lines indistinct. Scutellum, postscutellum and abdomen deep carmine, the scutellum, postscutellum and basal and terminal abdominal segments tinged with yellowish. Wings hyaline, costa dark brown, halteres yellowish basally, slightly fuscous apically. Legs nearly uniform dark brown; claws rather stout, slightly curved. Ovipositor probably two-thirds the length of the body, the terminal lobes slender, elliptical. Type Cecid. 713.

Dasyneura vernalis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 341

This species was taken at Nassau, N. Y., June 14, 1906 on New Jersey tea, Ceanothus americanus.

Female. Length 1 mm. Antennae extending to the second abdominal segment, rather sparsely haired, dark brown, 12 segments, fifth subsessile, with a length one-half greater than its diameter, terminal segment greatly prolonged, more than twice the length of the preceding, obtusely rounded distally. Palpi; the first segment subquadrate, the second as long as the first, more slender, the third one-half longer, more slender and the fourth a little shorter than the third. Mesonotum uniform dark brown, submedian lines pale yellowish, sparsely ornamented with fine setae. Scutellum dark reddish brown with numerous reddish apical setae, postscutellum reddish brown. Abdomen dark reddish brown, sparsely clothed with fine, yellowish hairs, terminal segments fuscous yellowish. Wings hyaline, costa dark reddish brown; halteres yellowish transparent. Coxae and femora pale straw color, tibiae and tarsi nearly uniform reddish brown; claws stout, strongly curved. Ovipositor nearly as long as the body, terminal lobes long, stout, broadly rounded. Type Cecid. 262.

Dasyneura bidentata Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 114 Separate, p. 18
1908 ———— N. Y. State Mus. Bul. 124, p. 341

This species was taken on white oak, Quercus alba, at Albany, N. Y., June 21, 1906.

Male. Length 1.25 mm. Antennae extending to the base of the abdomen, dark brown, fuscous yellowish basally; 13 segments, the fifth subcylindric, the length about one and one-half times the diameter. Palpi; first segment short, almost obconic, second a little longer, third more so and the fourth one-half longer than the third. Face fuscous yellowish. Mesonotum dark brown with distinct submedian lines, sparsely ornamented with pale setae. Scutellum rather dark red or yellowish orange, postscutellum dark red. Abdomen a reddish or dark salmon, segments margined with pale yellowish posteriorly. Genitalia slightly fuscous. Wings subhyaline, costa light brown. Coxae and basal portion of femora pale yellowish, other parts of legs brownish; tarsi slightly darker, lighter ventrally; claws stout, strongly curved. Genitalia; basal clasp segment stout; terminal clasp segment stout; dorsal plate broad, deeply incised; ventral plate narrow, deeply emarginate. Harpes narrow, approximate distally. Type Cecid. 344, 345.

Dasyneura fraxinifolia Felt

1907 **Felt, E. P.** New species of Cecidomyiidae II, p. 12
1908 ———— N. Y. State Mus. Bul. 124, p. 293, 341

This species was reared August 1, 1907 from tightly rolled leaves of ash, Fraxinus, taken at Bath, N. Y.

Male. Length .75 mm. Antennae nearly as long as the body, thickly haired, brown, yellowish basally; 14 segments, the fifth with a stem two-thirds the length of the subcylindric basal enlargement, which latter has a length about one-fourth greater than its diameter, terminal segment somewhat produced, narrowly oval. Palpi; the first segment rather short, stout, with a length about twice its diameter, the second a little longer, rounded at the extremities, the third one-fourth longer and more slender and the fourth one-half longer than the third, more slender, face yellowish. Mesonotum reddish brown, the submedian lines pale yellowish. Scutellum light reddish brown, postscutellum a little lighter. Abdomen fuscous yellowish, the second to seventh segments shaded with light brown; genitalia fuscous, venter light yellowish. Wings hyaline, costa dark brown. Halteres yellowish basally, light brown apically. Legs light straw, the distal tarsal segments darker; claws long, slender, strongly curved, the pulvilli nearly as long as the claws. Genitalia: basal and terminal clasp segments long, stout; dorsal plate short, broad, deeply and triangularly incised; ventral plate narrow, long, deeply and roundly emarginate; harpes broad at base, long, tapering.

Female. Length 1.5 mm. Antennae extending to the base of the abdomen, thickly haired, brown, yellowish basally; 13 subsessile segments, the fifth with a length one-half greater than its diameter; terminal segment somewhat produced, narrowly oval. Ovipositor pale yellowish, about as long as the body, the terminal lobes long, broad, narrowly rounded. Other characters as in the male. Type Cecid. a1648a.

Dasyneura vitis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 341

This species was reared July 16, 1907 from a tumid gall on grape, Vitis sp., taken at West Nyack, N. Y., and presumed to be that of Lasioptera vitis O. S. This form is probably an inquiline.

Female. Length .75 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 13 sessile segments, the fifth with a length about two and one-half times its diameter; terminal segment much produced, with a length about four times its diameter, narrowly rounded. Mesonotum dark brown, the scutellum, postscutellum and basal abdominal segments fuscous yellowish, the distal ones yellowish. Wings hyaline, costa dark brown. Halteres yellowish basally, slightly fuscous apically. Legs a variable fuscous yellowish; claws long, slender, strongly curved, the pulvilli a little shorter than the claws. Ovipositor about one-third the length of the abdomen, stout, the lobe with a length nearly thrice its diameter, narrowly rounded. Type Cecid. a1165b.

Dasyneura karnerensis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 341

This species was taken June 4, 1906 on aster or solidago at Karner, N. Y.

Female. Length 1 mm. Antennae extending to the fourth abdominal segment, thickly haired, dark brown; 13 subcylindric segments, the fifth with a length three times its diameter; terminal segment slightly prolonged, broadly rounded distally. Palpi; the first segment subquadrate, slightly incrassate, the second suboval, a little longer, the third one-half longer than the second, the fourth a little longer than the third; face reddish brown. Mesonotum dark brown, submedian lines clothed with fine hairs. Scutellum reddish brown, postscutellum and abdomen dark reddish. Wings hyaline, costa reddish brown; halteres yellowish transparent. Legs a nearly uniform pale brown; claws slender, slightly curved. Ovipositor three-fourths the length of the body, terminal lobe long, slender, broadly rounded. Type Cecid. 128.

Dasyneura spiraeina Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 341.

This species was taken June 4, 1906 on Spiraea at Karner, N. Y.

Female. Length 1 mm. Antennae scarcely extending to the base of the abdomen, sparsely haired, dark brown; 13 subcylindric segments, the fifth with a length two and one-half times its diameter; terminal segment slightly prolonged, suboval. Palpi; the first segment short, subquadrate, the second about as long, oval, the third slender, twice the length of the second, the fourth a little longer than the third, flattened; face dark brown. Mesonotum dark brown, submedian lines ornamented with fine hairs. Scutellum, postscutellum and abdomen reddish brown. Wings hyaline, costa dark brown; halteres pale reddish transparent basally, whitish transparent apically. Legs nearly uniform pale brown, tarsi slightly darker; claws slender, uniformly curved. Ovipositor probably nearly as long as the body, terminal lobes long, slender, probably broadly rounded. Type Cecid. 133.

Dasyneura graminis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 342

This female was captured while ovipositing in red-top or June grass, A g r o s t i s v u l g a r i s, at Albany, N. Y., June 9, 1907. The midges were observed in numbers, May 29 and 31, 1908, at Kinderhook and Poughkeepsie respectively, ovipositing in June grass. The fragile adults would carefully insert the ovipositor between the glumes of the nodding heads. The females were very intent upon their work and could be readily watched under a hand lens.

Female. Length 1.5 mm. Antennae extending to the second abdominal segment, sparsely haired, brown; 13 subsessile segments, the fifth with a length about twice its diameter; terminal segment greatly produced, apparently composed of two closely fused segments, broadly rounded apically. Palpi; the first segment short, stout, subquadrate, slightly swollen basally, the second a little longer, stouter, the third one-half longer than the second, more slender, the fourth one-half longer than the third; face fuscous. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum brown, postscutellum a little darker. Abdomen a deep reddish orange, the dorsal sclerites slightly darker, ovipositor pale yellowish. Wings hyaline, costa light brown. Halteres a pale orange. Legs a nearly uniform yellowish brown; claws long, slender, strongly curved, the pulvilli longer than the claws. Ovipositor about as long as the body, terminal lobe long, slender, narrowly rounded. Type Cecid. 1209.

Dasyneura piperitae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 342

A pale yellowish green larva was observed in the enlarged terminal buds of peppermint, M e n t h a p i p e r i t a, and adults were reared in early August 1907. Galls were rather common at Nassau, N. Y.

Female. Length .75 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown, yellowish basally; 14 sessile segments, the fifth with a length about twice its diameter, tapering slightly distally; terminal segment somewhat produced, with a length about three times its diameter, narrowly rounded. Palpi; the first segment short, stout, slightly expanded distally, the second narrowly oval, with a length about two and one-half times its diameter, the third one-half longer and more slender, the fourth nearly twice the length of the third, face yellowish. Mesonotum shining reddish brown. Scutellum and postscutellum pale yellowish. Abdomen light yellowish brown. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs a nearly uniform yellowish brown; claws long, slender, evenly curved, the pulvilli about as long as the claws. Ovipositor about as long as the abdomen, the terminal lobes with a length about four times the width, hardly constricted basally, narrowly rounded. Type Cecid. a1663a.

Dasyneura borealis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 117. Separate, p. 21
1908 ———— N. Y. State Mus. Bul. 124, p. 342

This species was taken June 7, 1906 at Lake Clear, N. Y., while collecting from spruce, Abies species.

Female. Length 1 mm. Antennae extending to the middle of the abdomen, sparsely haired, dark brown; probably 14 subsessile segments, the fifth with a length one-half greater than its diameter. Palpi; the first segment subquadrate, the second stout, subrectangular, with a length two and one-half times the diameter, the third a little longer, subrectangular, the fourth one-fourth longer than the preceding, more slender. Mesonotum dark brown, lighter posteriorly, submedian lines yellowish, distinct. Scutellum yellowish carmine, postscutellum and abdomen light yellowish red. Wings hyaline, costa light brown; halteres whitish transparent. Legs light brown, lighter ventrally, tarsi darker; claws stout, uniformly curved Ovipositor about as long as the body, terminal lobes with a length seven times the width. Type Cecid. 160.

Dasyneura glandis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 342

This species, studied through the courtesy of the United States National Museum, was reared by Miss M. E. Murtfeldt of Kirkwood, Mo., October 20, 1896 from larvae found between the seed coats of an acorn, Quercus species.

Exuviae. Length 1.25 mm; antennal cases extending to the second abdominal segment, the wing cases nearly to the fourth abdominal segment and the leg cases almost to the tip of the abdomen. Cephalic horns long, slender. Near the base of the antennae, arising from conspicuous tubercles, are a pair of extremely long, slender setae. Dorsum of the abdomen thickly clothed with minute, chitinous points, the latter strongly developed near the anterior fourth of each segment. Color pale yellowish or whitish.

Female. Length 1 mm. Antennae extending to the fourth abdominal segment, sparsely haired, light brown; 14 sessile segments, the fifth with a length about two and one-half times its diameter; terminal segment greatly produced, with a length about five times its diameter and tapering to a narrowly rounded apex. Palpi; the first segment rather long, swollen near the distal third, the second narrowly oval, with a length over twice its diameter, the third one-half longer and more slender than the second, the fourth about twice as long as the third. Mesonotum dark brown. Scutellum reddish brown, postscutellum yellowish brown. Abdomen yellowish brown. Wings hyaline, costa dark brown. Halteres yellowish transparent. Legs mostly a light yellowish brown, the distal tarsal segments darker; claws long, slender, strongly curved, the pulvilli shorter than the claws. Ovipositor one-half longer than the body; terminal lobes with a length about three times the diameter, tapering, narrowly rounded. Type Cecid. 1030.

Dasyneura aurihirta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 342

This species was taken on New Jersey tea, Ceanothus americanus, at Albany, N. Y., July 6, 1906.

Female. Length 1.6 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown, yellowish basally; 14 subsessile segments, the fifth with a length over twice its diameter, slightly constricted near the basal third, tapering distally;

terminal segment produced, with a length about four times its diameter, subacute. Palpi; the first segment short, stout, swollen distally, the second stout, subrectangular, with a length about three times its diameter, the third one-half longer than the second, more slender, the fourth a little longer than the third, face yellowish. Mesonotum black, the submedian lines sparsely haired. Scutellum fuscous reddish, postscutellum dark brown. Abdomen dark brown, rather thickly clothed with pale golden hairs, especially laterally. Wings hyaline, costa dark brown. Halteres yellowish basally, reddish apically. Coxae fuscous brown, femora yellowish brown basally, fuscous apically; tibiae and tarsi mostly dark fuscous brown; claws long, slender, evenly curved, the pulvilli a little longer than the claws. Ovipositor about as long as the abdomen, the terminal lobes stout, with a length about three times the width, broadly rounded. Type Cecid. 509.

Dasyneura rubiflorae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 343

This species, loaned for study through the courtesy of the United States National Museum, was reared April 20 and 26, 1886 from blossoms of blackberry, Rubus species.

Male. Length 1 mm. Antennae extending to the second abdominal segment, rather thickly haired, the apical three segments dark brown, the others mostly yellowish brown; 14 segments, the fifth with a stem three-fourths the length of the basal enlargement, which latter has a length about one-half greater than its diameter; terminal segment slightly produced, narrowly oval. Palpi; the first segment short, stout, irregular, the second narrowly oval, with a length about twice its diameter, the third one-half longer, more slender, and the fourth nearly twice the length of the third, more slender. Mesonotum dark brown. Scutellum yellowish brown, postscutellum yellowish. Abdomen a variable light brown, the incisures pale yellowish; genitalia fuscous. Wings hyaline, costa reddish brown. Halteres pale yellowish. Legs a variable yellowish, tarsi somewhat darker; claws long, slender, evenly curved, unidentate, the pulvilli as long as the claws. Genitalia; basal clasp segment short, slender; terminal clasp segment short, stout; dorsal plate long, broad, deeply and triangularly incised; ventral plate long, slender, deeply and triangularly emarginate. Harpes long, slender, tapering, irregularly truncate.

Female. Length 1 mm. Antennae hardly extending to the base of the abdomen, sparsely haired, dark brown; 14 segments, the fifth with a length about three-fourths greater than its diameter. Scutellum yellowish brown, postscutellum and abdomen dark brown. Ovipositor nearly as long as the body, the terminal lobes with a length about four times their width, tapering distally, narrowly rounded. Type Cecid. 990.

Dasyneura anemone Felt

1907 **Felt, E. P.** New Species of Cecid. II, p. 11
1908 ———— N. Y. State Mus. Bul. 124, p. 292, 343
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 45

This species was reared July 12, 1907 from a loose bud gall of Anemone canadense taken at Kinderhook and Nassau, N. Y.

Gall. Numerous pale orange larvae were found in the unfolding leaves inclosing an apparently normal though slightly enlarged bud.

Larva. The larva is 3 mm long, pale orange.

Male. Length 1.25 mm. Antennae about as long as the body, sparsely haired, reddish brown; 15 segments, the fifth with a stem about three-fourths the length of the basal enlargement, which latter has a length about one-half greater than its diameter; terminal segment reduced, narrowly oval. Palpi; the first segment short, stout, subquadrate, the second one-half longer, narrowly oval, the third one-half longer than the second, slender, the fourth one-half longer than the third, more slender. Head reddish yellow. Mesonotum dark brown, the narrow submedian lines yellowish. Abdomen dark brown, the incisures and pleurae yellowish, the venter reddish orange. Wings hyaline, costa dark brown. Halteres pale yellowish, femora pale yellowish basally, darker apically, the tibiae and tarsi dark brown, the latter almost black in some specimens; claws long, stout, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment short, stout, the basal two-thirds swollen; dorsal plate long, broad, deeply and triangularly incised; ventral plate long, narrow, deeply and broadly emarginate. Harpes long, slender, irregular.

Female. Length 1.25 mm. Antennae extending to the second abdominal segment, sparsely haired, reddish brown; 14 segments, the fifth with a very short stem, the basal enlargement with a length about twice its diameter, a rather distinct constriction near the basal third; terminal segment greatly produced, with a distinct constriction near the distal third. Color characters about as in the male, except that the mesonotum is not so dark and the dorsal surface of the abdomen is more heavily clothed with darker hairs. Ovipositor a little longer than the body, very slender, the terminal lobes slightly constricted at the base, narrowly rounded. Other structural characters practically as in the opposite sex. Type Cecid. a1522.

Dasyneura photophila Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 114. Separate, p. 18
1908 ———— N. Y. State Mus. Bul. 124, p. 343

This male was taken on a window at Nassau, N. Y., June 10, 1906.

Male. Length .75 mm. Antennae probably nearly as long as the body, sparsely haired, dark brown; probably 14 segments, the fifth with a stem about one-fourth the length of the basal enlargement. Palpi; the second segment long, narrowly oval, the third a little longer, more slender, the fourth a little longer and more slender than the preceding; face dark brown, sparsely clothed with whitish hairs. Mesonotum dark brown. Scutellum yellowish, postscutellum and abdomen nearly uniform dark brown. Wings (pl. 6, fig. 2) hyaline, costa dark brown; halteres yellowish or orange yellow. Legs a nearly uniform dark brown; claws rather long, strongly and evenly curved. Genitalia; basal clasp segment stout, with a conspicuous rounded lobe internally at the basal third; terminal clasp segment stout. Dorsal plate short, very broad, apparently divided, the lobes widely separated at the base, broadly rounded; ventral plate broad, stout, apparently suborbicular. Harpes stout, subtriangular, apically with a long, subquadrate, chitinous process and several minor ones. Type Cecid. 194.

Dasyneura yuccae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 343

This species, loaned for study through the courtesy of the United States National Museum, was reared September 12, 1893 from the pods of Yucca angustifolia.

Male. Length 1 mm. Antennae a little longer than the body, thickly haired, light brown; 14 segments, the fifth with a stem about one-half the length of the basal enlargement; terminal segment narrowly oval. Palpi; the first long, slender, with a length about three times its diameter, the second about as long as the first, narrowly oval, the third as long as the second, slightly more slender, the fourth one-half longer than the third, more slender. Mesonotum dark reddish brown. Scutellum and postscutellum pale yellowish. Abdomen yellowish brown. Wings hyaline, costa dark brown. Halteres yellowish transparent. Legs a variable fuscous yellowish, the femora distally, tibiae and tarsi dark brown; claws very long, slender, strongly curved, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment long, slender; dorsal plate long, deeply and triangularly incised; ventral plate long, broad, broadly rounded. Harpes short, stout, roundly truncate. Type Cecid. 1053.

Dasyneura ampelophila Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 343

This fuscous yellowish and dark brown species was taken at Albany, N. Y., July 13, 1906 on Virginia creeper, Psedera quinquefolia.

Male. Length 1 mm. Antennae nearly as long as the body, sparsely haired, dark brown, the basal segments yellowish, the fifth with a length three-fourths that of the basal enlargement, which latter has a length one-half greater than its diameter; terminal segment narrowly oval. Palpi; first segment rather slender, irregular, the second subrectangular, somewhat stout, the third a little longer, more slender, the fourth one-third longer than the third, somewhat dilated. Mesonotum dark brown, the submedian lines narrow, yellow, sparsely haired. Scutellum and postscutellum dark brown. Abdomen dark sooty yellow, with the dorsum of the second, third and fourth abdominal segments dark brown. Pleurae sooty yellowish; genitalia dark brown. Wings hyaline, costa dark brown. Halteres yellowish white basally and apically, fuscous subapically. Coxae and base of femora pale yellowish, the other parts of the legs nearly uniform dark brown; claws slender, strongly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment stout, long; dorsal plate long, deeply and triangularly incised; ventral plate rather long, tapering, narrowly rounded. Harpes short, thickly spinose apically. Type Cecid. 449.

Dasyneura setosa Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 115. Separate, p. 19
1908 ———— N. Y. State Mus. Bul. 124, p. 343

This dark brown male was taken on a window at Nassau, N. Y., August 10, 1906.

Male. Length .75 mm. Antennae a little shorter than the body, thickly haired, dark brown; 14 segments, the fifth with a stem about three-fourths the length of the basal enlargement; terminal segment with a distal prolongation one-fourth the length of the subcylindric basal portion. Palpi; the first segment elongate, slender, slightly swollen distally, second suboval, about as long as the first, the third a little longer than the second, the fourth one-half longer than the third; face fuscous. Mesonotum dark brown, submedian lines sparsely haired. Scutellum reddish brown, postscutellum fuscous yellowish brown. Abdomen dark brown, sparsely yellow-haired. Wings hyaline, costa dark brown; halteres yellowish, slightly fuscous apically. Coxae and base of femora yellowish, other portions of legs dark brown; claws slender, strongly curved. Genitalia; basal clasp segment moderately stout; terminal clasp segment stout at base. Dorsal plate broad, deeply incised; ventral plate indistinct. Harpes short, subtriangular. Type Cecid. 750.

Dasyneura unguicula Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 344

This male was taken on a window at Nassau, N. Y., July 15, 1907 and also late in July and in August in 1906.

Male. Length .5 mm. Antennae a little longer than the body, rather thickly haired, dark brown; 14 segments, the fifth with a stem about three-fourths the length of the basal enlargement, which latter has a length about one-half greater than its diameter; terminal segment produced, narrowly oval. Palpi; the first segment elongate, slender, slightly expanded distally, the second a little longer, stouter, the third as long as the second, more slender, the fourth one-half longer and more slender than the third. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum dark reddish brown with a few coarse setae apically, postscutellum and abdomen dark brown. Wings (pl. 6, fig. 3) hyaline, costa dark brown. Halteres fuscous subapically, whitish apically. Legs a nearly uniform dark brown; claws very long, slender, strongly curved, the pulvilli much shorter than the claws. Genitalia; basal clasp segment long; terminal clasp segment swollen at the base, tapering; dorsal plate long, broad, deeply and triangularly incised; ventral plate long, narrowly rounded. Type Cecid. 1225.

Dasyneura pudorosa Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 344

This species was taken at Nassau, N. Y., June 14, 1906 in general collecting.

Male. Length .75 mm. Antennae probably about as long as the body, thickly fine haired, dark brown; 14 segments, the fifth with a stem about three-fourths the length of the basal enlargement; terminal segment reduced, suboval, narrowly rounded. Palpi; the first segment rather slender, subquadrate, second a little longer, stouter, tapering slightly distally, the third a little longer, more slender, narrowly rounded, the fourth one-half longer and more slender than the third. Mesonotum nearly uniform dark brown. Scutellum dark brown, yellowish apically, postscutellum yellowish brown. Abdomen dark reddish brown, the terminal segments pale yellowish. Genitalia fuscous yellowish. Wings hyaline, costa dark brown; halteres yellowish transparent. Coxae and basal portion of femora whitish or whitish transparent, other parts of legs dark brown; claws long, slender, evenly curved. Genitalia; basal clasp segment long, slender; terminal clasp segment short, stout; dorsal plate broad, deeply and triangularly incised; ventral plate narrow, broadly rounded. Harpes stout, heavily chitinized basally, a series of stout subapical teeth, the terminal portion slender. Type Cecid. 279.

Dasyneura simulator Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 344

This species with a dark brown abdomen was taken on a window at Nassau, N. Y., July 3 and 21, 1906.

Male. Length 1 mm. Antennae nearly as long as the body, thickly haired, dark brown; 14 segments, the fifth with a stem three-fourths the length of the basal enlargement, which latter has a length only one-fourth greater than its diameter and is thickly clothed with long, stout setae; terminal segment narrowly oval. Palpi; first segment slender, slightly incrassate, the second a little longer, stouter, the third longer than the second, more slender, the fourth a little longer than the third, slightly dilated. Mesonotum dark brown, the narrow submedian lines indistinct. Scutellum dark brown with sparse apical setae, postscutellum yellowish brown. Abdomen with the basal and terminal segments fuscous yellowish, the intermediate ones dark brown. Wings hyaline, vestiture sparse. Halteres orange yellow basally, whitish apically. Coxae pale yellowish, femora pale yellowish basally, fuscous apically; tibiae and tarsi a nearly uniform dark brown; claws slender, strongly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment swollen basally; dorsal plate long, deeply and narrowly incised; ventral plate long, tapering to a narrowly rounded apex. Type Cecid. 445.

Dasyneura trifolii Loew

Clover leaf midge

1874 **Loew, F.** Vehr. z.-b. Ges. Wien, 24:143
1880 **Comstock, J. H.** U. S. Comm. of Agric. Rep't, p. 197–99
1881 **Lintner, J. A.** N. Y. State Agric. Soc. 40th Rep't, p. 24–25
1894 **Comstock, J. H.** Manual for the Study of Insects, p. 446
1901 **Howard, L. O.** Insect Book, p. 113
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 344
1909 **Folsom, J. W.** Ill. Agric. Exp't Sta. Bul. 134, p. 171–75

This European species was first recognized in America by Prof. J. H. Comstock in 1879. White clover was observed in the middle of June to be infested with Cecidomyiid larvae, the affected leaves being closely folded together upon the midrib so that the upper side of each half of the leaflet was apposed, there being from one to twenty whitish or pale orange maggots in the shelter thus formed. The under surface of infested leaves has a sickly appearance, being yellowish or brownish. This species is of comparatively slightly economic importance in this country, since its attacks appear to be confined largely to white clover, T r i f o l i u m r e p e n s, though in Europe it is said to affect the lower root leaves of red clover, T r i f o l i u m p r a t e n s e. Doctor Folsom states that he has been unable to find this midge upon red clover in Illinois.

Life history. The following summarized account was taken largely from Doctor Folsom's discussion of this species. The pod-like galls formed by the adherent discolored halves of clover leaflets are common on white clover throughout the growing season, since the species breeds almost continuously during this entire period. Several stages in the development of the insect may be represented at the same time in one gall. Even larvae coming from eggs laid at the same time do not all develop equally, the more vigorous thriving at the cost of the weaker, the latter frequently perishing from lack of nourishment. Doctor Folsom records June 21st as the earliest date for affected leaves containing larvae and cocoons. The species occurred in Illinois thereafter up to October 5th on which date larvae were common. The latest eggs and larvae are killed by frost, along with the leaves upon which they subsist. It is probable that this insect winters in the cocoon, though Doctor Folsom thinks it may possibly survive in the adult stage. His observations lead him to fix the number of broods at four, with a scattering fifth generation, each requiring about a month on an average for its development. The broods overlap sufficiently to make their separation in the field difficult, though there are times when almost all the galls are empty, indicating an interval between generations. The eggs are deposited by the females in the unfolded leaflets. The process has been described by Doctor Folsom as follows: " Standing at the base of this (young leaflet), she wriggles her long, flexible ovipositor in between the two contiguous faces of the leaflet as far as possible; at intervals a slight wave of distention passes back along the ovipositor, indicating probably the passage of an egg. Usually several eggs are laid on the same leaflet — sometimes a dozen or more. After many eggs are laid, the abdomen of the female is noticeably smaller." The eggs hatch in about six days and the young larvae, instead of folding the leaves as might be supposed, in reality prevent their unfolding. This species, like the clover seed midge, Dasyneura leguminicola Lintn., is very sensitive to moisture, contracting and becoming motionless when it is dry and resuming activity with the appearance of moisture. The larva may pupate without making a cocoon or may spin a cocoon as described by Doctor Folsom, the insect remaining in the cocoon from 9 to more than 20 days. Doctor Folsom states that the dorsal bands of black scales are much larger and denser in this species than in D. leguminicola and that the scales do not rub off so easily, the abdomen being usually blackish.

Gall. This is simply the unfolded leaves of white clover, Trifolium repens, or the root leaves of red clover, Trifolium pratense, adhering together and thus resembling small, thin pods. The leaf substance is a little thickened, yellowish or yellow, with brownish specks.

Egg. Length .3 mm, width .075 mm, elliptico-cylindrical, with a slight curvature, colorless and translucent when laid but showing an internal red spot on the second day and becoming pale orange in color. Several eggs are usually laid side by side. (Folsom)

Larva. The young larva is .27 mm in length, colorless and transparent, and soon becomes white. The full grown larva is 1.5 to 2 mm, long, orange, the skin is coarsely granulate.

Cocoon. Length 1.5 mm, oval, often a little flattened from contact with the leaflet or with other cocoons. (Folsom)

Pupa. Orange in color, with a darker median ventral stripe and blackish eyes. (Comstock)

Male. Length 1.5 mm. Antennae nearly as long as the body, rather thickly haired; 14–16 antennal segments, the fifth with a stem as long as the basal enlargement, which latter has a length one-half greater than its diameter; terminal segment reduced, sometimes broadly fused with the preceding. Palpi; first segment subquadrate, the second a little longer, stout, the third one-half longer than the second, slender, the fourth a little longer than the third. Mesonotum reddish brown, the submedian lines sparsely haired. Scutellum yellowish orange, postscutellum a little darker. Abdomen reddish orange; genitalia reddish brown. Wings (pl. 6, fig. 1) hyaline, costa dark brown, subcosta uniting therewith at the basal third. Halteres yellowish. Coxae and femora basally yellowish, distal portion of femora, tibiae and tarsi dark brown; claws stout, strongly curved, the pulvilli longer than the claws. Genitalia; basal clasp segment stout; terminal clasp segment long, stout; dorsal plate short, broad, deeply and triangularly emarginate, the divergent lobes broadly rounded; ventral plate deeply and roundly emarginate, the lobes narrow. Harpes long, narrow, irregular; style long, slender.

Female. Length 1.5 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 14 or 15 cylindric segments, the fifth with a length twice its diameter; subbasal whorl sparse, subapical band scattering; terminal segment reduced or fused with the preceding. Palpi; first segment short, stout, second broadly oval, the third a little longer, more slender, the fourth longer and more slender than the third. Ovipositor relatively stout and not longer than the body, the terminal lobes with a length four or five times greater than their breadth. Color characters nearly as in the male.

This species occurs in Illinois, Massachusetts and New York. It is probably widely distributed.

Dasyneura cyanococci Felt

1907 **Felt, E. P.** New species Cecidomyiidae, 2, p. 11–12
1908 ———— N. Y. State Mus. Bul. 124, p. 292–93, 344

This species was reared from an apical bud gall on blueberry, probably Vaccinium canadense, taken at Stowe, Mass., September 9, 1907.

Female. Length 1.25 mm. Antennae one-half the length of the body, sparsely haired, dark brown, the basal segment yellowish;

15 sessile segments, the fifth subcylindric, with a length nearly twice its diameter; terminal segment somewhat produced, tapering to an obtuse apex. Palpi; the first segment short, stout, subquadrate, the second about as long, narrowly oval, the third one-half longer than the second, more slender, the fourth a little longer and more slender than the third; face yellowish. Mesonotum dark brown, the submedian lines thickly haired. Scutellum brownish red, postscutellum yellowish red. Abdomen deep brown, the incisures dark reddish, pleurae and venter pale yellowish. Ovipositor fuscous yellowish. Wings hyaline, costa dark brown. Halteres pale yellowish, slightly fuscous apically. Coxae and base of femora pale yellowish, the latter slightly fuscous distally; tibiae and tarsi dark brown; claws long, rather stout, strongly curved, the pulvilli shorter than the claws. Ovipositor about as long as the abdomen, the terminal lobes broad, narrowly rounded apically. Type Cecid. a1700.

Dasyneura flavescens Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 344

This yellowish species was taken on ash, Fraxinus, at Albany, N. Y., July 17, 1906.

Female. Length 1 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 15 segments, the fifth with a length about one-half greater than its diameter, the terminal segment narrowly oval. Palpi; first segment short, stout, the second rectangular, with a length three times its diameter, the third longer, more slender and the fourth one-half longer than the third, more slender. Mesonotum dark brown, the submedian lines yellowish and fusing posteriorly to form a conspicuous yellowish median area. Scutellum pale orange, postscutellum yellowish. Abdomen pale yellowish, the dorsal sclerites with the second and third abdominal segments dark brown and with lateral dark brown markings on the posterior margins of the sclerites of the fourth and fifth segments; ovipositor pale yellowish. Wings hyaline, costa dark brown. Halteres yellowish transparent; coxae, femora and tibiae mostly pale yellowish, tarsi mostly dark brown; claws stout, strongly curved, the pulvilli as long as the claws. Ovipositor nearly as long as the body, the slender, terminal lobes with a length three times the breadth. Type Cecid. 601.

Dasyneura rhois Coq.

1895 **Coquillett, D. W.** Ins. Life, 7:348 (Cecidomyia)
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This species does not appear to have been noticed since its discovery in 1895. It was reared by Mr Coquillett from galls on the roots of the common poison ivy sent to him in March 1894 by Mr W. H. Harrison of Lebanon Springs, N. Y. The adults began to issue May 3d and continued up to the 18th of the month.

Dasyneura clematidis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 344, 345
1909 ———— Ent Soc. Ont. 39th Rep't, p. 45.
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 34

This species was reared in August 1907 from an irregular, subglobular gall on Virgins bower, Clematis virginiana. The gall was found at Highland, Albany and Newport, N. Y.

Gall. This is an irregular, subglobular, axillary mass 1 cm in diameter and composed of deformed and enlarged rudimentary leaves or young buds; it is green and slightly hoary.

Male. Length 1 mm. Antennae extending to the fifth abdominal segment, thickly haired, dark brown, yellowish basally; 15 segments, the fifth with a stem one-half the length of the basal enlargement, which latter has a length twice its diameter; terminal segment narrowly oval. Palpi scaled; first segment irregularly oval, the second narrowly elliptical, the third a little longer, more slender, the fourth one-half longer than the third. Mesonotum a variable yellowish brown. Scutellum and postscutellum pale yellowish orange. Abdomen pale orange with the dorsal sclerites light reddish brown; genitalia slightly fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Coxae and base of femora yellowish, the distal portion of femora, tibiae and tarsi mostly dark brown, the tarsi darker; claws strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment stout; dorsal plate long, deeply and narrowly incised; ventral plate long, deeply and narrowly divided. Harpes rather long, stout.

Female. Length 1.25 mm. Antennae extending to the base of the abdomen, thickly haired, dark brown, yellowish basally; 16 antennal segments, the fifth with a length one-half greater than its diameter, the terminal segment produced, with a length four times its diameter, the distal third slender, tapering, narrowly rounded. Palpi scaled; the first segment slender, with a length nearly three times its diameter, the second narrowly oval, the third longer than the second, more slender, the fourth nearly twice the length of the third. Mesonotum reddish orange, the submedian lines indistinct. Scutellum and postscutellum pale orange. Abdomen a light fuscous yellowish, the segments sparsely margined with fuscous. Ovipositor nearly as long as the body, the terminal lobes slender, with a length about four times the width. Other characters as in the opposite sex. Type Cecid. a1659.

Dasyneura smilacifolia Felt

1911 **Felt, E. P.** Econom. Ent. Jour., 4:480

This species was reared during the latter part of August and early September 1911 from rolled leaves of Smilax, green brier, collected by Miss Cora H. Clarke at Magnolia, Mass. Similar larvae were obtained three years before, although no midges were reared therefrom.

Larva. Length 2 mm, rather stout, whitish. Head rather broad, the antennae with a length fully three times the diameter and rather stout; breastbone bidentate, the anterior portion deeply chitinized, the shaft slender and semitransparent. Skin coarsely shagreened, each segment with a transverse row of rather long, stout setae near the anterior third; posterior extremity subtruncate and sparsely ornamented with stout setae.

Dasyneura filicis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 115–16. Separate, p. 19
1908 ———— N. Y. State Mus. Bul. 124, p. 344.

This species was taken on ferns or wild Cranesbill at Albany, N. Y., May 17, 1906.

Male. Length 1.5 mm. Antennae shorter than the body, dark brown, sparsely haired; 15 segments, the fifth with a stem about two-thirds the length of the cylindric basal enlargement; terminal segment produced, obtusely rounded. Palpi; first segment short, the second and third suboval, twice the length of the second, the fourth one-half longer than the third, slender. Mesonotum yellowish laterally, slaty brown dorsally and with long, dark hairs. Scutellum yellowish, postscutellum yellowish and red. Abdomen yellowish red with a fuscous spot basally. Wings hyaline, costa dark brown. Halteres, coxae, femora and tibiae yellowish transparent, thickly gray haired; tarsi grayish brown; claws stout, strongly curved. Genitalia; basal and terminal clasp segments stout; dorsal plate broad, deeply incised; ventral plate broad, long, roundly emarginate. Harpes broad at base, tapering, irregularly dentate apically. Type Cecid. 43.

Dasyneura flavicornis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 345

This species was reared the latter part of July 1907 from a peculiar, greenish or purplish, pouchlike gall occurring on narrow-leaved Solidago, S. graminifolia, at Albany, N. Y.

Gall. The gall ranges in length from 2.5 to 5 cm, tapering gradually from an enlarged base to a very slender, frequently curved tip. It is composed of two or more leaves, the folded edges of which have become adherent. It varies in color from greenish to purplish and the interior is inhabited by yellow larvae.

Larva. The yellowish larva is about 1.3 mm in length with both ends rounded and the segmentation distinct. One specimen mounted has no distinct breastbone and may not prove to be the larva of this species, hence it is not described in detail.

Female. Length 1.5 mm. Antennae extending to the third abdominal segment, sparsely haired, light fuscous yellowish, tinged with reddish distally; 16 segments, the fifth with a length about one-half greater than its diameter, suboval, the terminal segment not produced and closely fused with the preceding. Palpi; first segment rectangular, the second broader, the third longer than the second, slender, the fourth one-half longer than the third, more slender. Face yellowish. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum reddish orange, postscutellum a little darker. Abdomen sparsely haired, dark brown, the incisures a deep carmine, pleurae mostly yellowish, ovipositor fuscous yellowish. Wings hyaline, costa dark brown. Halteres yellowish basally, light fuscous apically. Coxae and base of femora light yellowish, the distal portion of femora, tibiae and tarsi a nearly uniform dark fuscous straw; claws long, stout, evenly curved, unidentate, the pulvilli longer than the claws. Ovipositor about as long as the abdomen, the terminal lobes with a length three times the width, narrowly rounded. Type Cecid. a1154.

Dasyneura maritima Felt

1909 **Felt, E. P.** Econom. Ent. Jour., 2:288

The pale whitish larvae of this species were found October 7, 1908 in tightly rolled terminal leaflets of the beach-pea, L a t h y r u s m a r i t i m u s , by Miss Cora H. Clarke at Magnolia, Mass. Adults were reared April 13 and 15, 1909.

Gall. The galls or rolled leaves are about 1 to 2 cm long, .2 cm in diameter and a variable yellowish green. They are inhabited by several larvae.

Larva. Length 3 mm, pale whitish, rather stout, tapering at both extremities. Head small, antennae long, slender. Breastbone bidentate, weakly chitinized, the shaft subobsolete. Skin coarsely shagreened. Posterior extremity broadly rounded, slightly bilobed.

Male. Length 1.75 mm. Antennae nearly as long as the body, thickly haired, dark brown; 18 segments, the fifth with a stem three-quarters the length of the basal enlargement, which latter has a length one-half greater than its diameter; subbasal whorl thick, subapical band very thick; terminal segment reduced, narrowly oval. Palpi; the first segment presumably subquadrate, the second with a length over three times its diameter, the third one-third longer and the fourth one-half longer than the third. Mesonotum shining black, the submedian lines sparsely haired. Scutellum yellowish, fuscous apically, postscutellum fuscous. Abdomen sparsely haired, dark brown, the sclerites and venter pale yellowish. Genitalia fuscous. Wings hyaline, costa dark brown. Halteres pale yellowish. Coxae and femora basally fuscous yellowish, the distal portion of femora and tibiae dark brown, the tarsi nearly black; claws slender, strongly curved, the pulvilli longer than the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment stout; dorsal plate broad, broadly and roundly emarginate; ventral plate broadly and roundly emarginate. Harpes stout, tapering, irregular apically.

Female. Length 2 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown, yellowish basally; 16–17 sessile segments, the fifth cylindric, with a length about twice its diameter; terminal segment produced, tapering to a narrowly rounded apex. Palpi; probably as in the male. Face fuscous yellowish. Mesonotum yellowish brown, the submedian lines rather thickly haired. Scutellum yellowish orange, postscutellum a little darker. Abdomen sparsely clothed with short, yellowish hairs, dark brown, the incisures, pleurae and venter reddish orange, the extremities of the abdomen and ovipositor yellowish. Ovipositor nearly as long as the body; terminal lobes with a length about three times the diameter, narrowly oval. Type Cecid. a1895.

Dasyneura eugeniae Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:106

The midges were reared from the fruit of Eugenia buxifolia collected at Key West, Fla., by E. A. Schwarz.

Dasyneura vaccinii Smith

1890 **Smith, J. B.** N. J. Agric. Exp't Sta. Bul. K., p. 31–37 (Cecidomyia vaccinii O. S.)
1890 ——— Cat. Ins. N. J., p. 369 (Cecidomyia vaccinii O. S.)
1892 **Fernald, C. H.** Mass. Agric. Exp't Sta. Bul. 19, p. 134–35 (Cecidomyia vaccinii O. S.)
1899 **Johnson, C. W.** Ent. News, 10:80 (C. oxycoccana proposed)
1900 ——— Ent. News, 11:324 (Cecidomyia oxycoccana)
1908 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Bul. 23, p. 392 (Cecidomyia vaccinii O. S.)
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 345
1910 **Stebbins, F. A.** Springf. Mus Nat. Hist. Bul. 2, p. 46 (Cecidomyia)

This species is known to the cranberry grower as the tip worm. The first sign of its presence, according to Doctor Smith, is the unusual prominence of certain terminal buds accompanied by a cessation in the growth of the leaves. An examination discloses the yellowish Cecidomyiid larvae within the affected bud. The tip usually though not always dies. This midge causes considerable injury to cranberry beds.

Dr J. B. Smith, who has investigated the life history of this species, states that there are at least four and probably five generations annually, the insects occurring at any time from the beginning of May to the middle or end of September, the larva requiring about 13 days to complete its growth. The egg has not been observed nor is there any record as to the method of hibernation, though it is probable that this species, like many of its allies, winters in an oval, larval cell in the soil. The transformation of the larva to the adult during the warm season at least, occurs within the buds, the larva spinning a white cocoon prior to pupation. The reddish brown adult, with its curved third vein, may be recognized by the 16 antennal segments, the fifth of the male having a stem as long as the basal enlargement, while that of the female has a length twice its diameter.

Synonymy. This species was first described by Doctor Smith under the name of Cecidomyia vaccinii, which designation, we believe, must stand, since Osten Sacken's vaccinii was not applied to an insect but to a vegetable deformation and therefore has no standing in zoological nomenclature. This obviously renders it impossible to accept Professor Johnson's proposed Cecidomyia oxycoccana for the species described by Doctor Smith. There are two European Cecidomyiidae to which the specific name of vaccinii has been applied; one Dasyneura vaccinii described by Rubsaamen in 1885 and the other Cecidomyia vaccinii described by Kieffer in 1897. The application of this specific name to our American species antedates both of these and should it prove co-generic with either, the name of the European form must be changed.

Larva. The larva has been described by Doctor Smith as a minute, orange, red or yellow grub about .06 of an inch or a trifle more in length.

The following descriptions of adults have been drafted from specimens evidently deposited by Doctor Smith in the United States National Museum.

Male. Length 1 mm. Antennae a little longer than the body, thickly haired, fuscous yellowish; 16 segments, the fifth with a stem about as long as the basal enlargement, which latter has a length about one-half greater than its diameter; terminal segment somewhat produced, broadly rounded distally. Palpi; the first segment short, stout, irregularly subquadrate, the second a little longer, stout, broadly oval, the third one-half longer, more slender, the fourth about as long as the third, more slender. Mesonotum reddish brown, the submedian lines probably indistinct. Scutellum fuscous yellowish, postscutellum a little darker. Abdomen reddish brown. Wings hyaline, costa light brown. Halteres yellowish brown, slightly fuscous apically. Legs yellowish brown, the tarsal segments somewhat darker; claws rather long, slender, strongly curved, the pulvilli distinctly longer than the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment stout; dorsal plate short, broad, deeply and triangularly incised, the lobes widely separated, narrowly rounded; ventral plate long, broad, deeply and roundly emarginate, the lobes long, slender, obtuse. Harpes stout at base, tapering, irregularly tuberculate.

Female. Length 3 mm. Antennae extending to the fourth abdominal segment, thickly haired, light brown; 16 segments, the fifth with a stem about one-sixth the length of the basal enlargement, which latter has a length about twice its diameter; terminal segment somewhat produced, narrowly rounded apically. Palpi; the first segment short, stout, irregularly subquadrate, the second a little longer, narrowly oval, the third one-half longer than the second, more slender, the fourth one-half longer than the third, more slender. Color characters about as in the male, except that the abdomen is somewhat lighter. Ovipositor nearly as long as the body, the terminal lobes long, rather broad, tapering, narrowly rounded. Type Cecid. 957.

Dasyneura modesta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 345

A female of this form was observed in the vicinity of red oak at Albany, N. Y., May 19, 1907.

Female. Length 1.75 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown, the basal segments yellowish; 16 segments, the fifth subsessile, subcylindric; terminal segment produced, narrowly rounded distally. Palpi; the first segment irregularly subquadrate, somewhat dilated apically, the second one-half longer, tapering distally, the third twice the length of the second, more slender, the fourth one-half longer than the third, face fuscous. Mesonotum dark brown, sparsely bordered laterally and anteriorly with golden yellow scales, the submedian lines thickly set with yellowish scales. Scutellum deep red, postscutellum fuscous red. Abdomen sparsely clothed with fine hairs, light brown, the incisures and venter a pale salmon. Wings hyaline, costa light brown. Halteres pale salmon basally, yellowish transparent apically. Legs a variable light fuscous, the distal tarsal segments darker; claws long, slender, strongly curved, the pulvilli as long as the claws. Ovipositor about as long as the body, terminal lobe long, slender, narrowly rounded. Type Cecid. 1200.

Dasyneura apicata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 345 (D. apicatus)

This pale yellow species was reared September 7, 1907, from a deformed, terminal growth on ash, Fraxinus, shoots taken at Highland, N. Y., August 22, 1907.

Gall. This species was reared from ash shoots, the young terminal leaves forming a head and two petioles often coalescing to produce a hoary, pubescent gall containing whitish larvae some 2 mm long.

Larva. Length 2 mm, whitish, rather stout; head broad, obtuse apically. Antennae rather stout, uniarticulate; breast-bone bidentate, subobsolete posteriorly. Skin nearly smooth, posterior extremity broadly rounded, the latero-posterior angles with three or four slender spines arising from more or less distinct tubercles.

Female. Length 1.25 mm. Antennae one-half the length of the body, sparsely haired, fuscous yellowish, yellowish basally; 16 sessile segments, the fifth with a length one-half greater than its diameter, the terminal segment produced, narrowly oval. Palpi scaled; the first segment short, subquadrate, the second broadly oval, the third a little longer and more slender, the fourth nearly twice the length of the third. Mesonotum pale yellowish, slightly fuscous, the submedian lines indistinct. Scutellum, postscutellum and abdomen pale yellowish, the latter slightly fuscous dorsally; pleurae pale yellowish. Wings hyaline, costa brown. Halteres pale yellowish. Coxae and femora basally yellowish, the distal part of femora and tibiae fuscous yellowish, tarsi dark brown or black. Ovipositor longer than the abdomen, the slender terminal lobes with a length fully four times the width. Type Cecid. a1712.

Dasyneura caricis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 116. Separate, p. 19–20
1908 ———— N. Y. State Mus. Bul. 124, p. 345

This species was taken June 4, 1906 on sedge, Carex vulpinoidea, at Albany, N. Y.

Male. Length 1 mm. Antennae longer than the body, thickly haired, light brown; 16 segments, the fifth with a stem one-quarter longer than the basal enlargement; terminal segment irregularly suboval, the apex obtusely rounded. Palpi; the first segment short, subquadrate, the second fully twice the length of the first, with a distinct lateral knob, the third as long as the second, subrectangular, the fourth nearly twice the length of the third, slender, the fifth one-quarter longer than the fourth, flattened, slender; face light brown. Mesonotum dark brown with narrow, submedian lines of fine setae. Scutellum reddish brown with sparse apical setae, postscutellum yellowish. Abdomen yellowish brown, rather sparsely clothed with yellowish hairs, tip of genitalia dark brown. Wings hyaline, costa thickly clothed with blackish hairs; halteres yellowish transparent basally, yellowish fuscous apically. Legs nearly uniform light brown; tarsi slightly darker; claws rather slender, uniformally curved. Genitalia; basal clasp segment slender, internally with a broadly rounded lobe at the basal third; terminal clasp segment with the basal third greatly swollen; dorsal plate broad, deeply incised; ventral plate broad at base, narrowing at the basal third, deeply and triangularly emarginate. Harpes stout, subtriangular, apically several inconspicuous subquadrate teeth.

Female. Length 1 mm. Antennae probably a little shorter than the body, sparsely haired, dark brown; probably 16 segments, the fifth with a stem about one-quarter the length of the basal enlargement. Palpi; the first segment short, irregularly subquadrate, the second a little longer, subquadrate, the third more than twice the length of the second, the fourth one-quarter longer than the third, more slender; face dark brown. Mesonotum dark brown, posterior median area reddish. Scutellum yellowish red, postscutellum darker. Abdomen yellowish red. Wings hyaline, costa yellowish brown; halteres and legs yellowish transparent, the latter with the articulations and tarsi variably tinged with carmine. Ovipositor longer than the body, terminal lobe long, narrow, broadly rounded distally. Type Cecid. 111.

Dasyneura quercina Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 116. Separate, p. 20
1908 ———— N. Y. State Mus. Bul. 124, p. 345

This dark brown male was taken on oak, probably red oak, Quercus rubra, at Albany, N. Y., May 18, 1906.

Male. Length 1.5 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 16 segments, the fifth with a stem about two-thirds the length of the basal enlargement; terminal segment produced, constricted near the middle. Palpi; the first segment subquadrate, the second one-half longer than the first, the third more slender, one-half longer than the second and the fourth one-half longer than the third. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum reddish brown, postscutellum darker. Abdomen dark brown, sparsely haired, reddish laterally. Wings hyaline, costa yellowish brown. Halteres yellowish transparent basally, reddish fuscous apically. Legs light brown, tarsi slightly darker; claws slender, strongly curved. Genitalia; basal clasp segment slender; terminal clasp segment slightly enlarged basally; dorsal plate broad; ventral plate narrow; both deeply and triangularly incised (pl. 7, fig. 1). Harpes broad, convolute, broadly rounded, indistinctly dentate. Type Cecid. 47.

Dasyneura lepidii Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This reddish brown species was reared in early July from seed capsules of Lepidium virginicum taken at Washington, D. C., July 7, 1899 by Mr Pergande. Several Chalcids were reared the middle of July.

Gall. The gall of this species, as described by Pergande, consists of peculiarly swollen or inflated seed capsules having an abnormally dark green color.

Female. Length 1.25 mm. Antennae about three-quarters the length of the body, sparsely haired, dark brown; 17 segments, the fifth with a length one-quarter greater than its diameter; terminal segment slightly produced, narrowly oval. Palpi; the first segment subquadrate, the second rectangular, with a length three times its diameter, the third longer, more slender, the fourth a little longer and more slender than the third. Mesonotum shining dark brown. Scutellum fuscous yellowish, postscutellum a little darker. Abdomen reddish brown (dark red according to Pergande). Wings hyaline, costa reddish brown. Halteres yellowish transparent. Legs mostly yellowish brown, the distal tarsal segments darker; claws strongly curved, the pulvilli longer than the claws. Ovipositor about two-thirds the length of the abdomen, the terminal lobes short and broad. Type Cecid. 1035.

Dasyneura smilacinae Bish.

1911 **Bishop, S. C.** Ent. News, 22:346

The above named midge was reared by Mr S. C. Bishop at Ithaca, N. Y., January 15, 1910 from root galls on false Solomon seal, Smilacina racemosa. See the above citation for a detailed description.

Dasyneura tumidosae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This species was reared in small numbers in July 1907 from a jar containing numerous galls generally referred to as Cecidomyia pellex O. S.

Gall. A large, tumid, green, reddish or brownish midrib swelling ranging in length from 5 to 15 cm (pl. 2, fig. 4), the larger deformities containing from 30 to even 60 or more larvae irregularly distributed along the length of the deep fold evidently caused by their operations.

Male. Length 1.5 mm. Antennae nearly as long as the body, rather thickly haired, fuscous yellowish, the basal segments yellowish; 17 segments, the fifth with a stem about one-half the length of the basal enlargement; terminal segment somewhat reduced, obtusely obconic. Palpi; the first segment short, stout, subquadrate, expanded distally, the second one-half longer than the first, stout, rounded distally, the third one-half longer and more slender than the second, the fourth more slender and about twice as long as the third; face yellowish. Mesonotum dark brown, the broad submedian yellowish lines sparsely haired. Scutellum reddish brown, postscutellum pale orange. Abdomen pale yellowish, slightly fuscous. Genitalia fuscous. Wings hyaline, costa dark brown. Halteres yellowish transparent, slightly fuscous subapically. Legs mostly pale yellowish, the two basal tarsal segments light fuscous, the three distal ones dark brown or black; claws long, slender, strongly curved, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment long, tapering; dorsal plate short, broad, the lobes broadly and triangularly divided; ventral plate long, broad at base, tapering, broadly and roundly emarginate. Harpes long, stout at base, tapering, obtuse.

Female. Length 1 mm. Antennae extending to the second abdominal segment, thickly long-haired, dark brown, basal segments yellowish; 19 segments, the fifth cylindric, with a length about two and one-half times its diameter; terminal segment produced, with a length about four times its diameter, narrowly rounded apically. Palpi; the first segment short, stout, subquadrate, the second broadly oval, with a length over twice its diameter, the third one-half longer and more slender than the second, the fourth one-half longer and more slender than the third; face yellowish. Mesonotum a light fuscous orange, the submedian lines sparsely haired. Scutellum, postscutellum and pleurae deep orange. Abdomen a light fuscous yellowish, the venter yellowish. Wings hyaline, costa dark brown. Halteres pale orange; coxae and femora mostly pale orange, the latter narrowly or slightly marked with fuscous apically; tibiae fuscous orange, tarsi mostly dark brown, the basal segments somewhat lighter; the pulvilli as long as the claws. Ovipositor nearly as long as the body, the terminal lobes stout, with a length over four times the diameter, narrowly rounded. Type Cecid. a1532.

Dasyneura pergandei Felt

1911 **Felt, E. P.** Econom. Ent. Jour., 4:480

This species was reared by Mr Theodore Pergande in 1878 from swollen fruit of wild cherry, probably Prunus melanocarpa, collected by Prof. C. V. Riley at Glen Eyrie, Col., the preceding June. The reddish larvae deserted the infested fruit, wintering in the ground. Mr Pergande's rearings paralleled those of the writer, in that he secured more than one species, as is evidenced by a study of the specimens reared.

Gall. Somewhat oval, pointed at the end, the upper half reddish, the other yellowish green (Pergande).

Dasyneura multiannulata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This species was taken on hickory, Carya, at Nassau, N. Y., June 14, 1906.

Female. Length 1 mm. Antennae extending to the second abdominal segment, sparsely clothed with fine setae, reddish brown, yellowish white basally; 18 segments, the fifth subsessile, subcylindric, the basal portion having a length fully one-half greater than its diameter, terminal segment somewhat prolonged, apparently consisting of two closely fused and fully twice the length of the preceding. Palpi; the first segment subquadrate, second narrowly oval, the third one-quarter longer than the second, stouter, the fourth a little longer than the third, more slender, face dark yellowish. Mesonotum brownish black, the anterior portion rather thickly clothed with fine setae, submedian lines rather distinct. Scutellum dull black, thickly clothed anteriorly with a patch of yellowish white scales, postscutellum reddish brown. Abdomen pale reddish brown. Wings hyaline, costa yellowish brown; halteres whitish transparent. Legs a nearly uniform pale straw color, tarsi slightly darker; claws long, rather strongly curved. Ovipositor as long as the body, terminal lobes long, slender, broadly rounded. Type Cecid. 261.

Dasyneura florida Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

One female kindly placed at our disposal by the United States National Museum was reared April 27, 1887 from leaves collected by Mr E. A. Schwarz at Keywest, Fla., possibly oak-bearing galls similar to though much smaller than those made by Cincticornia pilulae O. S.

Female. Length 1.25 mm. Antennae extending to the base of the abdomen, sparsely haired, light brown; 18 segments, the fifth sessile, cylindric, with a length a little greater than its diameter; terminal segment produced, tapering, narrowly rounded. Palpi; the first segment somewhat expanded distally and with a length nearly three times its diameter, the second nearly as long as the first, rather stout, the third a little longer and more slender than the second and the fourth one-quarter longer and more slender than the third. Mesonotum light brown, the submedian lines rather thickly clothed with fine hairs. Scutellum and postscutellum yellowish brown. Abdomen a nearly uniform dark reddish brown, the basal segment and ovipositor mostly light yellowish brown. Wings hyaline, costa dark brown; halteres pale yellowish. Coxae and femora mostly yellowish brown, the tibiae mostly a little darker, apically dark brown, the tarsi a nearly uniform dark brown; claws rather long, stout, evenly curved, the pulvilli a little shorter than the claws. Ovipositor about one-half the length of the abdomen, the terminal lobes very short, broad, having a length only about three-quarters the diameter. Type Cecid. 1057.

Dasyneura aberrata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This male was taken in association with the female described as Dasyneura modesta and at first supposed to be the opposite sex of this species. There are, however, striking differences between the two, and it has therefore been characterized as a distinct form. It was captured May 19, 1907 in the vicinity of red oak at Albany, N. Y.

Male. Length 1.25 mm. Antennae about two-thirds the length of the body, sparsely haired, dark brown; 11 segments, the fifth with a length one-half greater than its diameter; terminal segment somewhat produced, narrowly rounded. Palpi; first segment stout, ovoid, second segment slender, narrowly oval, the third a little longer, more slender, the fourth a little longer than the third, somewhat dilated. Mesonotum dark brown, sparsely bordered laterally and anteriorly with yellowish scales, the submedian lines thickly ornamented with yellowish scales. Scutellum deep red, postscutellum fuscous red. Abdomen sparsely clothed with fine hairs, light brown, the incisures and venter pale salmon. Wings hyaline, costa pale straw, subcosta uniting therewith at the basal third. Halteres pale salmon basally; yellowish transparent apically. Legs a variable light fuscous, the distal tarsal segments somewhat darker; claws rather slender, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment stout; terminal clasp segment stout at the base, short; dorsal plate short, deeply and narrowly incised; ventral plate short, broad, tapering broadly and roundly emarginate. Harpes long, irregularly truncate. Type Cecid. 1200a.

Dasyneura cirsioni Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This fuscous yellowish female was taken on Canada thistle, Cirsium arvense, at Albany, N. Y., July 17, 1906.

Female. Length .75 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 12 segments, the fifth subcylindric, with a length about one-half greater than the diameter; terminal segment somewhat prolonged, broadly rounded. Palpi; the first segment short, subquadrate, the second short, narrowly oval, the third one-half longer, more slender, the fourth a little longer and more slender. Mesonotum dark brown, submedian lines narrow, yellowish. Scutellum and postscutellum reddish brown. Abdomen fuscous yellowish, pleurae pale yellowish, ovipositor orange yellow. Wings hyaline, costa thickly clothed with dark brown scales; halteres yellowish basally, slightly fuscous apically. Coxae and femora basally semitransparent; the latter distally, tibiae and tarsi mostly dark brown; claws long, slender, evenly curved. Ovipositor as long as the body, the terminal lobes long, slender, narrowly rounded. Type Cecid. 619.

Dasyneura scutata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

The dark brown female was taken at Albany, N. Y., July 16, 1906 in general collecting on goldenrod and aster.

Female. Length 1 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 13 segments, the fifth subsessile; terminal segment with a length twice that of the preceding, tapering and obliquely rounded. Palpi; first segment irregular, rectangular, the second about as long as the first, narrowly oval, the third a little longer, the fourth more slender and a little shorter. Mesonotum nearly black, submedian lines sparsely setose. Scutellum nearly black, sparsely setose apically, postscutellum and abdomen dark brown, the latter sparsely clothed with silvery setae. Wings hyaline, costa dark brown. Halteres pale yellowish, basally fuscous. Legs dark brown; claws stout, slightly curved. Ovipositor nearly as long as the body, the terminal lobes slender, narrowly rounded. Type Cecid. 507.

Dasyneura acerifolia Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 115. Separate, p. 18–19

The light brown male was taken on maple at Albany, N. Y., May 21, 1906.

Male. Length .75 mm. Antennae extending to the base of the abdomen, sparsely haired, light brown; 14 segments, the fifth with a stem one-quarter the length of the basal enlargement; terminal segment produced, broadly rounded apically. Palpi; the first segment swollen at the distal third, the second a little longer, suboval, the third slightly longer than the second, more slender, and the fourth one-quarter longer than the third, slender. Mesonotum and scutellum dark brown. Abdomen brown. Wings hyaline, costa light brown. Halteres yellowish transparent. Legs mostly yellowish transparent, variably dark brown distally; claws slender, slightly curved. Genitalia; basal clasp segment long, stout; terminal clasp segment swollen basally; dorsal plate deeply and triangularly emarginate; ventral plate narrow, deeply emarginate. Harpes subtriangular, obtuse.

Female. Length .75 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 13 segments, the fifth subsessile. Face dark brown; eyes large, black. Mesonotum dark brown, the submedian lines dark haired. Scutellum reddish brown, postscutellum yellowish. Abdomen dark brown. Wings hyaline, costa light brown. Ovipositor nearly as long as the body, the terminal lobes slender, acutely rounded. Type Cecid. 66.

Dasyneura albohirta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This light brown species was taken on fern or cranesbill, G e r a n i u m m a c u l a t u m, at Albany, N. Y., May 17, 1906.

Female. Length 1.35 cm. Antennae extending to the third abdominal segment, rather sparsely haired, dark brown; 13 segments, the fifth with a length one-half greater than its diameter, the twelfth and thirteenth closely fused, the latter nearly twice the length of the normal segment, narrowly rounded apically. Palpi; first segment irregular, somewhat produced, the second narrowly oval, the third one-half longer, more slender, the fourth as long as the third, slightly expanded. Mesonotum very dark brown, the submedian lines thickly haired. Scutellum and postscutellum dark brown, the former with dark fuscous hairs apically. Abdomen light brown, sparsely clothed with white hairs. Wings hyaline, costa dark brown. Halteres yellowish white. Legs dark brown; claws strongly curved, pulvilli distinctly longer than the claws. Ovipositor nearly as long as the abdomen, the terminal lobes slender, with a length three times the width. Type Cecid. 44.

Dasyneura similis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 346

This reddish brown species was taken on thistle at Albany, N. Y., July 17, 1906.

Female. Length 2 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown, yellowish basally; 13 segments, the fifth with a length twice its diameter, the terminal segment greatly produced, evidently composed of two closely fused. Palpi; first segment slender, rectangular, the second a little longer, stouter, the third one-half longer than the second, the fourth little longer and more slender than the third. Face yellowish. Mesonotum dark brown, the submedian lines yellowish, thickly haired. Scutellum brown, postscutellum darker. Abdomen reddish brown, the dorsal sclerites fuscous. Wings hyaline, costa dark brown. Halteres yellowish transparent. Legs a nearly uniform dark brown; claws strongly curved, the pulvilli longer than the claws. Ovipositor when extended as long as the body; terminal lobes narrowly oval. Type Cecid. 596.

Dasyneura antennata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 347

This dark brown species was taken on sugar maple at Albany, N. Y., June 11, 1906.

Female. Length .75 mm. Antennae dark brown, about three-quarters the length of the body, sparsely haired; 13 ovate segments, the fifth with a length one-half greater than its diameter, the terminal segment greatly produced, with a length four times its diameter, evidently composed of two segments closely fused. Palpi; first segment long, slender, second stout, irregularly curved, the third rectangular or ovate, the fourth more than twice the length of the third. Face dark brown. Mesonotum very dark brown. Scutellum reddish brown, postscutellum and abdomen dark brown the latter sparsely ornamented with fine setae. Wings hyaline. costa dark brown. Halteres yellowish transparent. Legs a nearly uniform fuscous brown; claws strongly curved, the pulvilli longer than the claws. Ovipositor nearly the length of the abdomen, the terminal lobes slender, with a length nearly four times the width. Type Cecid, 213.

Fig. 19 Gall of Dasyneura parthenocissi (natural size, original)

Dasyneura parthenocissi Stebb.

This species produces the rather common turgid midrib swelling (plate 2, figure 13) on the Virginia creeper and has been noticed by the author in detail in the Journal of the New York Entomological Society, 21:216–17, 1913.

Dasyneura canadensis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 157
1908 ———— N. Y. State Mus. Bul. 124, p. 347, 350

This pale salmon midge was reared by the late Dr James Fletcher May 1, 1907 from Cecidomyiid larvae infesting the seeds of white spruce, Picea canadensis, taken in the vicinity of Ottawa, Canada. The larvae live within the seeds, and do not produce a deformity in the cone. This species might become of some economic importance on account of destroying spruce seed, though Doctor Fletcher informed us that it was much parasitized by a Proctotrypid and sparsely by a Chalcid. Microdus bicolor Prov.? (Ins. Life 3:18) may be a parasite of this midge. Polygnotus species was reared from this species.

Male. Length 2 mm. Antennae nearly as long as the body, sparsely haired dark brown, yellowish basally, a few of the terminal segments reddish; mouthparts fuscous yellowish; 17 segments, the fifth with a stem as long as the basal enlargement; terminal segment with the basal portion produced, narrowly oval. Palpi; the first segment subrectangular, the second a little longer, stouter, the third one-half longer and more slender than the second, the fourth a little longer and more slender than the third. Mesonotum reddish brown, sometimes darker, the submedian lines narrow, rather thickly clothed with fine hairs. Scutellum pale yellowish re with a few coarse setae apically, postscutellum and abdomen a pale salmon, the latter sparsely clothed with fine hairs; genitalia fuscous; venter a pale yellowish orange, the subquadrate sclerites dark brown. Wings hyaline, costa dark brown; halteres and basal portion of femora pale yellowish, distal portion of femora and tibiae fuscous yellowish, the tarsi a variable fuscous brown; claws short, stout, strongly curved, the pulvilli longer than the claws. Genitalia; basal clasp segment stout; terminal clasp segment stout at base; dorsal plate broad, deeply and triangularly emarginate; ventral plate long, tapering slightly, broadly and roundly emarginate.

Female. Length 2 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown, slightly reddish distally, the basal segments fuscous yellowish; 13 segments, the fifth subsessile, subcylindric, tapering, with a length about twice its diameter. Mesonotum a shining brownish black, submedian lines narrow, thickly haired. Scutellum fuscous yellowish with a few coarse setae apically, postscutellum brownish black. Abdomen a pale salmon; ovipositor somewhat lighter. Ovipositor about as long as the abdomen, terminal lobes long, slender, broadly rounded. Other characters about as in the male. Type Cecid. a1428.

Dasyneura gleditschiae O. S.

1867 **Osten Sacken, C. R.** Ent. Soc. Phila. Proc., 6:219–20 (Cecidomyia)
1892 **Beutenmueller, William.** Amer. Mus. of Nat. Hist. Bul., 4:266 (Cecidomyia)
1900 **Smith, J. B.** Ins. N. J. Cat., p. 620 (Cecidomyia)
1904 **Cook, M. T.** Ohio St. Univ. Bul. 15, s. 6, p. 267 (Cecidomyia)
1903 ——— Ohio St. Univ. Bul. 20. s. 7, p. 426–27 (Cecidomyia)
1904 **Beutenmueller, William.** Amer. Mus. Jour. Guide Leaflet 16, p. 26 (Cecidomyia)
1905 **Cook, M. T.** Geol. & Nat. Resour. Ind. 29th Rep't, p. 839 (Cecidomyia)
1906 **Felt, E. P.** N. Y. State Mus. Bul. 104, p. 125 (Cecidomyia)
1906 ——— N. Y. State Mus. Mem. 8, 2:729 (Cecidomyia)
1908 ——— N. Y. State Mus. Bul. 124, p. 337, 347.

This species was first observed by Osten Sacken in August 1866 on account of its deforming the leaflets of the honey locust, Gleditschia triacanthos. The young leaves are transformed into characteristic podlike swellings inhabited by two or three pale orange larvae. Osten Sacken states that the adults began to appear about the 10th of August. This species is evidently widely distributed, since it has been recorded by Beutenmueller as not common in Central Park, though Doctor Smith lists it as a common form in New Jersey. It is recorded by Cook in his List of Insect Galls of Indiana, as a common species. This species was also reared by B. H. Walden June 20, 1904 from rolled leaves collected at New Haven, Conn. Beutenmueller reports the appearance of the adult in July and August. These records clearly show that the emergence of the flies extends over a considerable period.

Gall. The gall of this species is composed of a folded leaflet deformed in such a way as to assume the appearance of a pod (pl. 8, fig. 4), each gall containing 2 to 3 pale orange larvae with a very delicate, narrow breastbone. Doctor Cook states that the two halves of the leaflet never have an opportunity to unfold though there is a growth of cells allowing the leaflet to enlarge and form the larval chamber between the two halves. The cells are at first normal but gradually lengthen in an axis at right angles to the midrib.

Dasyneura pseudacaciae Fitch

1859 **Fitch, Asa.** N. Y. S. Agric. Soc. Trans., 18:833 (Cecidomyia)
1859 ——— Nox. & Other Ins. N. Y. 5th Rep't, p. 53 (Cecidomyia)
1874 **Glover, Townend** MSS. Notes from My Journal Dipt., p. 68 (Cecidomyia)
1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p. 368 (Cecidomyia)
1906 **Felt, E. P.** Inj. & Other Ins. N. Y. 21st Rep't, p. 125–27
1906 ——— Ins. Affect. Pk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:730

This species occasionally occurs on black locust, Robinia pseudoacacia, in such numbers as to badly deform the young leaves, preventing their unfolding and causing them to assume a peculiar, podlike form. This is caused by the female depositing probably two or three eggs in each unfolding leaf. The young maggots cause sufficient irritation to prevent the leaf unfolding. It is occasionally so abundant as to affect most of the leaves on an entire hedge, as reported by Mr C. L. Williams of Glens Falls, N. Y., in 1905. The adults appear in July. It is probable that this species has been confused with the described D. gleditschiae O.S., which produces similar galls on the honeylocust This dark brown species with the third vein nearly straight and 14 sessile segments, may be separated from the allied D. gleditchiae O.S. by the fifth tarsal segment having a length three times its width and by the long ovipositor lobes, the latter tapering and with a length three times their width.

Gall. The gall of this species simply consists of badly deformed, rolled leaflets forming peculiar, podlike structures about one-quarter of an inch long. Occasionally the insect is so abundant as to deform most of the young leaflets.

Pupa. Length 1.6 mm, brownish; cephalic horns long, slender. The antennal cases extend to the base of the wing pads, the latter to the tip of the second abdominal segment, the leg cases to the third and fourth abdominal segments; eyes dark brown.

Dasyneura californica Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 347

This reddish brown species was reared February 13, 1886 by Mr Pergande from bud galls on willow, Salix californica, taken at Alameda, Cal. One parasite was also reared.

Gall. This has been described simply as a bud gall and the larvae inhabiting the same as pale orange.

Female. Length 1 mm. Antennae extending to the fourth abdominal segment, sparsely haired, reddish brown; 14 segments, the fifth with a length one-half greater than its diameter, the fourteenth evidently composed of two closely fused, the distal portion being subconic and separated from the larger basal part by a distinct constriction. Palpi; first segment irregularly subquadrate, the second longer, stouter, the third one-half longer and more slender than the second, the fourth a little longer and more slender than the third. Mesonotum reddish brown, the submedian lines indistinct. Scutellum a little darker, postscutellum yellowish. Abdomen reddish brown, sparsely haired. Wings hyaline, costa light brown. Halteres pale yellowish; coxae and base of femora yellowish, distal part of femora, tibiae and probably tarsi darker; claws strongly curved, unidentate, the pulvilli longer than the claws. Ovipositor about as long as the body, the terminal lobes with a length three times the diameter. Type Cecid. 981.

Dasyneura denticulata Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 117. Separate, p. 21
1908 ———— N. Y. State Mus. Bul. 124, p. 347

This peculiar female with very hairy wings and dark carmine abdomen was taken on white spruce, Picea canadensis, at Lake Clear, N. Y., June 7, 1906.

Female. Length 1.5 mm. Antennae a little shorter than the body, sparsely haired, reddish brown; 14 segments, the fifth subsessile, ovate with a length three-quarters greater than its diameter; terminal segment prolonged, subfusiform. Palpi; the first segment fusiform, the second as long as the first, rather stout, subrectangular, the third two-thirds the length of the preceding, narrowly oval, the fourth a little longer, broadly lanceolate, face dark brown. Mesonotum dark carmine. Scutellum tinged with yellowish, postscutellum and abdomen dark carmine. Wings hyaline, costa dark brown; halteres yellowish transparent, femora and tibiae yellowish brown, tarsi dark brown with suggestions of annulations; claws stout, strongly curved at the distal third. Ovipositor three-quarters the length of the body, the terminal lobes stout, broad, narrowly rounded. Type Cecid. 156.

Dasyneura augusta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 348

This reddish orange female was taken on oak, Quercus, at Albany, N. Y., August 6, 1906.

Female. Length 1.25 mm. Antennae one-third the length of the body, sparsely haired, dark brown; 14 segments, the fifth subcylindric, with a length one-half greater than its diameter. Palpi; the first segment swollen and rounded distally, the second elongate, subquadrate, stout, the third more slender and the fourth one-half longer than the third; face fuscous. Mesonotum dark brown, submedian lines fuscous yellowish. Scutellum and postscutellum dark brown. Abdomen reddish orange, the ovipositor fuscous yellowish with the subterminal segment pale orange. Wings hyaline, costa dark brown; halteres pale yellowish. Coxae a variable fuscous and fuscous yellowish, femora yellowish basally, fuscous apically, tibiae fuscous yellowish, darker apically, tarsi dark brown; claws rather slender, strongly curved. Ovipositor moderately long, terminal lobe very long, slender, broadly rounded. Type Cecid. 737.

Dasyneura rosarum Hardy

1850 **Hardy, James.** Ann. Mag. Nat. Hist., s. 2, 6:186
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 348

This dark brown species was reared July 11, 1907 from the folded terminal leaves of rose taken at Albany, N. Y. The insects reared agree so closely with the description of the above named European species that they have been provisionally identified therewith. Torymus ostensackenii D.T. was reared from this midge.

Gall. The three terminal leaflets of the branch are folded together longitudinally and containnumerous white larvae. The gall is greenish tinged with brown and about 18 mm long. The general appearance is very similar to the illustration given by Connold in his Vegetable Galls.

Female. Length 2 to 2.5 mm. Antennae extending to the fifth abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth with a stem about one-fourth the length of the basal enlargement, which latter has a length about twice its diameter; terminal segment reduced, broadly oval. Palpi; the first segment short, stout, subquadrate, the second more than twice the length of the first, more slender, the third a little longer and more slender than the second, the fourth a little shorter than the third. Head slightly reddish. Mesonotum dark brown, the submedian lines sparsely haired, fuscous orange. Scutellum fuscous yellowish, postscutellum lighter. Abdomen sparsely clothed with fine hairs, dark brown, the incisures and venter dark salmon. Wings hyaline, costa light brown; halteres yellowish basally, fuscous apically. Legs a uniform dark brown, femora pale beneath; claws long, slender, strongly curved, the pulvilli a little longer than the claws. Ovipositor pale salmon, about half the length of the abdomen, the terminal lobes long, slender, narrowly oval. Cecid. a1491.

Dasyneura semenivora Beutm.

Violet seed midge

1907 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Bul. 23, p. 390–91 (Cecidomyia)
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 45 (as Cecidomyia)

The work of this species has been known for several years. The late Dr James Fletcher called the writer's attention to the fact that a noted botanist described the distorted fruits produced by this species as the natural production of Viola dicksonii. This species is evidently widely distributed, since it is usually present though not abundant, according to the late Doctor Fletcher, in the vicinity of Ottawa, Canada. It has been found at Albany, N. Y., and taken at Plainfield, N. J. It is stated by Professor Beutenmueller that the gall was first recorded by E. L. Green in 1902[1] and described by E. Brainerd in 1904.[2] The galls from which the type specimens were reared were taken by Mr W. De W. Miller at Plainfield, N. J., who states that they occur from July until late in October, the mature larvae spinning up and hibernating within the gall.

Gall. The gall is about 1 cm long, 7 cm in diameter, irregular, a variable brown and has been characterized by Doctor Fletcher as a large plumlike gall. The interior consists of a mass of old cells among the seeds, the individual cells being about 2 mm by 1 mm yellowish gray, adherent and irregularly placed. Professor Beutenmeuller states that the gall is about the size of a pea or gooseberry, measures from 6 to 14 mm in diameter and is attached by a short stalk to the base of the plant.

Male. Length 1.25 mm. Antennae nearly as long as the body, thickly haired, dark brown; 14 segments, the fifth with a stem three-quarters the length of the basal enlargement, which latter has a length nearly twice its diameter; terminal segment reduced, narrowly oval. Palpi; the first segment broadly oval, the second with a length over twice its diameter, the third one-half longer than the second, more slender, the fourth a little longer and more slender than the third. Mesonotum shiny dark reddish brown. Scutellum yellowish brown, postscutellum and abdomen dark yellowish brown, the latter thickly haired. Genitalia fuscous. Wings hyaline, costa dark brown, subcosta uniting with the anterior margin near the basal third, the third vein well before the apex. Halteres yellowish transparent. Coxae and femora basally fuscous yellowish; femora distally, and tibiae light brown, the tarsi mostly darker brown claws evenly curved, the pulvilli shorter. Genitalia; basal clasp segment long, slender; terminal clasp segment short, stout; dorsal plate long, broad, narrowly incised; ventral plate long, broad. Harpes long, broad, tapering, roundly truncate.

Female. Length 2 mm. Antennae extending to the base of the abdomen, thickly haired, dark brown; 16 segments, the fifth subsessile, with a length twice its diameter. Ovipositor fuscous yellowish, nearly as long as the abdomen, the terminal lobes large, narrowly oval.

Described from type specimens, Cecid. a1830, kindly donated by Prof. William Beutenmueller.

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[1] Pittonia, 5:103.

[2] Rhodora, 6:15.

Dasyneura americana Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 348 (D. galii)
1913 ———— Psyche, 20:136 (D. americana proposed)

This deep red species was reared September 1, 1907 from irregular, flower bud galls on bedstraw, Galium asprellum, collected at Magnolia, Mass., by Miss Cora H. Clarke.

The earlier name was preoccupied by D. galii H. Lw., to which this species is allied, though there is a marked difference in the ventral plate as illustrated by Rubsaamen. There are probably other differences.

Gall. This is an irregularly aborted, flower bud some 3 mm in diameter and containing pale yellowish larvae.

Female. Length 1.5 mm. Antennae extending to the fifth abdominal segment, sparsely haired, dark brown; 15 segments, the fifth with a length twice its diameter, tapering slightly apically, the terminal segment reduced, broadly oval. Palpi; the first segment irregular, the second subrectangular, with a length three times its diameter, the third a little longer and more slender, the fourth only one-quarter the length of the third. Mesonotum shining reddish brown, the submedian lines indistinct. Scutellum and postscutellum fuscous yellowish. Abdomen deep red, the basal segments and distal margins of terminal segments more or less fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Coxae and base of femora fuscous yellowish, the distal portion of femora, tibiae and tarsi a variable brown, the distal tarsal segments darker; claws strongly curved, the pulvilli longer than the claws. Ovipositor yellowish orange, as long as the abdomen, terminal lobes stout, with a length two and one-half times the diameter, broadly rounded.

Male. Length 1.5 mm. Antennae as long as the body, sparsely haired; 16 segments, the fifth with a stem one-quarter longer than the cylindric basal enlargement, which latter has a length twice its diameter; terminal segment reduced, narrowly oval. Palpi; first segment short, subquadrate, the second irregularly and narrowly ovate, the third one-half longer than the second, slender, the fourth one-half longer than the third, slender. Colorational, alar and pedal characters presumably the same as in the female. Genitalia; basal clasp segment short, stout; terminal clasp segment long, stout; dorsal plate deeply and broadly incised; the lobes broadly rounded, ventral plate long, broadly and roundly emarginate; harpes stout, irregular apically. Type Cecid. a1678k.

Dasyneura corticis Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:289.
1910 ———— Econ. Ent. Jour., 3:355.

This small midge was reared by Miss Cora H. Clarke May 21, 1909 from small willow twigs, Salix species, taken in the Arnold arboretum, Boston, Mass., May 15th. The twigs were infested with supposedly Rhabdophaga gnaphaloides galls and the appearance of this insect was accidental, since the midges emerged from apparently normal twigs, there being no external swelling or enlargement to indicate the presence of larvae underneath the bark.

Habitat. The larva of this species, as stated above, lives under the bark in small cavities but does not form an appreciable swelling.

Male. Length 2 mm. Antennae nearly as long as the body, sparsely haired, dark brown; presumably 16 segments, the fifth with a stem three-quarters the length of the cylindric basal enlargement, which latter has a length twice its diameter, the subbasal whorl sparse, the subapical whorl broad, thick; terminal segment wanting. Palpi; first segment short, subquadrate, the second one-half longer, stout, the third a little longer than the second, more slender, the fourth one-quarter longer than the third. Mesonotum dull black, the submedian lines sparsely haired. Scutellum fuscous yellowish, postscutellum a little darker. Abdomen a variable dull reddish orange; genitalia fuscous yellowish. Wings hyaline, costa pale straw, halteres pale orange, fuscous subapically. Legs a variable fuscous yellowish, the tarsi somewhat darker; claws rather long, slender, evenly curved, the pulvilli a little longer than the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment long, swollen basally; dorsal plate broad, divided; ventral plate long, broad, broadly and deeply emarginate. Harpes stout, irregularly chitinized apically.

Female. Length 1.75 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 15 segments, the fifth with a length two and one-half times its diameter, the subbasal whorl rather thick, subapical band broad, scattering; terminal segment greatly produced, with a length fully six times its diameter and evidently composed of two closely fused segments. Palpi; nearly as in the male. Mesonotum dull brown, the submedian lines sparsely haired. Scutellum fuscous reddish, postscutellum fuscous yellowish. Abdomen deep red. Ovipositor about one-third the length of the abdomen, yellowish, the terminal lobes slender, with a length four times their width, narrowly rounded. Type Cecid. a1966.

Dasyneura salicifolia Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 12
1908 ———— N. Y. State Mus. Bul. 124, p. 293, 348, 350

This dark brown species was reared in August 1907 from young, terminal, adherent, willow, Salix, leaves taken at Albany, N. Y. Apparently the same gall was collected by Miss Cora H. Clarke at Magnolia, Mass., June 11, 1909.

Gall. The affected leaves form a fusiform pod some 10 mm long, 2 mm in diameter (pl. 9, fig. 2) and contain several large, deep orange larvae. The apex may be more or less discolored.

Larva. Length 2.5 mm, deep orange.

Male. Length 1.5 mm. Antennae nearly as long as the body, thickly haired, fuscous yellowish, basally with silvery hairs ventrally; 16 segments, the fifth with a stem as long as the basal enlargement, which latter has a length about one-quarter greater than its diameter; terminal segment produced, with a length over twice its diameter and tapering from the basal third to an irregularly rounded apex. Palpi; the first segment short, stout, with a length about twice its diameter, slightly expanded distally, the second about as long, stouter, the third one-quarter longer than the second, more slender, the fourth one-half longer than the third; face with patches of short, silvery hairs. Mesonotum dark brown, the lateral and submedian lines distinct and rather thickly clothed with long, pale brown hairs. Abdomen dark brown dorsally, silvery laterally, pleurae with patches of silvery hairs interrupted beneath. Wings hyaline, costa dark brown. Halteres pale yellowish. Coxae pale yellowish with silvery hairs, femora pale silvery at base, fuscous apically; tibiae and tarsi darker; claws long, stout, strongly curved, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment stout at base; dorsal plate short, broad, divided; ventral plate short, stout, deeply and triangularly emarginate; harpes long, stout, tapering, irregularly tuberculate.

Female. Length 2 mm. Antennae extending to the second abdominal segment, sparsely haired, fuscous yellowish; 15 segments, the fifth subsessile, subcylindric, with a length one-half greater than its diameter; terminal segment produced, with a length fully three times its diameter, the distal portion tapering to an obtuse point. Palpi; the first segment stout, slightly expanded distally and with a length about twice its diameter, the second as long as the first, more slender, the third one-half longer than the second, more slender and the fourth a little longer and more slender than the third. Ovipositor nearly as long as the abdomen, the terminal lobes rather long, slender, narrowly rounded. Type Cecid. a1675.

Dasyneura gibsoni Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:479

Specimens of this midge were reared from flower heads of Canada thistle, C i r s i u m a r v e n s e, collected by Arthur Gibson in the vicinity of Ottawa, Canada, in August 1911. The larvae occur here and there among the florets and, according to Mr Gibson, are of material service in checking this weed. Specimens of the same species were received from Dr Fernandus Payne of Indiana University, Bloomington, Ind., accompanied by the statement that they are not only checking the thistle, but in some parts of the State appear to have almost completely destroyed the weed. Trypeta ruficauda Fabr. was also reared from the Canadian material.

Dasyneura fulva Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 349

This orange yellow female was taken on huckleberry at Nassau, N. Y., June 14, 1906.

Female. Length 1.35 mm. Antennae extending to the middle of the abdomen, dark brown, thickly haired; 15 segments, the fifth with a length two and one-half times its diameter; terminal segment produced and evidently composed of two closely fused. Palpi; first segment rather long, quadrate, the second roundly rectangular, the third one-half longer than the second, more slender, the fourth a little longer than the third, somewhat dilated. Mesonotum dark brown, the yellowish submedian lines sparsely haired. Scutellum dark reddish, postscutellum fuscous yellowish. Abdomen dull orange yellowish with indistinct fuscous markings on the basal and terminal segments. Wings hyaline, costa reddish brown. Halteres yellowish transparent. Legs a nearly uniform pale brown; claws strongly curved, the pulvilli nearly as long as the claws. Ovipositor as long as the body; terminal lobes slender, with a length three times the width, narrowly rounded. Type Cecid. 257.

Dasyneura ulmea Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 349

This dark brown species was reared May 7, 1886 from aborted elm buds evidently taken in the vicinity of Washington, D. C., presumably by Mr Pergande. Apparently the same gall was collected at Jamaica Plain, Mass., by J. G. Jack.

Gall. The deformity is simply a collection of aborted buds, one fly at least, issuing from a circular hole a little before the apex.

Female. Length 1.5 mm. Antennae extending to the fourth abdominal segment, rather thickly haired, light brown; 16 segments, the fifth with a length one-half greater than its diameter; terminal segment narrowly rounded, greatly produced and evidently composed of two or more closely fused segments. Palpi; first segment irregular, rather stout, the second a little longer, broader, the third one-half longer than the second, more slender, the fourth a little longer and more slender than the third. Mesonotum dark brown. Scutellum and postscutellum fuscous yellowish. Abdomen a variable dark brown, sparsely clothed with very fine, short hairs. Wings hyaline, costa light brown. Halteres yellowish transparent basally and apically, slightly fuscous subapically. Legs a variable yellowish brown, the tarsi slightly darker; claws strongly curved, unidentate, the pulvilli a little longer than the claws. Ovipositor probably as long as the abdomen; terminal lobes slender, with a length five times the width. Type Cecid. 880.

Dasyneura leguminicola Lintn.

Clover seed midge

1879 **Lintner, J. A.** Can. Ent., 11:44–45 (Cecidomyia trifolii); p. 121–24 (leguminicola proposed)
1879 ——— Amer. Nat., 13:190 (Cecidomyia trifolii)
1879 ——— Country Gentleman, 44:455, 631 (Cecidomyia)
1879 **Riley, C. V.** Com'r of Agric. Rep't, p. 250–52 (Cecidomyia)
1880 **Comstock, J. H.** Com'r of Agric. Rep't, p. 193–97 (Cecidomyia)
1880 **Lintner, J. A.** N. Y. State Agric. Soc., 39th Rep't, p. 37–41 (Cecidomyia)
1880 ——— Ent. Soc. Ont. Rep't 1879, p. 28–30 (Cecidomyia)
1880 **Riley, C. V. & Howard, L. O.** Insect Life, 1:142–43 (Cecidomyia)
1881 **Saunders, William.** Ent. Soc. Ont. 12th Rep't p. 38–43 (Cecidomyia)
1881 **Lintner, J. A.** N. Y. State Agric. Soc., 40th Rep't, p. 20–24 (Cecidomyia)
1882 **Saunders, William.** Ent. Soc. Ont. Rep't 1881, p. 38–43
1885 **Fletcher, Jas.** Dep't Agr. (Can.) Rep't Ent. Sep. p. 12–13
1889 **Forbes, S. A.** Nox. & Benef. Ins. Ill., 15th Rep't, p. 3 (Cecidomyia)
1889 **Lintner, J. A.** Ins. of N. Y., 5th Rep't, p. 262–63 (Cecidomyia)
1891 **Ormerod, E. A.** Ins. Life, 3:293–94 (Cecidomyia)
1891 ——— Injur. Ins. & Common Farm Pests, 14th Rep't, p. 23–27 (Cecidomyia)
1894 **Comstock, J. H.** Manual for the Study of Insects, p. 446
1894 **Davis, G. C.** Mich. Agr. Exp't Sta. Bul. 116, p. 52–56
1898 **Lintner, J. A.** Ins. of N. Y., 13th Rep't, p. 359 (Cecidomyia)
1899 **Hunter, W. D.** Neb. State Bd. Agr. Rep't, 1898, p. 247–49
1901 **Howard, L. O.** Insect Book, p. 115
1906 **Webster, F. M.** U. S. Dep't Agric., Bur. Ent. Cir. 69, p. 3–7
1907 **Bethune, C. J. S.** Ont. Agric. Col. 32d Rep't, p. 46
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 349, 350
1909 **Folsom, J. W.** Ill. Agr. Exp't Sta. Bul. 134, p. 118–25
1910 **Gibson, Arthur.** Canada, Central Expt. Farm Rep't, 1909. Separate, p. 52 (Cecidomyia)
1910 **Pettit, R. H.** Mich. Agr. Expt. Sta. Bul. 258, p. 49–50 (Cecidomyia)

This small midge is so abundant as to render it practically impossible to grow clover seed in western New York and also in other parts of the country, though there are no recent reports of its occurring in such numbers as were observed in earlier years. The species was first brought to notice when Doctor Lintner's attention was called to some minute maggotlike creatures in the heads of red clover. It caused serious injuries to clover in Tompkins, Seneca and other counties in western New York during 1878.

The damage was so extensive in some places that fields of clover, grown for seed, were found not worth cutting at that time. Prof. William H. Brewer of Yale College stated that his father, Henry Brewer of Enfield Center, Tompkins county, who was an enthusiastic grower of clover and clover seed, was familiar before 1848 with an insect which attacked clover and was presumably this species. Some idea of the abundance of the pest may be gained from the following. In 1888 Miss E. J. Phillips, writing to the Department of Agriculture at Washington, stated that her brother had cut enough clover in the morning to feed 12 cows at night, and allowed it to lie in the wagon all day and when he removed it therefrom at night the bottom of the wagon was literally pink with larvae. Doctor Lintner has placed on record an instance where the second crop of clover was cut and put on the scaffolding above the barn floor. Four or five days later large numbers of the larvae were observed upon the floor beneath, giving it an appearance of having been sprinkled with red sand. Mr C. W. Stewart of Newark, N. Y., communicating with this office in 1897, stated that the crop of clover seed on 25 acres was completely ruined by this insect. Doctor Fletcher has recorded serious injury in Ontario and Professor Davis in Michigan.

Distribution. This species is known to occur generally in New York State. It has been recorded from Ohio, Michigan, Illinois, the District of Columbia, Virginia, Ontario, Canada, and is probably widely distributed over the eastern half of this country at least. Miss Ormerod has also recorded the species from England.

Name and identity. This species was first described by Doctor Lintner in February 1879 as Cecidomyia trifolii, the present name of leguminicola being proposed later, because trifolii was preoccupied by an European species. More recently this insect has been removed from the genus Cecidomyia and is now known as Dasyneura leguminicola Lintn.

This small, fragile, dark brown and reddish midge can not be readily separated from the European clover leaf midge, Dasyneura trifolii Loew, which has become well established in this country. Dasyneura leguminicola may be most easily distinguished by the relatively large wings and the straight third vein in connection with the very long, slender ovipositor, this organ being distinctly longer than the body, while the lobes are relatively short and stout and have a length only about three and one-half times their breadth. The venter of the abdominal segments is ornamented apically with a rather thin, irregular row of setae. The female normally has 16 subsessile antennal segments, the fifth with a length about two and one-half times its diameter, while the sixteenth is never reduced, and in some cases at least, is evidently composed of two closely fused segments. The male has 16 or 17 antennal segments, the fifth with a stem as long as the basal enlargement, which latter has a length one-half greater than its diameter.

Life history. There appear to be two and possibly three generations annually, since Doctor Lintner states that the flies begin to make their appearance the latter part of May, and larvae and adults have been observed at various times during July, August and often in September. It is probable that this species will breed at any time when clover heads afford favorable conditions, namely, from early summer until late in the fall. Professor Davis calls attention to the fact that the appearance of the midges is controlled to a considerable extent by weather conditions, they refusing to emerge when there was a dearth of moisture. This is to be expected and agrees with the behavior of the Hessian fly, Phytophaga destructor Say, under similar conditions.

The life history of this species has been worked out in Illinois in some detail by Dr J. W. Folsom, an abstract of his observations being given below. The insect winters as a full-grown larva or pupa in the soil of clover fields or in dead clover heads. A few warm days and a little rain suffice to bring the larvae to the surface of the ground a few days after red clover has started its second year's growth. This latter occurred at Urbana, in 1907, March 19th and the orange colored larvae were found March 25th to April 4th inclusive, being most numerous on March 30th and April 2d. Some of these larvae make a cocoon while others do not. All contract in length, the integument hardens, becomes duller in color, forming a puparium within which the insect develops. Midges were taken outdoors May 15th but were not common till May 23d (oviposition then being in progress) and attained their maximum numbers May 30th. The larvae work in the heads during June and the first week in July, leaving them when full grown and entering the ground to pupate. Most of the larvae desert the heads about June 30th, though not a few may be found as late as July 8th. Three weeks or more are required for the transformation from the larva to the adult, the second generation being most abundant the last week of July and the first two weeks of August, though scattering individuals may emerge at almost any time between the middle of July and the first of September. The egg period in early July is three days. Most of the injury to the seed crop is inflicted during the last two weeks of August and the first two weeks of September, at a time when the larvae are most numerous in the clover heads. Most of the insects winter as larvae and emerge as flies the following May. A few, however, transform and produce flies in early September or even later. Midges were obtained in the insectary without artificial heat as late as October 10th and in a warm room they were reared throughout the winter. These late appearing flies are unable to propagate their kind, owing to the frost killing the flies, and especially to the green clover heads dying before the larvae of the third generation can complete their growth. There is a possibility that larvae from flies appearing in early September may be wintered in safety. Doctor Folsom concludes that in central Illinois there are two full broods and a partial third generation.

Habits. The eggs are always laid in green flower heads and chiefly during the warmer part of the day, the female being frequently so busy as to pay no attention to slight interruptions. Standing on the outside of a green clover head the female inserts her long, slender ovipositor among the florets and works it deeper and deeper until it can go no further. The female then becomes quiet until an egg is laid, the entire process usually requiring 5 minutes and often 10 to 15 minutes. One female may lay several eggs in a clover head though she appears to make it a rule to distribute her eggs among a number of plants. Many females may oviposit in the same head and, as a result, more larvae hatch than can possibly find food. Thus, in one head of 80 florets Doctor Folsom found 106 eggs. Once in a while an egg is laid on a petal or on the calyx itself but almost always it is glued to one of the hairs of the immature calyx, the glue often forming quite a perceptible mass. The abundance of the larvae in a head is confirmed by the following observation from Professor Comstock: "A head, which one moment is motionless and at a glance seems to have no animal life about it, becomes the next fairly swarming with these maggots. From nearly every closed floret one emerges and wriggles violently until it works itself away so far that it falls to the ground. A batch of clover which was observed by Doctor Howard on the morning of May 23d last seemed entirely alive with the issuing maggots and their accompanying parasitic foes."

The newly hatched larva has but one way of entering the ovary of a flower, namely, by squeezing in between the unopened petals. Once inside the flower bud the maggot sucks or absorbs the fluid contents of the ovary, destroying the ovule or ovules. An affected floret presents externally a healthy appearance though the petals rarely expand. They remain fresh and pink until the maggot leaves the bud and eventually fade and wither without opening. The larvae when full grown may simply drop from the head or, when moisture is abundant, may wriggle their way down the stem of the plant. The larvae, although full grown, may not emerge if the air is too dry. Dryness causes them, even when on the ground, to squeeze themselves into crevices in the soil and to contract the body and become motionless as if for pupation; even then moisture will repeatedly revive them to a condition of wriggling activity. The duration of the pupa stage is prolonged by dryness and shortened by moisture. An extended dry spell kills both larvae and pupae. Continued dry weather may delay the appearance of flies as much as two weeks though they may be expected to emerge after a timely rain.

Natural enemies. Two undetermined Chalcids belonging to the genus Tetrastichus were reared by Doctor Folsom from this insect. They are possibly the same as those mentioned by Webster as having been reared from both larvae and pupae obtained about Lincoln, Neb. Sanderson reared in Delaware, from the larvae of the seed midge, in October 1899 and June 1900, parasites determined by Ashmead as Tetrastichus carinatus Forbes and a Torymus. Another parasite is Anopedias error Fitch, family Platygasteridae, a minute, black species which has received little mention since Comstock reported upon it in 1880. The common flower bug, Triphleps insidiosus Say, is, according to Doctor Folsom, an efficient enemy of this insect. He repeatedly found a nymph or an adult of this bug with its beak thrust into a larva or fly of this pest.

Several parasites were reared by us from the various collections of clover heads infested by this midge, namely, Telenomus podisi Ashm., Polynema striaticornis Girault, Decatoma sp. and Polygnotus sp.

Control. This species can be best controlled by cutting the first crop of clover as early as possible in order to secure a good seed crop at the expense of a slight reduction in the hay crop. This early cutting results in drying up the food plant and the undeveloped larvae, and hastens the development of a second lot of clover heads so that the midges of the second generation find but few green heads in which to lay their eggs. The proper date for early cutting depends on latitude, weather and other conditions. This, in central Illinois, according to Doctor Folsom, should not be later than June 17th and need not be earlier than June 7th. A clover head half red and half green means that the seed midge is present (or else the seed caterpillar, Enarmonia interstinctana Clem.,) and the grower who will take the trouble to study the habits of the midge will be able to cut his clover at just the right time to get rid of the midge without losing much of his hay crop. Similar results may be obtained by mowing back the clover as early as the middle of May in Illinois and Ohio, since this delays heading enough to escape the second brood of flies. Pasturing in spring and early summer exterminates the midge and yet insures a good crop of seed so far as this insect is concerned.

Doctor Folsom's observations show that the seed midge neither flies far nor is it carried any great distance in large numbers by the wind. Most of the midges remain and deposit eggs in the field where they develop. During windy spells they cling to the herbage or to the ground and take but short and occasional flights. This habit, in Doctor Folsom's opinion, justifies preventing the sporadic heading of first year clover by mowing it back a few weeks after oats (or other small grains) have been harvested, at a time when the growth is vigorous but yet sufficiently early to permit considerable further growth before frost sets in. Where clover and timothy are sowed together the field may be pastured lightly or clipped back in May, since this brings both the first and second blooming of the clover too late for the destructive work by the midge, and the hay crop as a whole is uninjured.

Dasyneura gemmae Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:288

This species was reared in late March and early April 1909 from small, conic, apical bud galls on willow, Salix and received from Mr C. P. Smith of Logan, Utah. The galls are diminutives of the familiar deformities produced by Rhabdophaga strobiloides Walsh.

Male. Length 2 mm. Antennae as long as the body, sparsely haired, light brown; 18 segments, the fifth with a stem one-quarter longer than the cylindric basal enlargement, which latter has a length one-half greater than its diameter; subbasal whorl rather thick, subapical band very thick and long; terminal segment slightly produced, narrowly oval. Palpi; first segment subquadrate, the second narrowly oval, with a length three times its diameter, the third and fourth subequal, each one-half longer than the second. Mesonotum dull black, the submedian lines sparsely haired. Scutellum dull orange, postscutellum fuscous. Abdomen sparsely haired, the dorsal sclerites dark brown, the pleurae and venter fuscous yellowish. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Coxae and femora basally fuscous yellowish, the remainder of the legs mostly dark brown; tarsi nearly black; claws slender, strongly curved, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment stout, subtruncate; terminal clasp segment swollen basally; dorsal plate very short, broad, broadly and triangularly emarginate; ventral plate long, deeply and roundly emarginate; harpes stout.

Female. Length 2.5 mm. Antennae extending to the second abdominal segment, sparsely haired, light brown; 16 segments, the fifth with a length two and one-half times its diameter; subbasal whorl sparse, the subapical band rather sparse; terminal segment somewhat produced, tapering distally. Ovipositor as long as the body, the terminal lobes very long, slender, with a length about six times the width. Other characters nearly as in the male. Type Cecid. a1937a.

Dasyneura radifolii Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:289

This species was reared April 16 to 20, 1909 in some numbers from irregular, oval galls formed of root leaves on Solidago puberula or S. juncea taken by Miss Cora H. Clarke at Magnolia, Mass.

Gall. Greenish, irregular, oval, about 1 cm long, composed of clusters of root leaves and inhabited by several larvae.

Larva. Length 3mm, pale orange. Head small; antennae relatively long, slender; breastbone rather conspicuous, bidentate, becoming obsolete posteriorly. Skin coarsely shagreened. Posterior extremity broadly rounded, slightly bilobed and with inconspicuous sublateral tubercles.

Male. Length 1.5 mm. Antennae one-half longer than the body, sparsely haired, dark brown; 17 segments, the fifth with a stem one-quarter longer than the cylindric basal enlargement, which latter has a length two and one-half times its diameter; subbasal whorl thick, subapical band thick, long; terminal segment reduced, narrowly oval. Palpi; first segment short, irregular, second narrowly oval, with a length three times its diameter, the third one-half longer, slender, the fourth one-quarter longer than the third, slender. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum reddish brown, postscutellum orange brown. Abdomen dark reddish brown, the distal segments dark orange; genitalia fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Coxae dark brown; femora basally yellowish, the distal portion of femora, tibiae and tarsi mostly dark brown; claws slender, strongly curved, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment rather stout, slightly swollen near the middle; dorsal plate broad deeply and triangularly incised; ventral plate broad, deeply and roundly emarginate; harpes rather long, slender.

Female. Length 2 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown, yellowish basally; 16 cylindric segments, the fifth with a length two and one-half times its diameter; terminal segment produced, with a length four times its diameter. Mesonotum dull black. Scutellum fuscous yellowish, postscutellum pale orange. Abdomen dark brown, the incisures and pleurae mostly deep reddish orange. Halteres yellowish basally, fuscous apically; coxae and femora basally fuscous yellowish. Ovipositor pale yellowish, as long as the body, the terminal lobes broad, with a length only three times the width. Other characters as in the male. Type **Cecid. a1911.**

Dasyneura albovittata Walsh

1864 **Walsh, B. D.** Ent. Soc. Phila. Proc., 3:620–23 (Cecidomyia)

1895 **Comstock, J. H.** Manual for the Study of Insects, p. 446 (Cecidomyia)

1906 **Felt, E. P.** N. Y. State Mus. Mem. 8, 2:746 (Cecidomyia)

1908 ———— N. Y. State Mus. Bul. 124, p. 352, 354

This small inquiline is very common in the familiar terminal pine cone galls of Rhabdophaga strobiloides Walsh. The pale yellowish larvae occur between the bracts of the gall and do not interfere in any way with the development of the species primarily responsible for the gall, though they are usually much more abundant than the larger form. This species was bred very commonly during April from pine cone galls on Salix taken at West Nyack. Walsh states that adults appear from the 10th of April to the Middle of May, a second brood emerging the latter part of July to September 11th. This species normally has 16 segments in both sexes, though occasionally specimens of the male may have 15 or 17 segments. The species described below is tentatively identified with the one reared by Walsh.

Description. The slightly mottled, orange colored larva of this species has a bidentate breastbone and is only about .75 mm in length.

Male. Length 1.25 mm. Antennae a little longer than the body, rather thickly haired, dark brown, usually 16, occasionally 15 or 17 segments, the fifth with a stem as long as the cylindric basal enlargement, which latter has a length three-quarters greater than its diameter; terminal segment narrowly oval, subacute. Palpi; the first segment irregular, the second subrectangular, with a length nearly three times its diameter, the third one-half longer, more slender, the fourth longer than the third, more slender. Mesonotum shining reddish brown, the submedian lines sparsely haired. Scutellum fuscous yellowish, postscutellum darker. Abdomen sparsely haired, dark brown; genitalia fuscous yellowish. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Coxae light brown; femora and tibiae mostly dark brown, the tarsi nearly black; claws slender, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate long, broad, broadly and triangularly incised, the divergent lobes narrowly rounded apically: ventral plate long, broad, deeply and broadly emarginate, the lobes long, tapering, irregularly. Harpes short, stout.

Fig. 20 Galls of Dasyneura communis (natural size, original)

Female. Length 1.5 mm. Antennae extending to the third abdominal segment, sparsely haired, light brown, yellowish basally; 15–16 subcylindric, sessile segments, the fifth with a length two and one-half times its diameter, terminal segment reduced, sometimes slightly fused with the preceding. Mesonotum dark brown, the submedian lines thickly clothed with yellowish hairs, the anterior lateral angles and base of the wings yellow haired. Scutellum fuscous yellowish, with a few coarse setae apically, postscutellum yellowish. Abdomen deep red, the dorsal sclerites sparsely clothed with dark brown scales, the latter thicker on the posterior margin. Ovipositor slightly fuscous basally, yellowish apically. Halteres pale yellowish orange, somewhat fuscous subapically. Coxae apically and femora basally yellowish or whitish yellow, the distal portion of femora, tibiae and tarsi dark brown or nearly black. Ovipositor as long as the body, the terminal lobes with a length about four times the width, narrowly rounded apically. Other characters as in the male. Cecid. a1442a.

Dasyneura communis Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:478-79

This species was reared in early spring of 1909 from jars containing soft maple, Acer rubrum, leaves bearing thickened pouch galls along the veins. The galls are often reddish (pl. 2, fig. 6) on the upper side and have a length of one-fourth inch or more. It was also obtained from a number of jars containing various galls and debris. There is grave doubt as to this species causing the gall mentioned above. A species of Polygnotus was reared from this gall.

Dasyneura rufipedalis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 349

This dark brown species was taken on red clover at Karner, N. Y., June 4, 1906.

Female. Length 1 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 16 segments, the fifth slightly oval, with a length three-quarters greater than its diameter; terminal segment reduced, narrowly oval. Palpi; first segment short, subquadrate, the second swollen, roundly rectangular, the third one-half longer, slender, the fourth one-half longer than the third. Mesonotum dark brown, the distinct submedian lines yellow haired. Scutellum yellowish brown, postscutellum reddish brown. Abdomen dark brown, sparsely clothed with fine hairs. Wings hyaline, costa dark brown. Halteres yellowish transparent. Femora mostly pale straw, brownish apically; tibiae and tarsi reddish brown; distal tarsal segments slightly darker; claws slender, strongly curved, the pulvilli about as long as the claws. Ovipositor longer than the body, the terminal lobes slender, with a length more than four times the width, narrowly rounded. Type Cecid. 127.

Dasyneura purpurea Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 349

This dark brown species was reared September 27, 1907 from enlarged florets of the Joe-Pye weed, Eupatorium purpureum, taken both on Staten Island and at Karner, N. Y.

Gall. Length 1 cm, diameter .4 cm. An oval or fusiform, budlike, purplish enlargement (pl. 4, fig. 15) inhabited by yellowish larvae.

Female. Length 2 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 16 segments, the fifth with a length twice its diameter, the terminal segment slightly reduced, narrowly oval. Palpi; first segment short, stout, irregularly subquadrate, the second roundly rectangular, the third one-half longer, rather stout, the fourth longer than the third, somewhat dilated. Mesonotum shining dark brown, the submedian lines thickly haired. Scutellum and postscutellum pale or fuscous orange. Abdomen dark brown, the incisures deep orange. Wings hyaline, costa dark brown. Halteres pale orange. Coxae and base of femora yellowish straw, the distal portion of femora and tibiae fuscous yellowish, the tarsi dark brown; claws rather slender, strongly curved, the pulvilli as long as the claws. Ovipositor one-half longer than the body; terminal lobe slender, with a length three times its width, narrowly rounded. Type Cecid. a 1693a.

Dasyneura lysimachiae Beutm.

1907 **Beutenmueller, William.** Can. Ent., 39:305–6 (Cecidomyia)
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 349, 350

This species was reared in August 1906 from a terminal conic leaf gall on the whorled loosestrife, Lysimachia quadrifolia, taken at Albany, N. Y. A similar gall, possibly that of this species, was found on L. terrestris August 9, 1912, at Elm Lake in the Adirondacks. Eupelmus dryorhizoxeni Ashm. was reared from an axillary bud gall possibly produced by the same midge.

Gall. This is a conical enlargement of the terminal bud (pl. 9, fig. 2) and contains a number of yellowish larvae.

Male. Length 2.5 mm. Antennae one-quarter longer than the body, thickly clothed with long hairs, brown; 16 segments, the fifth with a stem one-quarter longer than the basal enlargement; terminal segment slightly produced, narrowly oval. Palpi; the first segment long, subtriangular, swollen distally, the second as long as the first, narrowly oval, the third one-half longer than the second, mor slender, the fourth about as long as the third. Genitalia; basal clasp segment long, stout; terminal clasp segment short, stout greatly swollen near the middle; dorsal plate long, broad, deeply and triangularly incised; ventral plate long, broad, broadly and roundly emarginate. Harpes short, stout, tapering to a heavy, chitinous spur about one-quarter the length of the organ. Other characters nearly as in the female.

Female. Length 1 mm. Antennae extending to the third abdominal segment, sparsely haired, brown; 17 segments, the fifth subsessile, cylindric, with a length nearly thrice its diameter; terminal segment produced, tapering, narrowly rounded apically. Palpi; the first segment stout, expanded distally, the second narrowly oval, as long as the first, the third more slender, twice the length of the second, the fourth a little longer than the third, slightly more dilated. Face fuscous yellowish. Mesonotum dark brown, the submedian lines thickly yellow haired. Scutellum pale yellowish, postscutellum fuscous yellowish. Abdomen blood-red, the segments margined posteriorly with yellow hairs. Wings hyaline, costa dark brown. Halteres yellowish basally, reddish apically. Coxae and basal portion of femora a variable yellowish, the femora apically, and tibiae a variable brown, tarsi a nearly uniform dark brown; claws long, slender, the pulvilli as long as the claws. Ovipositor nearly as long as the body, the terminal lobes very long, slender, narrowly rounded.

Described from a type kindly donated for study by Prof. William Beutenmueller. Cecid. 1240.

Dasyneura flavoabdominalis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 350

This yellowish species was taken on solidago at Albany, N. Y., August 6, 1906.

Female. Length 2.5 mm. Antennae two-thirds the length of the body, sparsely haired, dark brown, fuscous yellowish basally; 16 segments, the fifth subcylindric, with a length twice its diameter. Palpi; the first segment subquadrate, second a little longer, suborbicular, the third twice the length of the second, more slender, the fourth one-half longer than the third, more slender, slightly enlarged distally. Mesonotum brownish black, submedian lines with sparse, yellowish hairs. Scutellum and postscutellum yellowish white. Abdomen yellowish orange, membrane and pleurae lighter, dorsally sparsely clothed with fuscous scales, ovipositor fuscous yellowish. Wings hyaline, costa dark brown, halteres pale yellowish. Coxae fuscous orange, femora and tibiae fuscous yellowish, tarsi light brown; claws rather slender, strongly curved. Ovipositor longer than the insect, terminal lobe slender, broadly rounded. Type Cecid. 738.

Dasyneura cercocarpi Felt

1913 **Felt, E. P.** N. Y. Ent. Soc. Jour., 21:215–16

The midges described elsewhere were reared in April from an imbricated bud gall on Cercocarpus parvifolius collected by Prof. E. Bethel at Golden, Col.

Dasyneura aromaticae Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:289

This species was reared August 23, 1908 from sprigs of mint taken at Barre, Mass., by Miss Cora H. Clarke.

Gall. An ovoid, hairy, green, axillary or terminal gall about 4 mm in length. The adults undergo their final transformations in whitish, oval cocoons about 3 mm long, irregularly placed among the distorted leaflets.

Male. Length 1.25 mm. Antennae as long as the body, rather thickly haired, dark brown; 14 segments, the fifth with a stem as long as the basal enlargement, which latter has a length one-half greater than its diameter, terminal segment slightly reduced, broadly oval. Palpi; the first segment irregularly subquadrate, the second broadly oval, with a length three times its diameter, the third more slender, the fourth only slightly longer than the third. Scutellum fuscous yellowish, postscutellum dark brown. Abdomen yellowish brown, the basal segments and genitalia fuscous. Wings hyaline, costa dark brown. Halteres yellowish, fuscous apically. Coxae and base of femora yellowish, the distal part of femora, tibiae and tarsi dark brown; claws slender, curved, the pulvilli as long as the claws. Genitalia; basal clasp segment stout, terminal clasp segment long, slightly swollen basally; dorsal plate broad, deeply and roundly emarginate, ventral plate short, broadly and roundly emarginate. Harpes stout, roundly truncate. Type Cecid. a1875.

Dasyneura attenuata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 350

The male was taken at Albany, N. Y., June 9, 1907 in a sweep capturing D. g r a m i n i s. It was at first presumed to belong to that species.

Male. Length .75 mm. Antennae longer than the body, sparsely haired, dark brown; 16 segments, the fifth with a stem one-quarter longer than the basal enlargement; terminal segment reduced, narrowly oval, subacute distally. Palpi; the first segment short, stout, subquadrate, the second a little longer, narrowly oval, the third one-half longer than the second, more slender, the fourth a little longer than the third. Face fuscous. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum brown, postscutellum a little darker. Abdomen dark reddish orange. Wings hyaline, costa light brown. Genitalia; basal clasp segment short, stout; terminal clasp segment stout, swollen basally; dorsal and ventral plates short, broadly and triangularly incised. Harpes short, stout, tapering, obtuse, with an irregular, subquadrate tooth.

Described from a dried specimen. Type Cecid. 1209b.

Dasyneura flavoscuta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 350

This reddish brown species was taken on solidago at Albany, N. Y., July 16, 1906.

Female. Length 2mm. Antennae extending to the fourth abdominal segment, rather thickly clothed with long hairs, dark brown, fuscous basally; 17 segments, the fifth subsessile, subcylindric, with a length two and one-half times its diameter; terminal segment rather reduced, obovoid. Palpi; the first segment short, subquadrate, slightly swollen distally, the second narrowly oval, the third a little longer and more slender than the second, the fourth longer than the third; face fuscous, eyes large, black. Mesonotum dark brown with narrow, yellowish submedian lines. Scutellum light fuscous yellow. Abdomen reddish brown, incisures and pleurae deep carmine, dorsal sclerites sparsely clothed with pale brown setae. Ovipositor pale yellowish, terminal segments irregularly ornamented with long, black hairs. Wings subhyaline, costa dark brown; halteres pale yellowish basally, semitransparent apically. Legs nearly uniform fuscous; claws stout, uniformly curved. Ovipositor as long as the body; the terminal lobes long, slender, broadly rounded. Type Cecid. 553.

Dasyneura consobrina Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 118. Separate, p. 21–22
1908 ———— N. Y. State Mus. Bul. 124, p. 350

This fuscous orange species was taken on white pine, Pinus strobus, at Albany, N. Y., June 11, 1906.

Female. Length 1.5 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 17 segments, fifth subsessile, subcylindric, with a length twice its diameter; terminal segment suboval. Palpi; the first segment subrectangular, slightly swollen at the distal fourth, the second a little longer, stouter, the third one-half longer, more slender and the fourth one-half longer than the third; face dark brown. Mesonotum dark brown, submedian lines pale, sparsely ornamented with fine setae. Scutellum bright orange with sparse apical setae, postscutellum bright orange. Abdomen slightly fuscous orange, the incisures and pleurae bright orange, terminal segments yellowish, sparsely ornamented with fine, pale yellowish setae. Wings hyaline, costa pale reddish; halteres yellowish transparent basally, whitish transparent apically. Coxae and femora pale straw, tibiae and tarsi rather dark brown, the former lighter ventrally; claws long, slender, uniformly curved. Ovipositor three-quarters the length of the body, the terminal lobes long, tapering, narrowly rounded. Type Cecid. 215.

Dasyneura meliloti Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 116. Separate, p. 20
1908 ———— N. Y. State Mus. Bul. 124, p. 350

This dark brown species was taken on sweet clover, Melilotus alba, at Albany, N. Y., August 6, 1906.

Male. Length 1 mm. Antennae a little longer than the body, sparsely haired, dark brown; 17 segments, the fifth with a stem three-quarters the length of the basal enlargement, which latter has a length three-quarters greater than its diameter; terminal segment short, subcylindric, tapering, broadly rounded. Palpi; first segment subquadrate, the second nearly twice as long as the preceding, the third one-half longer than the second, and the fourth a little longer than the third. Face fuscous. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum reddish brown, postscutellum slaty brown. Abdomen dark brown, membrane and pleurae yellowish; genitalia dark brown. Wings hyaline, costa dark brown. Halteres pale yellowish. Coxae fuscous yellowish. Legs mostly dark brown; claws slender, strongly curved. Genitalia; basal and terminal clasp segments stout; dorsal plate broad; ventral plate narrow; both deeply incised. Harpes stout, convolute, the edges irregularly serrate. Type Cecid. 744.

Dasyneura pedalis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 350

This dark brown form was taken in a trap lantern at Newport, N. Y., June 27, 1906.

Male. Length 1 mm. Antennae longer than the body, sparsely haired, dark brown, yellowish basally; 17 segments, the fifth with a stem one-quarter longer than the basal enlargement, which latter has a length two and one-half times its diameter; terminal segment short, suboval. Palpi; the first segment short, stout, the second one-half longer, stout, the third one-half longer than the second, more slender, the fourth a little longer and more slender than the third. Face yellowish. Mesonotum dark brown, the submedian lines obscurely yellowish. Scutellum deep reddish brown, with sparse apical setae, postscutellum reddish yellow. Abdomen a nearly uniform dark brown, the basal segments somewhat darker, sparsely clothed with fine setae. Wings hyaline, costa light brown. Halteres pale yellowish basally, slightly fuscous apically. Legs nearly uniform dark brown with a fuscous tinge at the articulations; claws long, stout. Genitalia; basal clasp segment stout; terminal clasp segment short, stout; dorsal plate broad, deeply and triangularly incised; ventral plate long, narrow, deeply and roundly incised. Harpes subtriangular, irregularly truncate. Type Cecid. 410.

Dasyneura serrulatae O. S.

1862 **Osten Sacken, C. R.** Monogr. Dipt. N. Am., 1:198 (Cecidomyia)
1891 **Riley, C. V. & Howard, L. O.** Insect Life, 4:125
1893 **Townsend, C. H. T.** Ent. Soc. Wash. Proc., 2:388–89 (Cecidomyia)
1900 **Smith, J. B.** List of Insects N. J., p. 621 (Cecidomyia)
1906 **Felt, E. P.** Insects Affect. Prk. & Wdld. Trees, 2:750
1907 **Jarvis, T. D.** Ent. Soc. Ont. 37th Rep't, p. 68
1908 **Felt, E P.** N. Y. State Mus. Bul. 124, p. 351
1909 **Jarvis, T. D.** Ent. Soc. Ont. 39th Rep't, p. 76
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 16.

The writer has found the gall of this species rather common on alders, Alnus crispa, in the vicinity of Albany, N. Y., and also at Davidson's River, N. C. It has been recorded by Dr J. B. Smith as common in New Jersey and is evidently abundant in and about Washington, D. C. The larvae enter the ground in late fall, the flies appearing the following April. Several parasites have been reared from galls of this midge, namely Polymecus alnicola Ashm., MS, Polygnotus alnicola Ashm., MS, Anagrus spiritus Gir. and Torymus ostensackenii D. T.

Gall. The gall is a subconic, deformed bud 6 to 12 mm in diameter. It is a variable greenish or pinkish and frequently with a distinct whitish bloom. The hollow interior contains several larvae, in some instances two types; a small, possibly young, whitish larva and a pale green or reddish larva with a distinct breastbone.

Male. Length 3.5 mm. Antennae shorter than the body, thickly haired, light brown; 18 segments, the fifth with a stem three-quarters the length of the cylindric basal enlargement, which latter has a length twice its diameter. Palpi; the first segment irregular, incrassate, the second with a length three times its diameter, the third a little longer, more slender, the fourth nearly twice the length of the third. Mesonotum dark brown, the submedian lines thickly haired. Scutellum reddish brown, postscutellum darker. Abdomen reddish brown, rather thickly clothed with fine hairs; genitalia dark brown. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs a nearly uniform light brown; claws long, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment stout, truncate; terminal clasp segment long, nearly straight, slender; dorsal plate long, broad, deeply and triangularly emarginate; ventral plate long, deeply and triangularly emarginate. Harpes long, slender, irregularly truncate.

Female. Length 4 mm. Antennae extending to the fourth abdominal segment, rather thickly haired, light brown; 18 segments, the fifth cylindric, with a length twice its diameter; terminal segment reduced, narrowly oval. Ovipositor when extended nearly as long as the abdomen; terminal lobes narrowly oval, with a length nearly four times the width, sparsely setose. Other characters practically as in the opposite sex.

The megascopic characters were drafted from type specimens in the Museum of Comparative Zoology, the microscopic characters from specimens reared by Mr Pergande, April 30, 1884.

Dasyneura toweri Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:289

This species was reared September 16 and October 20, 1908 from enlarged flower buds of Hypericum mutilum taken by

Miss Cora H. Clarke at Magnolia, Mass. Galls from which midges had issued were also observed by her July 13, 1909.

Gall. The axillary flower buds of Hypericum mutilum are swollen, ovate, 5 mm long, 3 mm in diameter and greenish or reddish.

Egg. Length .15 mm, narrowly elliptical, probably reddish orange in color.

Larva. Length 2 mm, yellowish, moderately stout, the head broadly triangular. Antennae short, stout, acute. Breastbone wanting, segmentation distinct. Skin smooth, posterior extremity roundly truncate, the lateral angles with irregular groups of three or more rather stout, semitransparent processes; anus ovate.

Pupa. Length 2 mm. Mesonotum reddish brown. Scutellum and postscutellum fuscous yellowish. Abdomen mostly dull gray, the dorsal sclerites a variable fuscous anteriorly, with stout, closely set spines. Thoracic horns long, slender, acute. Antennal and leg cases yellowish gray, the latter extending to the acute tip of the abdomen. Wing cases dark gray.

Male. Length 2.5 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 19 segments, the fifth with a stem one-quarter longer than the cylindric basal enlargement, which latter has a length twice its diameter; terminal segment reduced, narrowly oval. Palpi; first segment obconic, the second stout, suboval, the third a little longer, slender, the fourth one-half longer than the third, more slender. Genitalia; basal clasp segment long, slender; terminal clasp segment long, swollen near the middle; dorsal plate broad, deeply and triangularly emarginate, ventral plate broad, deeply and roundly emarginate. Harpes stout, truncate and irregularly tuberculate, broadly rounded. Other characters presumably as in the female.

Female. Length 2 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 19 cylindric sessile segments, the fifth with a length three times its diameter; terminal segment reduced, narrowly oval. Palpi; first segment short, stout, the second broadly oval, the third longer, more slender, the fourth twice the length of the third. Mesonotum shining dark brown. Scutellum dark reddish brown, postscutellum fuscous yellowish. Abdomen a variable reddish, the dorsal sclerites, especially basally, fuscous; terminal segment and ovipositor fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs a variable fuscous yellowish, the distal third of femora and the basal half of tibiae mostly fuscous; claws slender, strongly curved, the pulvilli as long as the claws. Ovipositor about one-third the length of the abdomen, the terminal lobe stout, with a length about four times its diameter, narrowly rounded. Type Cecid. a1883.

Lasiopteryx Westw.

Lepidomyia Kieff.

Ledomyia Kieff.

1840 **Westwood, J. O.** Introd. & Classif. of Ins., v. 2, suppl., p. 126
1864 **Shiner, J. R.** Fauna Austriaca Dipt., 2:410 (Diomyza Shin.)
1876 **Bergenstamm, J. E. & Low, Paul.** Syn. Cecidomyidarum, p. 24
1877 **Karsch, F. A. F.** Revis. der Gallmücken, p. 14
1894 **Kieffer, J. J.** Wien. Ent. Zeit., 13:201 (Lepidomyia)
1895 ——— Soc. Ent. Fr. Bul. 64, p. 320 (Ledomyia)
1897 ——— Syn. Cecid. Eur. & Alg., p. 55 (also Ledomyia)
1900 ——— Soc. Ent. Fr. Ann., 69:443
1901 ——— Soc. Hist. Nat. Metz. Bul., p. 17
1904 ——— Soc. Sci. Brux. Ann. 28, pt 2. Sep., p. 2–7 (Ledomyia)
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:44

This genus is easily recognized by the fuscous or subhyaline wings, the membrane being more or less thickly scaled; the third vein well separated from the anterior margin and uniting with the thickly scaled costa near the distal fourth. Tarsi quinquearticulate, the first or metatarsus short; claws unidentate. Antennal segments cylindric, sessile in the female, those of the male with a distinct stem; circumfili present. Palpi quadriarticulate. Type L. obfuscata Meigen. Represented by five specimens in the British Museum, one of which was placed in a balsam mount by the writer.

A study of Westwood's type in the British Museum shows this to be a valid genus though hardly referable to the Heteropezinae on account of circumfili being present. Kieffer's Ledomyia, erected with L. lugens as the type, is in all probability a synonym of this genus, though on examination of the antennae in water under a cover glass, we were unable to detect circumfili. These latter are easily demonstrated in other species which Kieffer has referred to this genus.

One American species referred to Lasiopteryx differs from European forms studied, in the unusually stout and greatly developed circumfili. These organs in the male are irregular and the longer loops extend to the tip of stems as long as the basal enlargement of the antennal segment. Likewise, in the female the circumfili extend to the tip of the shorter stem. This group exhibits a relationship with the Lasiopterariae on account of the heavily scaled costa, while the well separated third vein and the stemmed antennae of the male indicate a close connection with the Dasyneurariae. Our best known form, L. coryli Felt, was reared from leaf folds of hazel, Corylus americana. It is interesting to note that its ally, L. carpini Felt, was taken on ironwood, Carpinus americana, and may possibily be identical with Cecidomyia pudibunda O. S., the larvae of which live in the folds of beech leaves.

LASIOPTERYX

Key to species

a Antennae with 10 to 12 segments, the fifth of the male with a stem three-quarters the length of the basal enlargement, the ovipositor long

b Abdomen yellowish red; female antennae with 10, male antennae with 11 segments, the ovipositor one-third the length of the abdomen flavotibialis Felt, C. a1454

bb Abdomen reddish brown; antennal segments 12, the ovipositor as long or longer than the abdomen......schwarzi Felt, C. a2177

aa Antennae with 13 or 14 segments, the ovipositor short

b Fifth antennal segment of the male with a stem one-half the length of the subcylindric basal enlargement

c Wings broad, the fourth palpal segment one-half longer than the third

d Antennae of the male half the length of the body, the fifth segment having the basal enlargement with a length twice its diameter, that of the female with a length two and one-half times its diameter........................ arizonensis n. sp., C. a2063

dd Antennae of the male with a length nearly that of the body, the fifth having the basal enlargement with a length one-half greater than its diameter, that of the female with a length twice its diameter. Reared from Cassava...... manihot Felt.

cc Wings narrow; female antennae slender, the fifth segment with a length three times its diameter, the fourth palpal segment one-quarter longer than the third......carpini Felt, C. 346

bb Fifth antennal segment with a stem as long as the basal enlargement, circumfili greatly and irregularly produced in the male.... coryli Felt, C. a1543

Lasiopteryx flavotibialis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 157–58 (Dasyneura)
1908 ———— N. Y. State Mus. Bul. 124, p. 341 (Dasyneura)

This striking and interesting form is at once recognized by the subhyaline and brilliantly iridescent wings, due to the numerous dark broad scales and the yellowish tibiae. The presence of well-developed circumfili prevent its reference to the Heteropezinae, while the distinctly petiolate antennae of the male prohibit its association with Lasioptera, despite the numerous scales occurring upon both wings and body. This species is easily distinguished by the 11 and 10 segments of the male and female respectively, in connection with the strongly curved third vein. The adults reared May 7 and 8th, 1907 are very erratic in behavior, flying continuously perhaps for 10 minutes and then refusing to take wing. The pale salmon larvae were found in early May, under a hard, black, carbonaceous fungus overgrowing a decayed oak stump. The larvae were in cells and frequently folded so that the two extremities were approximate.

Larva. Length 3 mm, slender, color pale salmon. Head rather slender, with long, chitinous processes at the posterior lateral angles. Antennae uniarticulate, the segment with a length four times its diameter. Anterior margin of the first thoracic segment chitinized and supporting the subquadrate, slightly bidentate, chitinous process

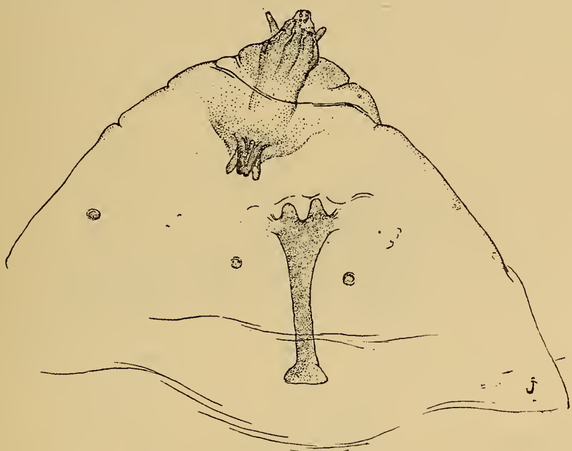

Fig. 21 Lasiopteryx flavotibialis, ventral aspect of larval head (enlarged, original)

resembling a small breastbone, from the base of which arises a pair of long, diverging, chitinous prongs, all extending posteriorly (fig. 21); breastbone well developed, bidentate, the shaft long, slender. Skin nearly smooth. Posterior extremity broadly rounded, the median apical portion thickly set with short, stout spines.

Male. Length 1.25 mm. Antennae nearly as long as the body, thickly haired, fuscous yellowish; 11 segments, the fifth with a stem three-quarters the length of the basal enlargement, which latter has a length one-quarter greater than its diameter; terminal segment with the basal portion greatly produced, nearly one-half longer than that of the preceding, the distal part short, thickly setose. Palpi; fuscous yellowish, the first segment short, stout, subquadrate, the second one-half longer, the third about twice the length of the second, more slender, the fourth a little longer than the third. Face fuscous yellowish. Mesonotum fuscous, greenish yellow, the submedian lines thickly clothed with long, fuscous hairs. Scutellum light reddish yellow with long setae apically, postscutellum yellowish. Abdomen dark yellowish red, thickly clothed with dark brown scales, the segments margined posteriorly with long, brown setae, the second to fifth segments with a pair of submedian, very small circular, orange spots near the distal third (these marks are visible only in favorable light and appear to be places where the black scales are missing). The sixth and seventh segments and genitalia fuscous yellowish; venter yellowish red, thickly clothed with dark brown scales, except a narrow mesial area. Wings subhyaline, brilliantly iridescent, costa black. Halteres whitish basally, black apically. Pleurae and coxae yellowish transparent, the latter with the anterior pair thickly clothed with long, black setae. Femora mostly dark brown or black, yellowish basally; tibiae a nearly uniform yellowish; tarsi fuscous yellowish, the three distal

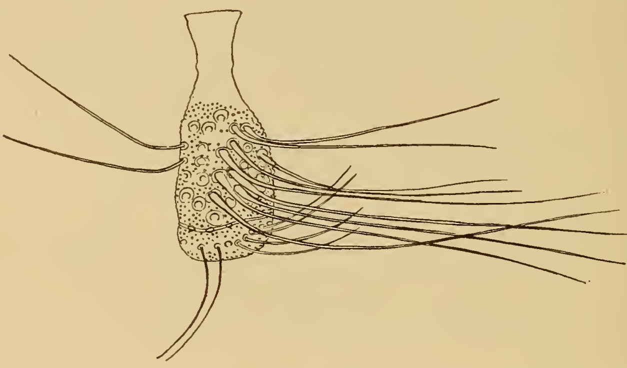

Fig. 22 Lasiopteryx flavotibialis, fourth antennal segment of male (enlarged, original)

segments black; claws long, slender, strongly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment short, stout; dorsal plate broad, broadly and deeply emarginate; ventral plate long, broad, truncate. Harpes long, tapering.

Female. Length 2 mm. Antennae extending to the second abdominal segment, sparsely haired, fuscous yellowish; 10 segments, the fifth subsessile, cylindric, with a length fully twice its diameter; terminal segment greatly produced, tapering, obtuse. Mesonotum yellowish brown, the submedian lines thickly setose. Scutellum pale yellow, sparsely setose apically, postscutellum yellowish. Abdomen reddish salmon, uniformly clothed with dark brown scales, terminal segments and ovipositor yellowish. Tibiae yellowish basally, fuscous yellowish distally; tarsi dark fuscous yellowish, the distal segments black. Ovipostor one-third the length of the abdomen, the terminal lobes short, narrowly rounded. Type Cecid. a1454.

Lasiopteryx schwarzi Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:191–92

Numerous midges were reared in the spring of 1911 from a dead wild fig branch collected by Mr E. A. Schwarz at Paraiso, Panama. It is easily separated from the preceding form by the larger number of antennal segments and marked differences in coloration.

Lasiopteryx coryli Felt

1907 **Felt, E. P.** New species of Cecidomyiidae II, p. 11 (Dasyneura)
1908 ———— N. Y. State Mus. Bul. 124, p. 292, 342 (Dasyneura)

This species was reared July 11, 1907 from a fuzzy, wrinkled, fold gall at the base of hazel leaves taken at West Nyack, N. Y. The work of this insect was quite common in the vicinity and a number of adults were reared.

a b c

Fig. 23 Lasiopteryx coryli, 5th antennal segment, *a* male, *b* female, *c* reverse of *b* (enlarged, original)

Gall. The gall produced by this species occurs at the base of hazel leaves, Corylus americana, and consists of a series of radiating folds from the point of its attachment with the petiole. These folds rarely extend beyond the basal third of the leaf and form a series of deep, thickly haired wrinkles usually with the basal portions tinted with pink. The white larvae are 1 mm long.

Male. Length 1 mm. Antennae longer than the body, sparsely haired, dark brown or black, the basal segments pale yellowish; 14 segments, the fifth with a stem as long as the subcylindric basal enlargement, which latter has a length two and one-half times its diameter; terminal segment somewhat prolonged, tapering (fig. 22). Palpi; the first segment short, stout, subquadrate, the second short, rounded distally, the third with a length fully twice that of the preceding segment, more slender, the fourth a little longer and more slender than the third, face yellowish. Head, thorax, abdomen, pleura, coxae and basal extremity of the femora all pale yellowish. Mesonotum dark brown, the narrow submedian lines yellowish, sparsely haired. Scutellum and postscutellum pale yellowish. Abdomen dark orange, very sparsely clothed dorsally with fuscous hairs; genitalia pale yellowish. Wings hyaline, costa dark brown, the wing margin and fringe unusually heavy. Halteres large, yellowish basally, fuscous subapically. Legs with the coxae and base of femora pale yellowish, darker apically, distal portion of femora and tibiae light fuscous, tarsi dark brown, claws very long, slender, strongly curved, the pulvilli one-half the length of the claws. Genitalia; basal clasp segment long, slender, terminal clasp segment swollen, long, slender; dorsal plate broad, broadly rounded, ventral plate shorter, broad, broadly and triangularly emarginate; harpes long, slender, tapering, obtuse.

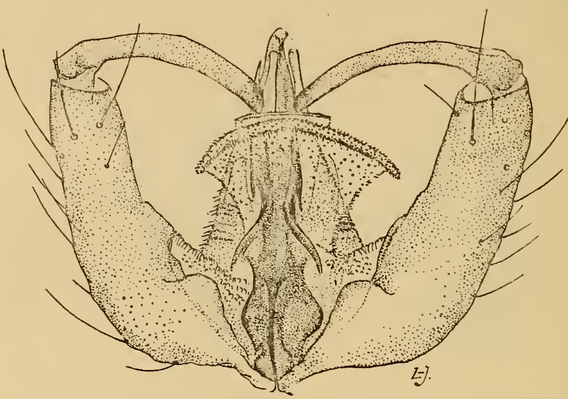

Fig. 24 Lasiopteryx coryli, male genitalia (enlarged, original)

Female. Length .66 to 1 mm. Antennae not quite as long as the body, sparsely haired, pale yellowish; 14 segments, the fifth subsessile, subcylindric, stem about one-quarter the length of the basal enlargement, which latter has a length two and one-fourth times its diameter; terminal segment produced, narrowly rounded apically. Palpi; the first and second segments presumably short, stout, the third with a length about two and one-half times its diameter, the fourth one-half longer than the third, more slender. Color a pale lemon yellow, the vestiture of the abdomen abundant enough to give some indication of banding. Halteres dark brown. Legs pale yellowish; the pulvilli apparently shorter than the claws. Ovipositor short, the terminal lobes short, stout, broadly rounded. Type Cecid. a1543.

Lasiopteryx arizonensis n. sp.

The yellowish midge described below was reared April 21 and 24, 1911 from a jar containing wild grape leaves with numerous galls infested apparently by Phylloxera and collected August 15, 1910, by Dr R. E. Kunze at Prescott, Ariz. The very broad wings serve to distinguish this species from its near allies.

Male. Length .8 mm. Antennae extending to the fifth abdominal segment, thickly haired, dark reddish brown; probably 14 segments, the fifth having a stem one-half the length of the cylindric basal enlargement, which latter has a length twice its diameter; terminal segment missing. Palpi; first segment small, irregularly subfusiform, the second a little longer, subrectangular, the third a little shorter than the second, slightly swollen near the middle, the fourth fully one-half longer than the third, dilated apically. Mesonotum dark reddish brown, the submedian lines sparsely haired. Scutellum yellowish, postscutellum yellowish brown. Abdomen mostly fuscous yellowish, the dorsum of the segments sparsely clothed with fuscous hairs; genitalia fuscous. Wings subhyaline, unusually broad, the length being less than one-half greater than the diameter; costa thickly scaled. Halteres yellowish basally, fuscous apically. Coxae mostly pale yellowish; femora basally yellowish straw, slightly fuscous apically; tibiae and tarsi mostly dark brown or black and thickly scaled; claws slender, strongly curved, unidentate, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment long, slender; terminal clasp segment slightly swollen basally, long; dorsal plate long, broad, deeply and triangularly emarginate; ventral plate rather long, broad, subtruncate. Halteres subtriangular, apically with a series of chitinized, digitate processes.

Female. Length .75 mm. Antennae hardly extending to the base of the abdomen, thickly haired, light brown, yellowish basally; 14 subsessile segments, the fifth cylindric, with a length about twice its diameter; terminal segment slightly produced, with a length two and one-half times its diameter, narrowly rounded apically. Palpi yellowish, the first segment irregularly subquadrate, the second narrowly oval, with a length about twice its diameter, the third as long as the second, slender, the fourth one-half longer than the second. Face yellowish. Mesonotum light brown, the submedian lines sparsely haired. Scutellum and postscutellum light orange yellow. Abdomen sparsely haired, dark orange yellow. Ovipositor short, the terminal lobes with a length one-quarter greater than the diameter, broadly rounded. Type Cecid. a2063.

Lasiopteryx manihot Felt

1912 **Felt, E. P.** Can. Ent., 44:144

The small yellowish midges were reared from Cassava, Manihot utilissima, July 15, 1911, by W. H. Patterson, St Vincent, W. I.

Lasiopteryx carpini Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 119. Separate, p. 23 (Asphondylia)
1908 ———— N. Y. State Mus. Bul. 124, p. 342 (Dasyneura)

This species was taken on ironwood or blue beech, Carpinus americana, at Albany, N. Y., June 21, 1906.

Female. Length .75 mm. Antennae extending to the middle of the abdomen, sparsely haired, dark brown, yellowish basally; 14 segments, the fifth cylindric, with a length two and one-half times its diameter, circumfili distinct, produced apically. Palpi; the first segment short, slightly expanded distally, second a little longer, the third suboval, a little longer than the second, the fourth more slender, elliptical and a little longer than the third. Face pale yellowish. Mesonotum fuscous orange with submedian lines yellowish, sparsely ornamented with fine setae. Scutellum pale yellowish with sparse apical setae, postscutellum fuscous yellow. Abdomen a pale fuscous orange, rather sparsely clothed with fuscous setae. Wings hyaline, costa dark brown; halteres pale yellowish. Legs fuscous, pale yellowish basally, tarsi slightly darker; claws slender, strongly curved. Ovipositor short, the lobes orbicular. Type Cecid. 346.

Lasiopteryx crispata Felt

1914 **Felt, E. P.** Psyche 20:111

One female provisionally referred to this genus was reared August 22, 1912, from a jar containing oval, yellowish blister leaf galls on Oakesia sessilifolia collected by Miss Cora H. Clarke at Magnolia, Mass.

Arnoldia Kieff.

Janetia Kieff.

1895 **Kieffer, J. J.** Wien Ent. Zeit., 14:7
1896 ———— Soc. Ent. Fr. Bul. 65, p. 236 (Janetia)
1897 ———— Syn. Cecid. Eur. & Alg., p. 15
1910 **Rübsaamen, E. H.** Zeitsch. Wissenschaft. Insektenbiol., 15:337
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:44

Members of this genus may be recognized by the quadriarticulate palpi, the 12 to 13 sessile antennal segments and the nearly straight third vein uniting with costa near the wing apex. The two latter characters serve to separate it from the American Neuromyia. The basal clasp segment of the male genitalia is not greatly dilated as in Macrolabis. The female has a slender, tapering ovipositor about as long as the abdomen. The type is Cecidomyia quercus Binn. Arnoldia gemmarum Rubs. produces a smaller, flattened, woolly gall on oak than does Dryomyia circinans Giraud. Balsam mounts of the type, prepared by Professor Rubsaamen were studied by the author in the Museum of Natural History at Berlin. No American forms have been recognized.

Neuromyia Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:44

This genus is erected for the reception of several small forms erroneously referred at the outset to Arnoldia. These insects resemble, in a general way, Rhizomyia and may be readily separated therefrom by the strongly curved third vein uniting with costa at the distal fourth, the 4 or 5 segments of the palpi and the relatively short terminal clasp segment of the male genitalia. Members of this genus are distinguished from Macrolabis Kieff. by the basal clasp segment not being greatly enlarged and from Arnoldia Kieff. by the stemmed antennal segments of the male. Type N. minor Felt, erroneously referred to Kieffer's genus Arnoldia.

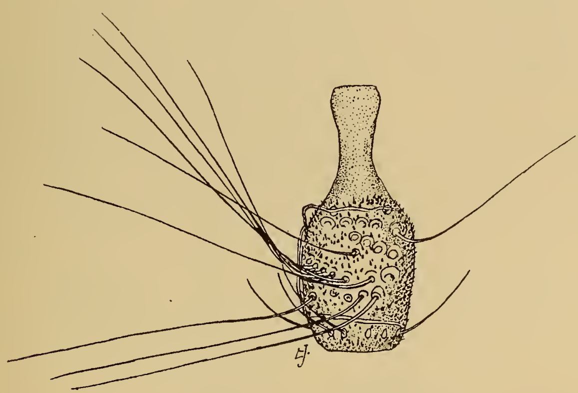

Fig. 25 Neuromyia minor, fifth antennal segment of male (enlarged, original)

Neuromyia minor Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 9 (Arnoldia)
1908 ———— N. Y. State Mus. Bul. 124, p. 290, 340 (Arnoldia)
1911 ———— N. Y. Ent. Soc. Jour., 19:44

Several specimens of this dark brown species, only .75 mm in length, were taken on a window at Nassau, N. Y., July 1, 1906. It is the only known representative of the genus.

Male. Length .75 mm. Antennae extending almost to the tip of the abdomen, rather thickly haired, dark brown, fuscous basally; 12 segments, the fifth with a stem as long as the basal enlargement, which latter has a length three times its diameter; terminal segment slightly prolonged, slender, fusiform, obtuse distally. Palpi; the first segment rather stout, subquadrate, the second stouter, narrowly oval, the third one-half longer, more slender, the fourth a little longer than the third, more attenuate, face fuscous. Mesonotum dark brown, submedian lines indistinct. Scutellum dark brown, yellowish orange basally, postscutellum dark brown. Abdomen a uniform dark brown. Wings subhyaline, costa thickly clothed with dark brown scales, subcosta uniting with the margin at the basal third, the third vein at the distal sixth, the fifth vein joining the posterior margin at the distal fourth, its branch at the basal third, subcosta and the base of the third and fifth veins rather thickly clothed with scales; halteres yellowish transparent. Coxae pale orange, femora and tibiae pale yellowish, distally with narrow reddish or brownish bands, tarsi dark brown; claws rather long, stout, evenly curved, the anterior unidentate. Genitalia; basal clasp segment long, stout; terminal clasp segment short, stout, swollen basally. Dorsal plate broad, deeply and triangularly incised. Harpes long, slender and irregularly truncate. Type Cecid. 431.

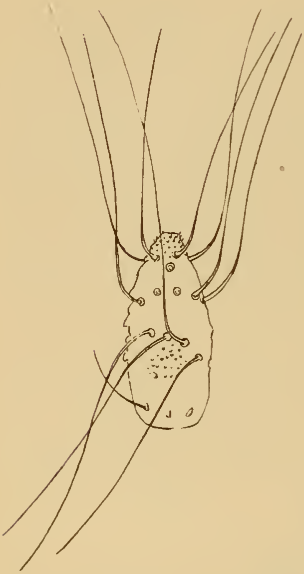

Fig. 26 Neuromyia minor, terminal antennal segment of male (enlarged, original)

Dryomyia Kieff.

1897 **Kieffer, J. J.** Syn. Cecid. Eur. & Alg., p. 17
1910 **Rübsaamen, E. H.** Zeitsch. Wissenschaft. Insektenbiol., 15:337
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:44

It is relatively easy to separate this genus from other genera of the Dasyneuriariae by the triarticulate palpi and the 18 to 20 antennal segments, in connection with the normal male genitalia. The type species is D. circinans Giraud. The male has 20 antennal segments, the fifth with a stem as long as the basal enlargement, which latter has a length one-half greater than its diameter. The palpi are triarticulate and the claws long and slender. Basal clasp segment stout, the terminal clasp segment stout, tapering; dorsal plate short, broad, triangularly emarginate, the lobes diverging, truncate; ventral plate long, divided, the lobes long, tapering, setose. The female has 20 sessile antennal segments, the fifth with a length thrice its diameter. The ovipositor is probably as long as the body. This species produces a woolly, brownish, spheroid gall on Quercus leaves, resembling somewhat a Caryomyia gall on hickory. The above is drafted from microscopical preparations prepared by Professor Rubsaamen and in the Natural History Museum at Berlin. One American species is known.

Dryomyia folliculi Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 348 (as Dasyneura)

1909 ———— Ottawa Nat., 22:247 (as Dasyneura)

This species was reared July 26, 1907 from a loose pod composed of the adherent terminal leaves of Solidago canadensis containing a number of Cecidomyiid larvae. This gall was taken by Mr L. H. Joutel at Jamesburgh, N. J., July 15, 1907. The pupa, before the adult emerges, escapes from the cocoon, leaving the exuviae lying beside the latter.

Gall. The gall made by this species is a loose, slightly swollen pod composed of the adherent terminal leaves of Solidago canadensis. It contains a number of yellowish larvae.

Cocoon. The cocoon is about 1.5 mm long, .75 mm in diameter and whitish.

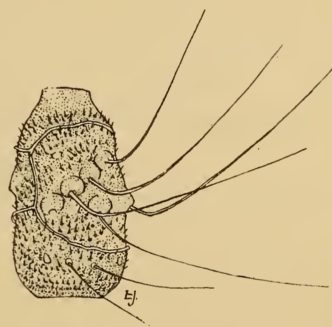

Fig. 27 Dryomyia folliculi, fifth antennal segment of female (enlarged, original)

Female. Length 1.25 mm. Antennae apparently extending to the third abdominal segment, sparsely haired, reddish brown; 15 segments, the first broadly obconic, the second flattened basally, subhemispheric, the third and fourth narrowly fused, the fifth subsessile, with a length nearly three times its diameter, a sparse subbasal whorl of short, curved setae and a broad subapical band of longer, rather stout setae; terminal segment evidently composed of two rather closely fused segments, the division being nearer the distal third. Palpi; the first segment short, stout, irregular, the second irregularly oval, stout, the third slender, greatly produced, being three times the length of the second. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum fuscous orange, postscutellum darker. Abdomen dark red, the incisures and pleurae deep carmine. Wings hyaline, costa dark brown, subcosta uniting therewith at the basal third, the third vein well before the apex, the fifth joining the posterior margin at the distal third, its branch at the basal third. Halteres yellowish basally, fuscous apically. Coxae and base of femora pale yellowish, the distal portion of femora and tibiae dark brown; tarsi apparently yellowish, the distal segments variably tinged with carmine. Claws rather long, stout, slightly curved, with a long, slender tooth basally; pulvilli longer than the claws. Ovipositor nearly as long as the abdomen, the terminal lobes long, narrowly oval. Type Cecid. a1581.

Fig. 28 Dryomyia folliculi, tip of ovipositor (enlarged, original)

Cystiphora Kieff.

1892 **Kieffer, J. J.** Wien Ent. Zeit., 11:212–14
1895 ———— Wien Ent. Zeit., 14:8–9
1897 ———— Syn. Cecid. de Eur. & Alg., p. 18
1910 **Rübsaamen, E. H.** Zeitsch. Wissenschaft. Insektenbiol., 15:337
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:44

This genus may be recognized by the 13 or 14 antennal segments, there being a distinct tendency toward reduction and fusion with the preceding in the case of the fourteenth segment. The male antennae have the stem fully as long as the basal enlargement, which latter is cylindric and presents much the same characters as obtained in Rhabdophaga. The female antennal segments are cylindric, sessile or subsessile and approach those of the female Rhabdophaga. The palpi are triarticulate. The wings are small, with the third vein nearly straight and uniting with the anterior margin distinctly before the apex, the general appearance of these organs being very close to that of Dasyneura, though the third vein is not quite so heavy. The claws are minutely unidentate in both sexes. The male genitalia present strong affinities with those of Rhabdophaga. The ovipositor is unique, having a broad, stout, retractile portion and a much more slender, presumably chitinized apical part.

This genus presents greater affinities with the Dasyneura group than with the Asphondylid group, and we have consequently included it in the former, despite the peculiar structure of the female ovipositor. This latter organ differs, we believe, widely from that of the typical Asphondylia, and as the antennae present no homologies therewith, we see no other alternative than to make the change. Type C. pilosellae Kieff.

Cystiphora viburnifolia Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:480-81

Only one female was reared May 5, 1909, from an inconspicuous elevation on the underside of the leaf of a hobblebush, Viburnum ? lentago, taken by Miss Cora H. Clarke at Magnolia, Mass., the preceding fall. This gall appears to be very common about Albany, N. Y. The small yellowish midge presents a close, superficial resemblance to Sackenomyia viburnifolia Felt, though it may be easily separated therefrom by the distinctly unidentate claws. The structure of the ovipositor does not agree exactly with that of the European Cystiphora and the species is therefore provisionally referred to this genus subject to further study.

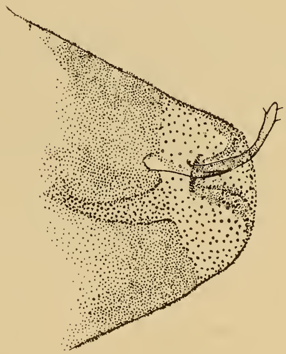

Fig. 29 Cystiphora viburnifolia, tip of abdomen (enlarged, original)

Gall. This is a minute, scarcely noticeable elevation, the larvae evidently lying between the upper and lower epidermis and producing a very slight swelling. (Pl. 8, fig. 3.)

Larva. Length 1.5 mm, whitish. Head small. Antennae rather long, tapering; breastbone, stout, bidentate, becoming obsolescent posteriorly. Skin coarsely shagreened; posterior extremity broadly rounded.

Cystiphora canadensis Felt

1913 **Felt, E. P.** Canad. Ent., 40:417

1914 **Cosens, A.** Canad. Ent., 41:180.

This midge was reared from a blister leaf gall on white lettuce or rattlesnake root, Prenanthes altissima or P. alba.

Rhizomyia Kieff.

1897 **Kieffer, J. J.** Syn. Cecid. Eur. & Alg., p. 56–57
1899 **Rübsaamen, E. H.** Biolog. Centralbl., 19:534 (Coccomorpha)
1904 **Kieffer, J. J.** Soc. Sci. Brux. Ann., v. 28, pt 2 Separate, p. 7
1910 **Rübsaamen, E. H.** Zeitschr. Wissenschaftl. Insektenbiol, 6:200–02
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:44

This genus is easily distinguished from all other Dasyneuriariae by the triarticulate palpi and the 12 antennal segments, those of the female subsessile, while in the male the stem is nearly as long as the basal enlargement. The terminal clasp segment of the male is very long, slender, and the ovipositor short and lobed. The type of this genus is R. perplexa Kieff.

A number of American species, closely allied to, if not cogeneric with, the European forms, have been tentatively referred to this genus. It is possible that further studies will warrant the placing of our American species in a separate genus. Two of the European species have been reared from the leaf sheath and roots of sedge, while our American species were obtained from jars containing various characteristic galls. The conditions were such as to lead us to suspect that the rearings were accidental.

The peculiar larva of R. circumspinosa Rubs. is oval, flattened and resembles a Coccid, hence its generic designation of Coccomorpha. This larva was found under the sheath of Carex leaves, while that of R. perplexa Kieff. occurred upon the roots of a sedge.

Key to species

Males

a Stem of fifth antennal segment one-quarter longer than the basal enlargement

b Abdomen light yellowish or yellowish orange; tibiae fuscous straw, tarsi dark brown or black, basal enlargement of fifth antennal segment with a length twice its diameter, the ventral plate roundly emarginate, the dorsal plate short, deeply and narrowly emarginate. Reared from rolled ash leaves........................ fraxinifolia Felt, C. a1572a

bb Abdomen fuscous yellowish, the segments margined posteriorly with dark brown, basal enlargement of fifth antennal segment with a length twice its diameter, the ventral plate very deeply and roundly emarginate.....................cincta n. sp., C. 722

bbb Abdomen pale orange, basal enlargement of fifth antennal segment with a length twice its diameter, the ventral plate broadly and roundly emarginate, the dorsal plate very short, deeply and roundly emarginate..................ungulata Felt, C. 1221 *bbbb* Abdomen dark yellowish fuscous, basal enlargement of fifth antennal segment with a length twice its diameter, the ventral plate roundly emarginate, the dorsal plate long, broad and roundly emarginate.................................c e r a s i Felt, C. 343

bbbbb Abdomen pale brown, the basal enlargement of the fifth antennal segment with a length three times its diameter, the ventral plate slightly emarginate, the dorsal plate triangularly emarginate...... h i s p i d a Felt, C. 519

aa Stem of fifth antennal segment as long as the basal enlargement

b Abdomen yellowish brown, the basal enlargement of the fifth antennal segment with a length twice its diameter, the ventral plate broadly emarginate......................v i t i s Felt, C. a1165a

bb Abdomen reddish yellow, tibiae and tarsi dark brown, the basal enlargement of the fifth antennal segment with a length two and one-half times its diameter, the ventral plate roundly and the dorsal plate triangularly emarginate.......................... a b s o b r i n a Felt, C. a1555x

Females

a Abdomen pale yellowish, fifth antennal segment with a length about three times its diameter, the lobes of the ovipositor broadly rounded apically..................a b s o b r i n a Felt, C. a1555x, a1518, a1579

aa Abdomen reddish yellow, the fifth antennal segment with a length three times its diameter, the lobes of the ovipositor subtriangular.......... h i r t a Felt, C. a1576a

aaa Abdomen light fuscous yellowish, fifth antennal segment with a length about two and one-half times its diameter, with the lobes of the ovipositor broadly ovate............v i t i s Felt, C. a1165a, a1568b

Rhizomyia fraxinifolia Felt

1907 **Felt, E. P.** New species Cecidomyiidae II, p. 8 (Arnoldia)
1908 ———— N. Y. State Mus. Bul. 124, p. 289, 384 (Arnoldia)

This light yellowish species was reared July 25, 1907 from a jar containing leaves of ash, Fraxinus, badly rolled by small, whitish larvae and collected by Mr L. H. Joutel at Newfoundland, N. J.

Male. Length 1 mm. Antennae as long as the body, sparsely haired, dark brown, yellowish basally; 12 segments, the fifth with a stem as long as the basal enlargement, which latter has a length nearly twice its diameter. Palpi; the first segment subquadrate, the second more than twice the length of the first, more slender, the third a little longer and more slender than the second. Face fuscous yellowish. Mesonotum light brown, the submedian lines indistinct. Scutellum, postscutellum and abdomen a nearly uniform light yellowish or yellowish orange, the last sparsely fuscous haired dorsally. Genitalia light fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, light fuscous apically. Coxae and femora pale yellowish; tibiae light fuscous straw; tarsi dark brown, almost black; claws long, slender, strongly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment short, stout; terminal clasp segment long, stout at base; dorsal plate short, stout, deeply and triangularly emarginate; ventral plate long, stout, broadly and roundly emarginate. Type Cecid. a1572a.

Rhizomyia cincta n. sp.

This fuscous yellowish species was taken on Cornus, probably C. stolonifera at Albany, N. Y., July 30, 1906.

Male. Length 2 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 12 segments, the fifth with a stem one-quarter longer than the basal enlargement, which latter has a length twice its diameter; terminal segment produced, with a length four times its diameter, tapering distally. Palpi; first segment broadly oval, the second slender, with a length four times its diameter, the third one-half longer, slender. Mesonotum dark brown, the submedian lines yellowish. Scutellum yellowish, reddish apically, postscutellum fuscous yellowish. Abdomen dark fuscous yellowish, the basal segment dark brown, the others margined posteriorly with dark brown and thickly clothed with fuscous hairs, the venter yellowish; genitalia brownish yellow. Wings hyaline, costa dark brown. Halteres pale yellowish. Coxae and femora basally yellowish, the remainder of the legs mostly dark brown; claws long, strongly curved, slender, the pulvilli much shorter than the claws. Genitalia; basal clasp segment stout, truncate; terminal clasp segment long, slender; dorsal plate short, deeply and triangularly emarginate; ventral plate long, broad, deeply and roundly emarginate; harpes long, slender. Type Cecid. 722.

Rhizomyia ungulata Felt

1907 **Felt, E. P.** New Species Cecidomyiidae II, p. 9 (Arnoldia)
1908 ———— N. Y. State Mus. Bul. 124, p. 290, 340 (Arnoldia)

This pale orange midge was taken at Albany, N. Y., July 6, 1907.

Male. Length 1 mm. Antennae a little longer than the body, thickly haired, light brown, yellowish basally; 12 segments, the fifth with a stem about one-quarter the length of the basal enlargement, which latter has a length one-half greater than its diameter; terminal segment produced, subcylindric, subacute. Palpi; the first segment short, stout, the second irregularly subquadrate, the third long, stout, with a length about thrice its diameter. Face pale yellowish. Mesonotum dark brown, the orange, submedian lines sparsely haired. Scutellum pale reddish, postscutellum pale orange. Abdomen sparsely haired, pale orange. Genitalia slightly fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs a variable fuscous straw, the tarsi slightly darker; claws very long, slender, strongly curved near the base, the pulvilli shorter than the claws. Genitalia; basal clasp segment short, stout; terminal clasp segment long, stout; dorsal plate very short, broadly and roundly emarginate; ventral plate long, the sides parallel, slightly constricted near the basal third and expanded subapically, broadly and roundly emarginate. Type Cecid. 1221.

Rhizomyia cerasi Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 114 (Dasyneura)
1908 ———— N. Y. State Mus. Bul. 124, p. 340 (Arnoldia)

This fuscous species was taken presumably on black cherry, Prunus serotina, at Albany, N. Y., June 21, 1906.

Male. Length 1 mm. Antennae probably one-half longer than the body, thickly setose, dark brown, yellowish basally; 12 segments, the fifth with a stem one-quarter longer than the basal enlargement, which latter has a length twice its diameter. Palpi; the first segment swollen, subquadrate, the second and third subequal, each fully twice the length of the first. Face fuscous yellowish. Mesonotum dark brown, the submedian lines pale yellowish and sparsely setose. Scutellum pale yellowish, sparsely setose apically, postscutellum fuscous yellowish. Abdomen dark fuscous yellowish, lighter basally, sparsely clothed with pale yellowish hairs. Wings hyaline. Halteres yellowish transparent. Legs pale straw, tarsi darker. Genitalia; basal clasp segment stout, a conspicuous internal tooth at the basal third; terminal clasp segment swollen basally, long, slender; dorsal plate long, broadly and slightly emarginate; ventral plate long, broadly Y-shaped. Type Cecid. 343.

Rhizomyia hispida Felt

1907 **Felt, E. P.** New Species Cecidomyiidae II, p. 9 (Arnoldia)
1908 ———— N. Y. State Mus. Bul. 124, p. 290, 340 (Arnoldia)

This pale brown midge was taken on Cornus, probably C. stolonifera, at Albany, N. Y., July 6, 1906.

Male. Length 1 mm. Antennae longer than the body, thickly haired, dark brown, fuscous basally; 12 segments, the fifth with a stem one-quarter longer than the basal enlargement, which latter has a length thrice its diameter; terminal segment produced, subcylindric, obtuse. Palpi; the first segment short, subquadrate, the second twice the length of the first, irregular, the third a little longer and more slender than the second. Mesonotum dark brown, submedian lines yellowish. Scutellum yellowish orange, postscutellum yellowish. Abdomen pale brown, thickly setose. Wings hyaline, costa dark brown. Halteres yellowish basally, whitish apically. Coxae, femora and tibiae mostly pale yellowish, tarsi light brown, the terminal segments darker; claws long, slender, strongly curved. Genitalia; basal and terminal clasp segments stout; dorsal plate broad, deeply and triangularly emarginate; ventral plate broad, long, slightly emarginate. Type Cecid. 519.

Rhizomyia vitis Felt

1907 **Felt, E. P.** New Species Cecidomyiidae II, p. 9–10 (Arnoldia)
1908 ———— N. Y. State Mus. Bul. 124, p. 290–91, 341 (Arnoldia)

This species was reared at Albany, N. Y., July 13, 1907 from a jar containing the familiar tumid gall of Lasioptera vitis O. S. on grape, Vitis species. It was also obtained from a jar in which were adherent leaf galls on Solidago inhabited by Camptoneuromyia adhesa Felt and Asphondylia monacha O. S.

Male. Length 1 mm. Antennae nearly as long as the body, thickly haired, fuscous yellowish, yellowish basally; 12 segments, the fifth with a stem as long as the basal enlargement, which latter has a length twice its diameter; terminal segment produced, tapering, narrowly rounded. Palpi; the first segment long, subquadrate, the second stouter, narrowly oval, the third one-half longer than the second, more slender. Mesonotum and dorsum of abdomen yellowish brown. Scutellum, postscutellum, parities and incisures pale yellowish. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs yellowish basally, dark brown distally; claws long, slender, strongly curved, the pulvilli shorter than the claws. Genitalia; basal and terminal clasp segments stout; dorsal plate long, narrow, broadly and roundly emarginate; ventral plate short, stout, narrowly rounded.

Female. Length 1.5 mm. Antennae extending to the third abdominal segment, rather thickly haired, dark brown, yellowish basally; 12 segments, the fifth subsessile, cylindric, with a length two and one-half times its diameter; terminal segment produced, narrowly rounded. Mesonotum dark brown, the submedian lines yellowish. Scutellum and postscutellum yellowish. Abdomen light fuscous yellowish, the incisures, pleurae and venter pale yellowish. Ovipositor short, the terminal lobes broadly oval, otherwise nearly as in the male. Type Cecid. a1165a.

Rhizomyia absobrina Felt

1907 **Felt, E. P.** New Species Cecidomyiidae II, p. 8 (Arnoldia)
1908 ———— N. Y. State Mus. Bul. 124, p. 289, 340 (Arnoldia)

This species was reared at Albany, N. Y., July 11th and 26th, 1906 from a jar containing Crataegus leaves bearing green, subcylindric, fimbriate, unicellular galls. Apparently the same form was obtained from a jar containing subglobular poplar leaf galls, and from another stocked with distorted cherries, produced by Dasyneura virginiana Felt. It is possibly an inquiline.

Male. Length 1.25 mm. Antennae nearly as long as the body, thickly haired, dark brown; 12 segments, the fifth with a stem as long as the basal enlargement, which latter has a length two and one-half times its diameter; terminal segment produced, tapering, obtuse. Palpi; the first segment short, stout, subquadrate, the second twice the length of the first, more slender, the third one-half longer than the second, expanded. Head, mesonotum, abdomen, coxae and pleurae all reddish yellow, the mesonotum with sublateral, slightly brownish areas, the abdomen sparsely clothed dorsally with dark hairs. Wings hyaline, costa dark brown. Halteres yellowish transparent, fuscous subapically. Legs with the coxae and femora pale yellowish, the latter darker distally; tibiae and tarsi dark brown; claws long, slender, strongly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment short, stout; terminal clasp segment long, stout at base; dorsal plate short, broad, deeply and triangularly incised; ventral plate long, broadly and roundly emarginate.

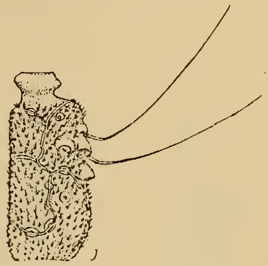

Fig. 30 Rhizomyia absobrina, fifth antennal segment of female (enlarged, original)

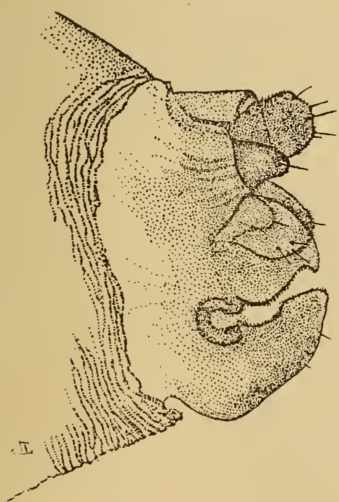

Fig. 31 Rhizomyia absobrina, tip of abdomen showing ovipositor (enlarged, original)

Female. Length 1 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown, yellowish basally; 12 segments, the fifth subsessile, cylindric, with a length thrice its diameter; terminal segment produced, narrowly rounded. Palpi probably triarticulate. Face yellowish. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum pale orange, postscutellum pale yellowish. Abdomen rather thickly clothed with fuscous hairs, pale yellowish. Ovipositor short, the terminal lobes short, stout, broadly rounded, otherwise nearly as in the male Type Cecid. a1555x.

Rhizomyia hirta Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:478

This species was reared August 17, 1907 from a jar containing numerous reddish, blisterlike leaf mines on Crataegus collected at Bath, N. Y., July 9. This gall is presumably made by L a s i o p t e r a excavata though this habit is abnormal for the genus. The light fuscous yellowish female may be distinguished by the fifth antennal segment having a length two and one-half times its diameter and by the broadly ovate lobes of the ovipositor.

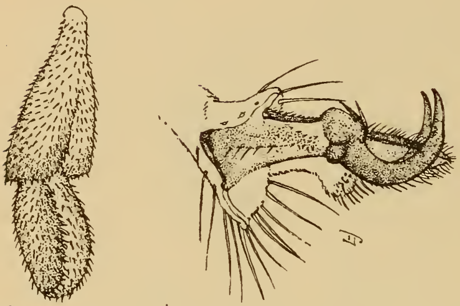

Fig. 32 Diarthronomyia artemisiae, *a* male palpus, *b* side view of claw (enlarged, original)

Larva. Length 2 mm, rather stout, pale yellowish. Head rather broad; antennae short, stout; breastbone slightly expanded apically, obtusely bidentate, subobsolete posteriorly. Skin smooth, posterior extremity broadly rounded, with sublateral, irregular groups of papillae. The larva is doubtfully referred to this species.

Ctenodactylomyia Felt, MS

This peculiar genus is easily distinguished from Rhizomyia by the larger number of antennal segments and, in particular, by the pectinate claws. The one known species, C. watsoni Felt, MS was reared from circular blister-like leaf galls on Coccolobis floridana.

Diarthronomyia Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 339
1910 **Rübsaamen, E. H.** Zeitschr. Wissenschaftl. Insektenbiol, 15:337
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:45

This genus presents a general resemblance to Rhopalomyia in its biarticulate palpi and the great similarity in the structure of the male genitalia. The minutely unidentate claws associate it with Rhabdophaga and its allies. The type species is D. artemisiae Felt.

Diarthronomyia californica Felt

1912 **Felt, E. P.** Pomona Coll. Jour. Ent., 4:752

The midge was reared from subconic leaf galls on Artemisia californica, Claremont, Cal.

Diarthronomyia artemisiae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 339–40

The species described below was reared June 16, 1883 from galls on sage bush, Artemisia tridentata, collected by Lawrence Bruner at Fort Garland, Col. This species approaches Rhopalomyia tridentatae Rubs. though it differs therefrom in the greater number of antennal segments, the longer stems

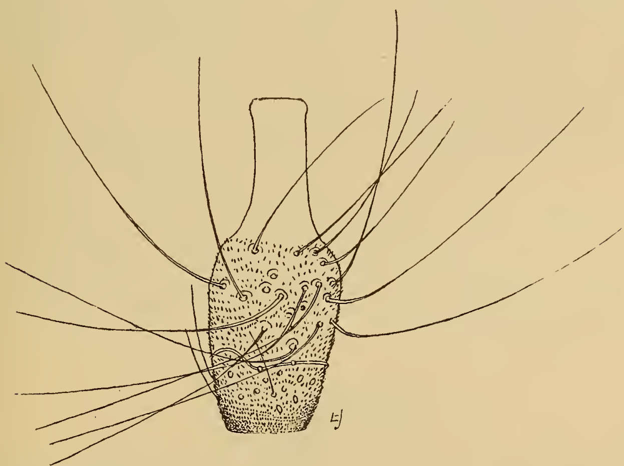

Fig. 33 Diarthronomyia artemisiae, fifth antennal segment, male (enlarged, original)

in the male flagellate segments and in the absence of what might be termed three whorls of hairs. There appears to be no description of the gall.

Male. Length 2 mm. Antennae nearly as long as the body, thickly haired, yellowish brown; 18 segments, the fifth with a stem about three-quarters the length of the subcylindric basal enlargement, which latter has a length twice its diameter; terminal segment greatly produced, with a length about four times its diameter, narrowly rounded apically. Palpi; first segment prolonged, swollen distally, with a length twice its diameter, the second short, stout, narrowly rounded apically. Mesonotum dark reddish brown, the submedian lines sparsely haired. Scutellum reddish brown; postscutellum darker. Abdomen sparsely haired, reddish brown. Wings hyaline, costa pale yellowish, subcosta uniting with the anterior margin near the basal half, the nearly straight third vein at the apex, the fifth, indistinct distally, at the distal fourth, its branch near the basal half. Halteres yellowish transparent. Legs a variable light straw, lighter distally; claws long, stout, strongly curved, unidentate, the pulvilli as long as the claws. Genitalia; basal clasp segment long, broad; terminal clasp segment short, stout, swollen near the basal third, apically with a heavy tooth; dorsal plate short, broad, deeply and triangularly incised, the lobes broadly rounded; ventral plate long, narrow, deeply and narrowly incised. Harpes short, stout, tapering, truncate.

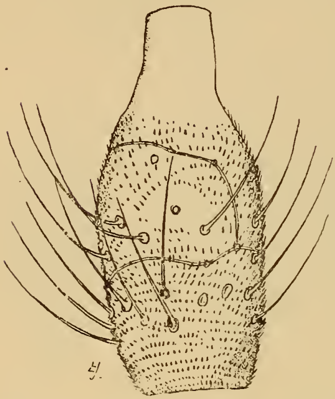

Fig. 34 Diarthronomyia artemisiae, fifth antennal segment of female (enlarged, original)

Female. Length 3 mm. Antennae extending to the third abdominal segment, sparsely haired, pale yellowish; probably 18 segments, the fifth with a stem one-third the length of the subcylindric basal enlargement, which latter has a length fully two and one-half times its diameter. Palpi; first segment stout, swollen distally, the second a little longer, narrowly oval. Color characters as in the male. Type Cecid. 989.

Coccidomyia Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:45

This genus was erected for a unique species evidently bred from young Lecanium scales. It may be separated from all other Itonididae known to us by the 12 antennal segments, those of the male being stemmed, in connection with the two palpal segments, the second being minute. The claws are toothed and the third vein unites with the margin at or very near the apex. Type C. pennsylvanica Felt.

Coccidomyia pennsylvanica Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:45

This interesting form was received from Mr W. S. Fisher of Highspire, Pa., through the United States Bureau of Entomology and sent by Mr Fisher under date of May 8th. The sole material received at that time consisted of a beech leaf, probably Fagus grandifolia, the under side of which was apparently rather thickly infested with young Lecanium scales and the upper side sparingly so. Dipterous exuviae were projecting from under the scales. Later additional material was received from which satisfactory microscopic preparations were made.

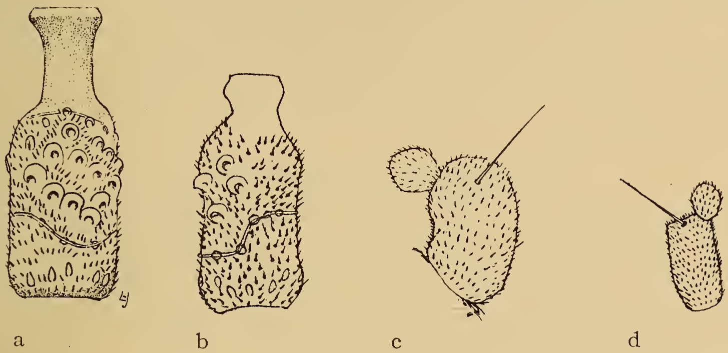

Fig. 35 Coccidomyia pennsylvanica, fifth antennal segment, *a* male, *b* female; palpus, *c* male, *d* female (enlarged, original)

Coccidomyia erii Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:147

The midges were reared by P. H. Timberlake from Artemisia californica infested by Erium lichtensioides collected in Ventura county, Cal.

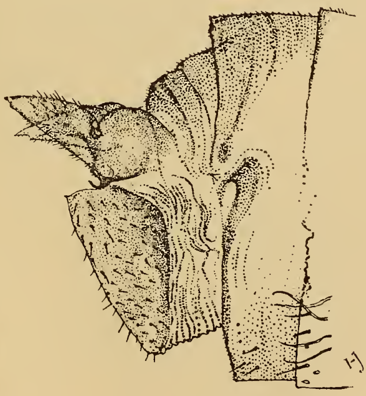

Fig. 36 Coccidomyia pennsylvanica, tip of abdomen showing ovipositor (enlarged, original)

Procystiphora n. g.

The genus has the general appearance of Rhabdophaga and is most easily separated therefrom by the apical chitinized blade of the long ovipositor and the simple or nearly simple claws of this sex. The claws of the male are weakly dentate and the harpes only slightly chitinized. This form approaches Cystiphora in the reduced teeth of the claws and the chitinized apex of the ovipositor, though it is easily distinguished from this genus by the quadriarticulate palpi and the larger number of antennal segments. Type P. coloradensis n. sp.

Procystiphora coloradensis n. sp.

Described from two males and one female collected by Prof. T. D. A. Cockerell at Long's Peak Inn, Colorado, in the Canadian Zone, July 21, 1914 and thought by him to have possibly come from Carex, though the appearance of the midge suggests to the writer that it may be an inhabitant of willow.

Male. Length 2.5 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 18 segments, the fifth with a stem one-fourth longer than the basal enlargement, which latter has a length three-fourths greater than its diameter, a moderately thick subbasal whorl of short, stout setae and a thick subapical band of longer setae; low circumfili occur at the basal third and apically; terminal segment broadly oval, with a length about one-fourth greater than its diameter, the apex broadly rounded. Palpi; first segment irregular, subquadrate, the second with a length two and one-half times its diameter, the third a little longer than the second, slender, the fourth one-fourth longer than the third. Mesonotum shining dark brown. Scutellum dark yellowish brown, postscutellum fuscous yellowish. Abdomen a variable dark reddish brown. Wings hyaline, costa fuscous straw, the third vein uniting with the margin at the apex of the wing, the fifth forked. Halteres fuscous yellowish, darker apically. Coxae and legs a variable yellowish brown, the claws minutely dentate, pulvilli distinctly longer than the claws. Genitalia; basal clasp segment long, rather slender; terminal clasp segment long, stout, with a distinct apical spur; dorsal plate long, broad, divided, the lobes long and narrowly rounded; ventral plate long, broad, deeply and roundly emarginate, the lobes narrow; harpes moderately long, expanded, roundly truncate and slightly chitinized apically; style short, swollen basally, broadly rounded apically.

Female. Length 2 mm. Antennae missing. Palpi; first segment quadrate, the second with a length over twice its diameter, the third as long as the second, more slender, the fourth one-third longer than the third, fusiform. Abdomen fuscous yellowish; claws apparently simple or very minutely dentate, the pulvilli longer than the claws; ovipositor stout, as long as the body, the seventh abdominal segment somewhat swollen and thus suggestive of Cystiphora, the apex of the ovipositor strongly chitinized, blade-like and tapering to an acute apex. Type Cecid. a2573.

EXPLANATION OF PLATES

PLATE 1

Midge galls

1 Small gall of Rhopalomyia capitata Felt, on goldenrod

2 Galls of Rhopalomyia racemicola O. S. among goldenrod blossoms

3 Gall of Rhopalomyia anthophila O. S. among goldenrod blossoms

4 Old gall of the nun midge, Asphondylia monacha O. S., on narrow-leaved goldenrod

5 Fusiform gall, Rhopalomyia fusiformis Felt, on leaves and stems of narrow-leaved goldenrod

6 Stemmed fusiform gall, Rhopalomyia pedicellata Felt, among flowers and on leaves of narrow-leaved goldenrod

7 Irregular mine in goldenrod leaf, adult not reared

8 Blister gall of Asteromyia flavolunata Felt on goldenrod

9 Blister gall of Asteromyia rubra Felt on goldenrod

9*a* Lower surface of leaf showing the whitish discoloration produced by the gall

10 Small blister galls of Asteromyia flavolunata Felt on solidago

11 Blister gall on Asteromyia rosea Felt on Solidago rugosa

12 Blister gall of Asteromyia laeviana Felt on Aster laevis

12*a* Lower portion of leaf showing characteristic discoloration on under surface of the gall

13 Old blister gall of Asteromyia rubra Felt on solidago

14 Blister gall of Asteromyia paniculata Felt on Aster paniculatus

15 Dark blister leaf gall of Asteromyia rubra Felt on solidago

15*a* Under surface of infested leaf

16 Blister leaf gall of Asteromyia carbonifera Felt on narrow-leaved solidago

17 Blister gall of Asteromyia on solidago, adult unknown


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21a
L. H. JOUTEL.

MIDGE GALLS

18 Irregular blister gall of Asteromyia on *Aster laevis*, adult unknown

19 Blister leaf gall of *Asteromyia laeviana* Felt on *Aster laevis*

20 Blister leaf gall provisionally identified as that of *Asteromyia rubra* Felt, a rather lighter type

21 Gall of *Rhopalomyia clarkeae* Felt on *Solidago rugosa*, natural size

21*a* Same gall, enlarged

PLATE 2

Midge galls

1 Stem of snapdragon, Impatiens fulva, infested with Oecidium impatientis, the latter inhabited by the larvae of Mycodiplosis impatientis Felt

2 The same fungus on leaves

3 Hazel leaf showing a pilose deformity from which was reared Lasiopteryx coryli Felt

4 Tumid midrib gall on ash from which have been reared Contarinia canadensis Felt, Dasyneura tumidosae Felt and which has been erroneously identified as the gall of Cecidomyia pellex O. S.

5 Blister leaf gall of Asteromyia asterifoliae Beutm. on aster leaves

6 Tumid vein swellings on soft maple from which has been reared Dasyneura communis Felt

7 Petiole gall on Vitis bicolor, producing Schizomyia petiolicola Felt

8 Upper surface of Linden leaf showing discoloration produced by the reddish galls of Cecidomyia verrucicola O. S., adult unknown

8*a* Under surface showing the size and globular character of the galls in a highly colored condition. Compare with plate 4, figures 5 and 6

9 Reddish swellings on under surface of hornbeam (Carpinus) leaves produced by Cecidomyia pudibunda O. S., adult unknown

10 Green bud gall on Cornus stolonifera, adult unknown

11 Discolored leaf mine inhabited by Lasioptera excavata Felt

11*a* Under surface of infested leaves

12 Swollen fruit of wild cherry, Prunus virginiana, from which has been reared Contarinia virginianiae Felt, Parallelodiplosis acerneae Felt, Itonida canadensis Felt, Arthrocnodax apiphila Felt, Rhizomyia absobrina Felt and a species of Lestodiplosis, the last is predaceous and the two preceding at least, probably inquilines

13 Leaves of Virginia creeper or woodbine with the midrib deformities produced by Dasyneura parthenocissi Stebb.

14 Petiole gall on fox grape, Vitis labrusca, produced by Schizomyia petiolicola Felt

MIDGE GALLS

15 Gall of Cecidomyia species on nettle, *Urtica gracilis*, adult unknown

16 Gall of *Cecidomyia urnicola* O. S. on *Urtica gracilis*, adult unknown

17 Peculiar adherent type of gall, potentially a bud deformation, on solidago from which has been reared both the nun midge, *Asphondylia monacha* O. S. and *Camptoneuromyia adhesa* Felt

18 Gall on leaf stem of *Vitis labrusca* produced by *Schizomyia petiolicola* Felt

19 Swelling at base of leaf stalk of wild cherry produced by Cecidomyia species, adult unknown

20 Another type of the same deformity

PLATE 3

Midge galls

1 Vein gall on the under side of Crataegus leaves, Lobopteromyia venae Felt and Dicrodiplosis venitalis Felt were reared, the latter probably an inquiline.

1*a* Side view of the same

2 Vein gall on chestnut leaves, adult not reared

3 Seed pods of Diervilla trifida deformed by Asphondylia diervillae Felt

4 Leaf roll on poplar, producer unknown, from which has been reared the predaceous Lestodiplosis populifolia Felt

5 Larger leaf roll on poplar, adult unknown

6 Reddish, globular leaf gall with slit on under surface on poplar, from which the presumably inquiline, Rhizomyia absobrina Felt has been reared, true maker unknown

6*a* Upper portion of infested leaf

7 Enlargement of the petiole of poplar leaf possibly produced by the insect which makes the gall figured under A

8 Cockscomb gall on Crataegus leaves produced by Hormomyia crataegifolia Felt

9 Larger, globular leaf gall on poplar, adult not reared

9*a* Under side of same

10 Typical bud gall on Diervilla trifida produced by Asphondylia diervillae

11 Globose basal enlargement of poplar leaf, possibly an early stage of the reddish, tumid, irregular gall resembling that of Lasioptera vitis on grape, producer unknown

12 Inconspicuous vesicular swellings with a small slit on the under surface of poplar leaves, adult unknown

13 Tumid apical gall on black cherry, Cecidomyia serotinae O. S., adult not reared

13*a* Old gall produced by the above named species

14 Vein swelling on Crataegus leaves possibly identical with that figured under 1

15 Folded edge leaf gall on poplar as seen from above, adult not reared

15*a* Appearance of the same gall from below

16 Cylindric, fimbriate gall on Crataegus from which has been reared Winnertzia hudsonici Felt and Rhizomyia absobrina Felt, the latter at least probably an inquiline


1
2
2a
2
3
4
4a
1a
5
6
6a
7
8
9
10
13
15a
12
9a
12
9
11
14
13
16
13a
15
17
10
18
19
16a
L. H. Joutel.

MIDGE GALLS

17 A distinctly smaller, fimbriate, cylindric gall on Crataegus, possibly identical with the preceding, adult not reared

18 Globose galls on poplar leaves from which has been reared Mycodiplosis populifolia Felt, this latter possibly an inquiline

19 Ocellate galls on Cornus stolonifera from which has been reared Lasioptera corni Felt

PLATE 4

Midge galls

1 Variable twig swellings on wild cherry produced by midge larvae working in the subcortical layers, adult not reared

1*a* Section of such a deformity

2 An older type of gall than that represented in 1

2*a* An old scar in process of healing

3 Leaf gall of Lasioptera farinosa Beutm. on blackberry

3*a* Early stage of same gall showing reddish discoloration

4 Irregular twig galls of Cecidomyia citrina O. S., adult not reared

5 Early stage of leaf stem gall on Linden, probably produced by Cecidomyia verrucicola O. S., adult unknown. Compare with figures 8 and 8*a* on plate 2

6 Globular green gall on Linden leaf. See under 5

7 Bud gall on Spiraea salicifolia produced by Hormomyia clarkeae Felt

8 Tubular gall on the under surface of the leaf of Cornus paniculata produced by Cecidomyia tuba Stebb., adult unknown

9 Galls along the under side of the midrib of the bitternut hickory produced by Caryomyia caryaecola O. S.

10 Enlarged bud gall on Rudbeckia produced by Asphondylia conspicua O. S.

11 Apical bud gall on solidago produced by Rhopalomyia hirtipes O. S.

12 Midrib swelling on Spiraea tomentosa produced by Rhabdophaga salicifolia Felt

13 Side view of a gall on willow leaf produced by Hormomyia verruca Walsh

14 Cluster of older galls on willow leaf produced by Hormomyia verruca Walsh

15 Flower bud galls on Eupatorium purpureum produced by Dasyneura purpurea Felt

16 Fringed terminal bud gall on Spiraea salicifolia, adult unknown

17 Leaf of shadbush, Amelanchier canadensis deformed by Hormomyia canadensis Felt

MIDGE GALLS

17*a* Same gall enlarged, showing the appearance of the upper surface of the leaf and a side view of several galls

18 Stem gall on thoroughwort produced by Neolasioptera perfoliata Felt

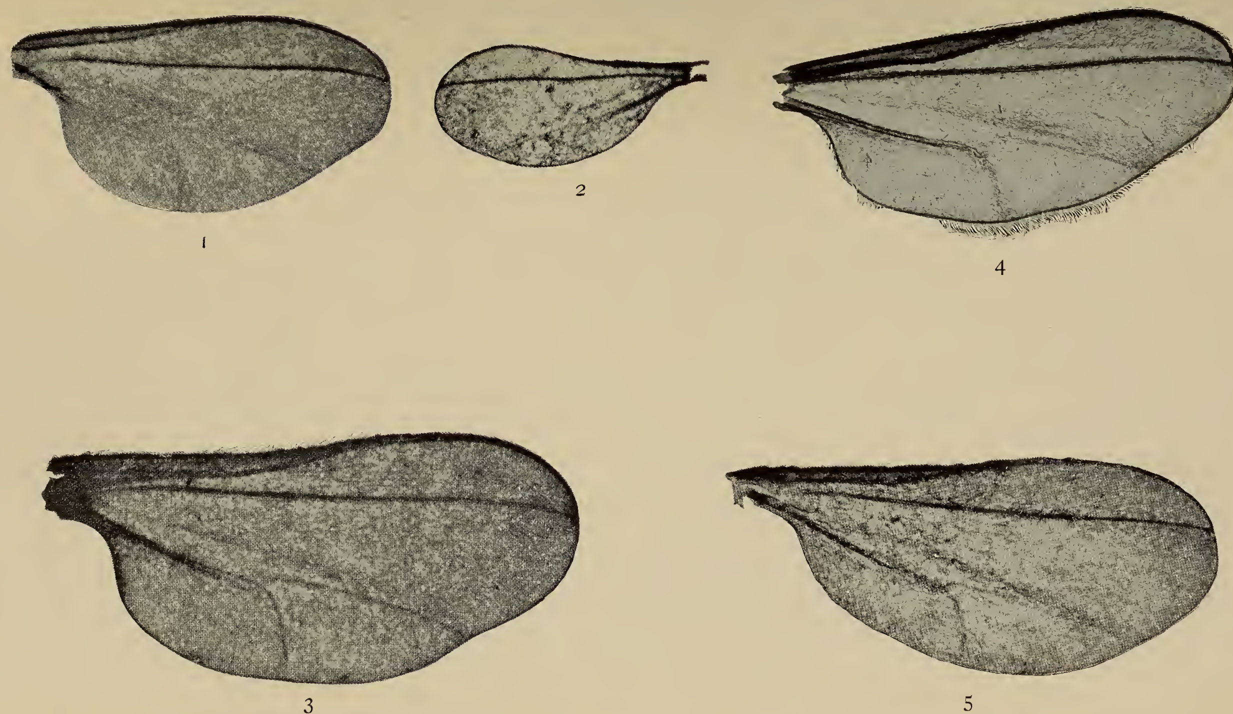
19 Blossom bud gall on white snake root, Eupatorium urticaefolium, from which has been reared Lestodiplosis eupatorii Felt, true producer unknown

PLATE 5

Gall midge wings

1 Wing of R h a b d o p h a g a p o p u l i Felt, C. 78, x 20
2 Wing of R h a b d o p h a g a a c e r i f o l i a Felt, C. 36, x 20
3 Wing of R h a b d o p h a g a c o n s o b r i n a Felt, C. 39, x 20
4 Wing of R h a b d o p h a g a b a t a t a s Walsh, C. a686, x 20
5 Wing of R . b a t a t a s Walsh, female, x 20

Plate 5



Gall midge wings

PLATE 6

Gall midge wings

1 Wing of *Dasyneura trifolii* Loew, C. 742, x 20

2 Wing of *Dasyneura photophila* Felt, C. 193, x 20

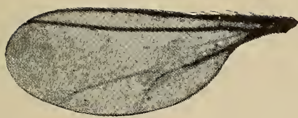
3 Wing of *Dasyneura unguicula* Felt, C. 745, x 20

4 Wing of *Dasyneura bidentata* Felt, C. 344, x 20

5 Wing of *Lasiopteryx flavotibialis* Felt, C. a1454, x 20

6 Wing of *Diarthronomyia artemisiae* Felt, C. 989, x 15

Plate 6



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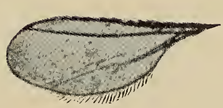

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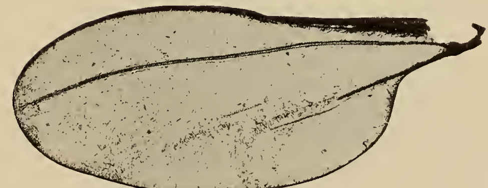

6

Gall midge wings

PLATE 7

Gall midge genitalia

1 Genitalia of Dasyneura quercina Felt, C. 47, x 260
2 Genitalia of Rhabdophaga populi Felt, C. 78X, x 260
3 Genitalia of Rhabdophaga batatas Walsh, C. a1102, x 260
4 Genitalia of Rhabdophaga consobrina Felt, C. 39. x 260

Plate 7

1

2

3

4

Gall midge genitalia

PLATE 8

Midge galls

1 A twig swelling on Salix provisionally referred to Rhabdophaga nodula Walsh

2 Twig swelling on Salix provisionally referred to the genus Rhabdophaga, adult unknown

3 Gall of Cystiphora viburnifolia Felt on Viburnum dentatum. Photo by Miss Cora H. Clarke

4 Gall of Dasyneura gleditschiae Felt on honey locust. Photo by Miss Cora H. Clarke

Plate 8

1

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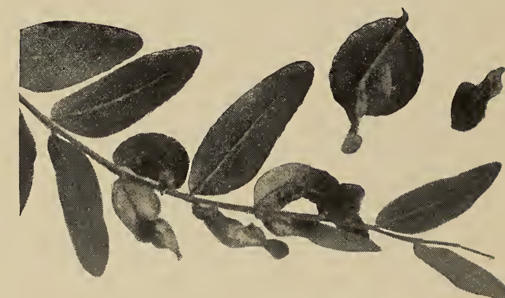
3



4

Midge galls

PLATE 9

Midge galls

Leaf galls of *Dasyneura salicifolia* Felt on Salix

Plate 9

Galls of Dasyneura salicifolia

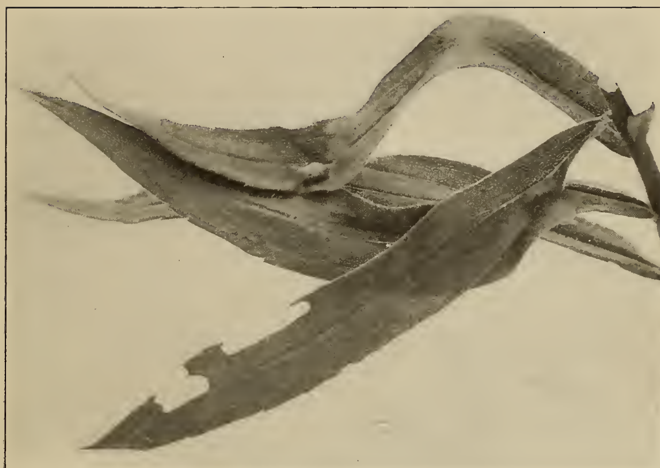
PLATE 10

Midge galls

1 Bud galls produced by *Dasyneura lysimachiae* Beutm. on loose strife

2 Adherent type of gall on solidago from which has been reared *Camptoneuromyia adhesa* Felt and *Asphondylia monacha* O. S.

Plate 10



2

1

Midge galls

PLATE 11

Midge galls

Galls of Rhabdophaga rosacea Felt on wild rose

Plate 11

Galls of Rhabdophaga rosacea

PLATE 12

Midge galls

1 Typical deformities on willow twigs produced by Rhabdophaga nodula Walsh, though the coalescing of several is somewhat uncommon

2 Apparently the same gall as the above, except that the bark covering the deformity is cracked in an unusual manner

Plate 12

1

2

Galls of *Rhabdophaga nodula*

PLATE 13

Midge galls

1 A rather stout type of gall on Salix produced by Rhabdophaga triticoides Walsh

2 The more usual type of R. triticoides Walsh gall with a few leaves attached to the stem

Plate 13

Midge galls

PLATE 14

Midge galls

1 Typical deformity on Salix twigs produced by Rhabdophaga triticoides Walsh

2 Early, leafy stage of the R. triticoides gall

Plate 14

1

2

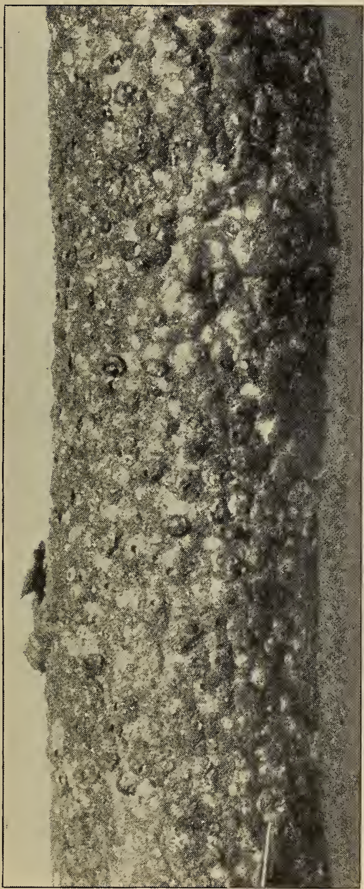
Midge galls

PLATE 15

1 Twig badly infested by San José scale and showing the numerous irregularly circular exit holes of parasites, x 4

2 Lobe of Cactus showing exudations from wounds caused by the larvae of the Cactus midge, Itonida opuntiae Felt

Plate 15



1

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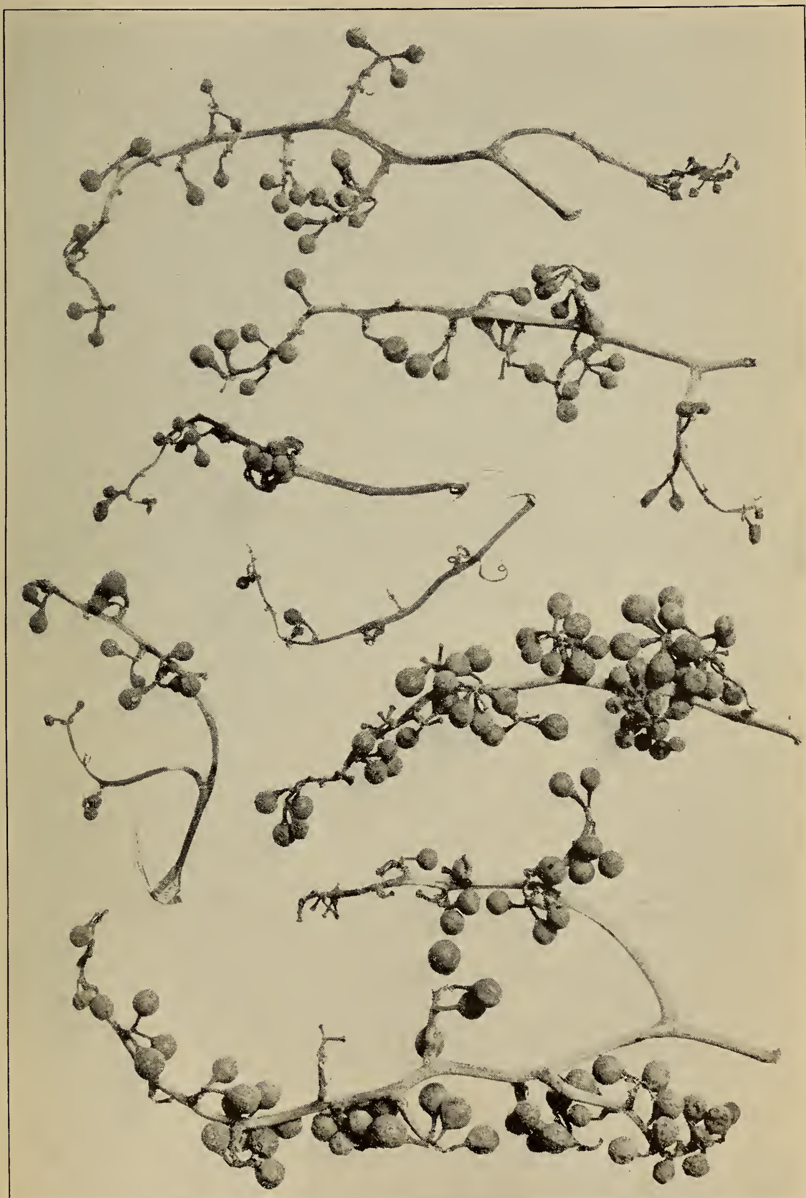
San José scale parasites and Cactus midge work

PLATE 16

1 Clusters of grapes injured by the banded grape bug, *Paracalocoris scrupeus* Say

Plate 16



Grapes injured by plant bug

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ERRATA

Page 66, line 10, for **Leucopsis**, read **Leucospis**
Page 129, line 6, from bottom, for **melilotii**, read **meliloti**
Page 132, line 25, for **Baldratia**, read **Asteromyia**

Appendix 4

Botany

Museum Bulletin 176

176 Report of the State Botanist 1913

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New York State Museum

JOHN M. CLARKE, Director

CHARLES H. PECK, State Botanist

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REPORT OF THE STATE BOTANIST 1913

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Museum Bulletin 176

REPORT OF THE STATE BOTANIST 1913

(During the past year the work of the office has practically passed into the hands of Dr H. D. House, assistant in botany, who has prepared this report.)

Noteworthy contributions. Specimens of ten species of Crataegus have been added to the herbarium. These were collected by Dr J. V. Haberer, in central New York, and are the cotypes of species described by Prof. C. S. Sargent in the report for 1912. Nearly all the 218 known species of Crataegus in this State are now represented by specimens in the herbarium. Doctor Haberer has also contributed four new species of Antennaria, to be described later by Dr E. L. Greene of Washington, D. C., a specialist upon that group. Doctor Haberer's set of plants also includes several other species either new to the State or new to central New York. Mr A. Olsson of Gloversville has collected and presented to the herbarium a large number of Fulton county plants containing several additions to the flora of the State and to Fulton county, the most interesting being a small orchid, Ophrys australis (Lindl.) House.

Dry weather damage to maples. About the middle of July several inquiries were received concerning damage to maple foliage. The first noticeable effect was a bronzing of the leaves, followed by the withering and death of the leaves, when they turned brown but remained attached to the limbs, thus causing a very unsightly appearance. Most of the complaints apparently considered the damage due to either fungus or insect enemies of the tree. By the last of July the damage seems to have been generally noticed on shade and park maples throughout most of the State. A personal examination of some of the badly affected trees in towns of the central part of the State and about Albany resulted in an explanation of the damage.

July was ushered in by about ten days of unusually hot weather, following a considerable period of drought, with high temperatures prevailing on some days. While the week of July 6th was a little cooler, the drought continued, and in fact the precipitation for the entire summer was far below normal. On July 12th and 13th there occurred a strong, hot and dry west and southwest wind, which continued with greater or less strength for several days.

The maple is well known as a very shallow rooted tree and the effect of the dry wind upon transpiration in the leaves is very marked in the case of any tree. It is apparent that the period of drought preceding the early part of July had reduced the available water of the soil to a minimum, so that the factors favoring transpiration (that is, dry, hot winds) which followed, greatly exceeded the power of the trees to absorb water from the soil which was actually deficient in moisture. Such a condition of affairs was particularly active in the case of maples along streets, highways, in parks or other situations where the soil was not protected from drying out by litter or undergrowth.

The leaves of the maple being unable to maintain the high rate of transpiration necessary under such conditions, were susceptible to the chemical activity of the sun's rays, causing the bronzing effect, a chemical change of the cell contents, somewhat analogous to what takes place normally in autumn when the leaves turn to shades of red or yellow. In many cases this state was followed by withering and death of the leaves, as sufficient moisture was not available to revive the leaves and to maintain their turgidity, which alone keeps them under ordinary conditions from collapsing.

That the dry weather and dry winds mentioned were responsible for the widespread damage seems probable also from the fact that the trees in situations of permanently damp soil, as in deep woodlands, suffered little or not at all; and of the trees affected, the greatest damage seems to have been on the side exposed most directly to the wind. Elms, having deeper-going roots, did not suffer so much as the maples, although considerable damage to their foliage was noticed in the case of some trees growing in dry soils. The leaves of the elm also possess a thicker epidermis and are better adapted by structure to withstand the factors like wind and heat which favor excessive transpiration and its subsequent damage.

The injury to maple and elm foliage thus noted is not likely to be permanent, nor is it likely that the trees thus affected will suffer from more than a slight setback. The damage consists chiefly in the unsightly appearance of the foliage. Local and even widespread occurrence of this sort of damage has frequently been reported in former years but not with such severity as during the summer of 1913.

A new fungus enemy of the maple. Several ornamental sugar maples at Glen Cove were observed by Mr F. E. Willets to be suffering from an attack of a fungus which caused the death of numerous twigs and branches, so that by August the trees were quite unsightly with the accumulation of dead twigs and brown leaves upon them. The fungus has been identified as Steganosporium piriforme (Hoff.) Cd., which is said to have been destructive to maples in a town in southern Minnesota at one time. It seems, however, not to have been previously noted in New York State. It is not usually regarded as a serious enemy of the maple and its destructive work at Glen Cove may be due to a combination of circumstances, not the least of which was the weakened condition of the trees due to the excessive and prolonged drought.

Weather and fungi. Numerous observations in former years have led to the conclusion that unusually dry seasons were productive of but few forms of fleshy fungi, and Doctor Peck makes special comment upon the abundance and variety of fungi following a damp or rainy summer (Annual Report of State Botanist for 1912, page 9). The season of 1913 seems to furnish abundant support to his conclusions for in most parts of the State few fleshy fungi developed during the summer, although numerous common ones appeared late in the fall and a large crop of field mushrooms followed favorable summer rains in most localities. Many correspondents have concurred in attributing the scarcity of fleshy species during the summer to the unusually dry weather.

Condition of the collections. The collections having been moved to the new Museum quarters early in the year, much time was necessarily occupied in properly arranging the herbarium and duplicate specimens in the new metal cases.

The collections of fungi made by the staff or received through contributions during the past year have been placed in cardboard boxes suitable for their reception and arranged in their proper places in the herbarium. The collections (345 in number) include 55 specimens of fungi and 290 specimens of ferns and flowering plants, collected in the counties of Albany, Madison, Rensselaer, Oneida, Onondaga, Schenectady and St Lawrence.

Specimens were contributed from the counties of Fulton, Herkimer, Monroe, Oneida, Onondaga, Queens, New York, Richmond, Washington and Wyoming.

Correspondents have contributed extralimital specimens collected in Alabama, Canada, California, Colorado, Connecticut, District of Columbia, Illinois, Maryland, Minnesota, New Hampshire, New Jersey, North Carolina, Oregon, Pennsylvania, Utah, Washington, Wisconsin, Wyoming, and Porto Rico and Germany.

The number of species of which specimens have been added to the herbarium from current collections and contributions is 837, of which 55 were not before represented in the State herbarium. Of these, 6 are considered new or hitherto undescribed species.

In addition, 2622 specimens have been placed in pasteboard boxes, labeled and promptly incorporated into the herbarium from the stored material. The following synopsis shows the number of such specimens now added to the herbarium, but heretofore stored away in bundles and not easily accessible:

	NEW YORK	EXTRALIMITAL
Agaricaceae	1160	293
Polyporaceae	333	205
Boletaceae	260	140
Other families	118	113
Total	1871	751

The total number of specimens added to the herbarium, from all sources, is therefore 3459. This large addition is made possible by the enlarged space now available in the new quarters.

A list of the names of the added species (not including those added from the stored material) shows which species are new and which are not new to the herbarium.

The number of those who have contributed specimens of plants is 33. This list includes the names of those who sent specimens for identification only, if the specimens were of such character as to make them desirable additions to the herbarium.

The number of identifications made is 830; the number of those for whom they were made, 110.

PLANTS ADDED TO THE HERBARIUM

New to the herbarium

Abies fraseri *Pursh*
Acer tomentosum *Desf.*
Andromeda floribunda *Pursh*
Antennaria grandis (*Fern.*) *House*
" novaboracensis *Greene*
" oneidica *Greene*
Azalea vaseyi (*Gray*) *Rehder*
Berteroa incana (*Linn.*) *DC.*
Burrillia pustulata *Setchell*
Carex carreyana *Torrey*
" conjuncta *Boott*
" bushii *Mackenzie*
" homathodes *Richi*
" projecta *Mackenzie*
" kneiskernii *Dewey*
Calvatia defodioidis *Lloyd*
Ceriomyces atkinsonianus *Murrill*
" housei *Murrill*
" vanderbiltianus *Murrill*
Cornus florida rubra *Temple*
Crataegus compta *Sargent*
" fallsiana *Sargent*
" gilbertiana *Sargent*
" hadleyana *Sargent*
" huntiana *Sargent*
" kneiskerniana *Sargent*
" maribella *Sargent*
" proctoriana *Sargent*
" tardipes *Sargent*
" uticaensis *Sargent*
Darlingtonia californica *Torrey*
Dryopteris clintoniana x goldiana *Dowell*
Dryopteris clintoniana x intermedia *Dowell*
" cristata x intermedia *Dowell*
" " x marginalis *Davenport*
" " x spinulosa *C. Chr.*
" goldiana x marginalis *Dowell*
Eriocaulon compressum *Lamark*
Filipendula ulmaria (*Linn.*) *Maxim.*
Lobularia maritima (*Linn.*) *Desv.*
Lycopodium habereri *House*
Marasmius delectans *Morgan*
Marsonia coronariae *Sacc. & Dearness*
Mycena polygramma (*Bull.*) *Fries*
Nardus stricta *Linn.*
Panicum addisonii *Nash*
" subvillosum *Ashe*
" tennesseense *Ashe*
" werneri *Scribner*
Physostegia latidens *House*
Pyropolyporus fulvus (*Scop.*) *Murrill*
Rhododendron catawbiense *Michaux*
Rubus elegantulus *Blanchard*
Sanicula trifoliata *Bicknell*
Scirpus lineatus habereri *House*
Viola emarginata x septemloba *House*
" septemloba *LeConte*
" villosa *Walter*

Not new to the herbarium[1]

Agaricus placomyces *Peck*
Bjerkandera adusta (*Willd.*) *Karsten*
Boletus luteus *Linn.*
" scaber areolata *Peck*
Brasenia schreberi *Gmelin*
Cantharel minor *Peck*
Ceriomyces atkinsonianus *Murrill*
" auriflammeus (*Berk. & Curt.*) *Murrill*
" communis (*Bull.*) *Murrill*
" housei *Murrill*

[1] This list includes only the more important additions to the herbarium from the current collections and contributions which are listed in detail under "Contributors and their contributions."

Ceriomyces illudens (*Peck*) *Murrill*
" retipes (*B. & C.*) *Murrill*
" roxanae (*Frost*) *Murrill*
" subglabripes (*Peck*) *Murrill*
" vanderbiltianus *Murrill*
Claudopus nidulans (*Pers.*) *Peck*
Clavaria obtusissima *Peck*
Clintonia umbellulata (*Mx.*) *Torrey*
Clitocybe clavipes (*Pers.*) *Fries*
Coriolus nigromarginatus (*Schw.*) *Murrill*
" prolificans (*Fries*) *Murrill*
" pubescens (*Schum.*) *Murrill*
" versicolor (*Linn.*) *Quel.*
Cortinarius corrugatus *Peck*
Cryptoporus volvatus (*Peck*) *Hubbard*
Daedalea aesculi (*Schw.*) *Murrill*
" confragosa (*Bolt.*) *Persoon*
" quercina (*Linn.*) *Persoon*
Elfvingia fomentaria (*Linn.*) *Murrill*
" megaloma (*Lev.*) *Murrill*
Fomes ungulatus (*Schaeff.*) *Murrill*
Fomitiporia prunicola *Murrill*
Ganoderma tsugae *Murrill*
Gloeoporus conchoides *Mont.*
Gomphidus rhodoxanthus *Schw.*
Gymnopilus spumosus (*Fries*) *Murrill*
" sapineus (*Fries*) *Murrill*
Hapalopilus gilvus (*Schw.*) *Murrill*
" rutilans (*Pers.*) *Murrill*
Hexagona alveolaris (*DC.*) *Murrill*
Irpex paradoxus *Fries*
Laccaria laccata (*Scop.*) *B. & Br.*
Laetiporus speciosus (*Batt.*) *Murrill*
Lentinus lepideus *Fries*
Lenzites betulina (*Linn.*) *Fries*
Lepiota farinosa *Peck*
" naucinoides *Peck*
Leptoglossum luteum (*Peck*) *Saccardo*
Lycogala epidendrum *Fries*
Lycopodium tristachyum *Pursh*
" inundatum *Linn.*
Marasmius subnudis (*Ellis*) *Peck*
" delectans *Morgans*
Mitrula paludosa *Fries*
Mutinus caninus *Fries*
Mycena epiptergyia (*Scop.*) *Fr.*
Nectria cinnabarina *Fries*
Onosmodium hispidissimum *Mackenzie*
Panus rudis *Fries*
Peridermium decolorans *Peck*
Piptoporus suberosus (*Linn.*) *Murrill*
Pleurotus sapidus *Kalchb.*
Pluteus nanus (*Persoon*) *Fries*
Polyporus admirabilis *Peck*
" arcularius (*Batsch.*) *Fries*
" distortus *Schw.*
" elegans (*Bull.*) *Fries*
" melanopus *Fries*
Poronidulus conchifer (*Schw.*) *Murrill*
Pseudomonas tumefaciens *Erw. Smith & Townsend*
Psilocybe spadicea *Schaeff.*
Pycnoporus cinnabarinus (*Jacq.*) *Karst.*
Pyropolyporus conchatus (*Persoon*) *Murrill*
" robiniae *Murrill*
Russula constans *Karsten*
" crustosa *Peck*
" obscura *Romell*
Scleroderma vulgare *Hornem.*
Spongipellis borealis (*Fries*) *Pat.*
Sphagnum palustre *Linn.*
Steganosporium piriforme (*Hoff.*) *Cd.*
Thelephora schweinitzii *Peck*
Tylopilus felleus (*Bull.*) *Murrill*
" indecisus (*Peck*) *Murrill*
Tyromyces chioneus (*Fries*) *Karsten*
Volvaria speciosus *Fries*

CONTRIBUTORS AND THEIR CONTRIBUTIONS

Miss Lizzie C. Allen, Newtonville, Mass.

11 specimens of Clavaria and four other fungi

Frank H. Ames, Brooklyn

Ceriomyces subglabripes (*Peck*) *Murrill*
Thelephora schweinitzii *Peck*
Tylopilus indecisus (*Peck*) *Murrill*

Miss H. C. Anderson, Lambertville, N. J.

Mutinus caninus *Fries*, with water color sketch

W. H. Ballou, New York

Agaricus campester majusculus *Peck*
Boletus scaber areolata *Peck*
Ceriomyces auriflammeus (*Berk. & C.*) *Murrill*
" communis (*Bull.*) *Murrill*
" retipes (*Berk & C.*) *Murrill*
Cantharel minor *Peck*
Coltricia folicola (*Berk. & C.*) *Murrill*
Cortinarius albidus *Peck*
" corrugatus *Peck*
" nucifluus *Fries*
" ophiopus *Peck*
" pulchrifolius *Peck*
Entoloma luteum *Peck*
Galera sphagnorum *Fries*
Gymnopilus spumosus (*Fr.*) *Murrill*
Hydnum blackfordae *Peck*
Hygrophorus eburneus (*Bull.*) *Fries*
Laccaria laccata (*Scop.*) *B. & Br.*
Lactaria volema *Fries*
" deceptiva *Peck*
Mycena haematopoda (*Persoon*) *Fries*
Pholiota spectabilis *Fries*
Polyporus distortus *Schweinitz*
Russula constans *Karsten*
" crustosa *Peck*
" emetica *Fries*
" obscura *Romell*
" olivescens *Fries*
" decolorans *Fries*
" squalida *Peck*
Spongipellis occidentalis *Murrill*
Tricholoma sordidum *Fries*

Miss Florence Beckwith, Rochester

Silene dichotoma *Ehrh.*

E. Bethel, Denver, Col.

Galera tenera (*Schaeff.*) *Fries*
Stropharia, sp.

F. J. Braendle, Washington, D. C.

Pleurotus sapidus *Kalch.*

S. H. Burnham, Hudson Falls

Mycena polygramma (*Bull.*) *Fries*
Rubus elegantulus *Blanchard*

Miss M. C. Burns, Middleville

Lepiota naucinoides *Peck*

M. S. Crosby, Rhinebeck

Gymnosporangium sp.

Simon Davis, Brookline, Mass.

Calvatia defodiodis *Lloyd*

J. Dearness, London, Ont.

Ascochyta colorata *Peck*
Burrullia pustulata *Setchell*
Cercospora rhinna *C. & E.*
Marsonia coronariae *Sacc. & Dearness*
Pestalozzia consocia *Peck*
Septagloeum ampelopsidis *Ellis & Ev.*
Septoria irregularis *Peck*
Melasmia galii *Ellis & Ev.*

Frank Dobbin, Shushan

Encalypta vulgaris var. pilifera *Hoffm.*
Entodon cladorrhizans (*Hedw.*) *C. Muell.*
Panicularia pallida (*Torrey*) *Kuntze*
Parmelia physodes var. vittata *Ach.*

Philip Dowell, Port Richmond

Adiantum pedatum *Linnaeus*
Asplenium montanum *Willdenow*
" platyneuron (*Linn.*) *Oakes*
" pycnocarpon *Spreng.*
Asplenium ruta-muraria *Linnaeus*
" trichomanes *Linnaeus*
Athyrium acrostichoides (*Sw.*) *Diels*
" felix-femina (*Linn.*) *Roth*
Botrychium dissectum (*Spreng.*) *Torrey*
" lanceolatum (*S. C. Gmelin*) *Angs.*
" neglectum *A. Wood*
" obliquum *Muhl.*
" virginianum (*Linn.*) *Sw.*
Camptosorus rhizophyllus (*Linn.*) *Link*
Cheilanthus lanosa (*Michx.*) *Watt.*
Dennstaedtia punctilobula (*Michx.*) *Moore*
Dryopteris clintoniana (*D. C. Eaton*) *Dowell*
" cristata (*Linn.*) *Gray*
" dilitata (*Hoffm.*) *Gray*
" goldiana (*Hooker*) *Gray*
" intermedia (*Muhl.*) *Gray*
" noveboracensis (*Linn.*) *Gray*
Dryopteris simulata *Davenport*
" spinulosa (*Mull.*) *Kuntze*
" thelypteris (*Linn.*) *Gray*
" clintoniana x goldiana *Dowell*
" clintoniana x intermedia *Dowell*
" cristata x intermedia *Dowell*
" cristata x marginalis *Davenport*
" cristata x spinulosa (*Milde*) *C. Chr.*
" goldiana x marginalis *Dowell*
Felix bulbifera (*Linn.*) *Underwood*
" fragilis (*Linn.*) *Underwood*
Lygodium palmatum (*Bernh.*) *Sw.*
Matteuccia struthiopteris (*Linn.*) *Todaro*
Onoclea sensibilis *Linn.*
Ophioglossum vulgatum *Linn.*
Osmunda cinnamonea *Linn.*
" claytoniana *Linn.*
" regalis *Linn.*
Pellaea atropurpurea (*Linn.*) *Link*
Phegopteris dryopteris (*Linn.*) *Fee*
" hexagonoptera (*Michx.*) *Fee*
Polypodium vulgare *Linn.*

Polystichium acrostichoides (*Michx.*) *Schott*
Pteris aquilina *Linn.*
Woodsia ilvensis (*Linn.*) *R. Brown*
Woodwardia areolata (*Linn.*) *Moore*
" virginica (*Linn.*) *J. E. Smith*

Victor Durr, Skillman, Pa.

Tylopilus felleus (*Bull.*) *Murrill*

W. B. Geiser, Albany

Boletus luteus *Linn.*

C. Gramesly, Charleston, Ill.

Lepiota farinosa *Peck*

Dr J. V. Haberer, Utica

Antennaria canadensis *Greene*
" grandis (*Fernald*) *House*
" neodioica *Greene*
" noveboracensis *Greene*
" oneidica *Greene*
Agrimonia mollis (*Torr. & Gray*) *Britton*
Agrostis maritima *Lam.*
Allonia hirsuta *Pursh*
Apocynum pubescens *R. Brown*
Arrhenantheum elatius (*Linn.*) *Beauv.*
Calamagrostis pickeringii *Gray*
Carex alopecoidea *Tuckerman*
" bushii *Mackenzie*
" canescens disjuncta *Fernald*
" conjuncta *Boott*
" castanea *Wahl.*
" diandra *Schrank*
" foenea *Willdenow*
" " perplexa *Bailey*
" gynandra simulans (*Fernald*) *Haberer*
" hirta *Linn.*
" kneiskernii *Dewey*
" leporina *Linn.*
" michauxiana *Boeckl.*
" novae-angliae *Schw.*
" paupercula pallens *Fernald*
" platyphylla *Carey*
" projecta *Mackenzie*
" schweinitzii *Dewey*
" suberecta *Britton*
Centaurea maculosa *Lam.*
Crataegus acclivis *Sargent*
" acuminata *Sargent*
" compata *Sargent*
" fallsiana *Sargent*
" hadleyana *Sargent*
" huntiana *Sargent*
" gilbertiana *Sargent*
" gracilipes *Sargent*
" finitima *Sargent*
" kneiskerniana *Sargent*
" maribella *Sargent*
" painiana *Sargent*
" proctoriana *Sargent*
" suavis *Sargent*
" tardipes *Sargent*
" uticaensis *Sargent*
Deschampsia flexuosa (*Linn.*) *Torrey*
Echinochloa frumentacea (*Roxb.*) *Link*
Echium vulgare *Linn.*
Eragrostis hypnoides (*Lam.*) *B.S.P.*
" pilosa (*Linn.*) *Beauv.*
Eriphorum alpinum *Linn.*
Galium verum *Linn.*
Hypericum ascyron *Linn.*
Hypopitys lanuginosa (*Michaux*) *Nuttall*
Ilysanthes dubia *Barnhart*
Juncus acuminatus *Michaux*
" brachycephalus (*Engelmann*) *Coville*
" brevicaudatus (*Engelmann*) *Fernald*
Koellia flexuosa (*Walter*) *MacMillan*
" virginiana (*Linn.*) *MacMillan*

Lapsana communis *Linn.*
Lepidium campestre *Linn.*
Lithospermum arvense *Linn.*
" officinale *Linn.*
Lychnis alba *Linn.*
Lycopodium habereri *House*
" tristachyum *Pursh*
Onosmodium hispidissimum *Mackenzie*
Panicum addisonii *Nash*
" clandestinum *Linn.*
" depauperatum *Muhl.*
" dichotomum *Linn.*
" huachucae *Ashe*
" " silvicola *Hitchc. & Chase*
" implicatum *Scribn.*
Panicum miliaceum *Linn.*
" tsugetorum *Nash*
Pentstemon hirsutus (*Linn.*) *Will-*
" laevigatus *Ait.*
Physostegia latidens *House*
Poa sylvestris *Gray*
Puccinella distans (*Linn.*) *Parl.*
Sanicula trifoliata *Bicknell*
Scirpus lineatus *Michaux*
" " habereri *House*
Sedum ternatum *Michaux*
Senecio obovatus *Muhl.*
Silene dichotoma *Ehrh.*
Sporobolus uniflorus (*Muhl.*) *Schribn. & Merr.*
Trisetum spicatum (*Linn.*) *Richter*
Washingtonia claytoni *Britton*

J. W. Harshberger, Philadelphia, Pa.

Pluteus cervinus (*Schaeff.*) *Fries*

L. M. Hasbrouck, Alexandria Bay

Cornus racemosa *Lamarck*
Viburnum lentago *Linn.*

Miss Caroline C. Hayes, Highlands, N. J.

Anthoceros laevis *Linn.*
Asterella gracilis (*Web. f.*) *Underwood*
Calypogeia tenuis (*Austin*) *Evans*
Cephalozia bicuspidata (*L.*) *Dumort*
" connivens (*Dicks.*) *Lindberg*
" fluitans (*Nees*) *Spruce*
" hampeana (*Nees*) *Schiffn.*
Frullania asagrayana *Mont.*
" inflata *Gottsche*
" plana *Sullivant*
Gymnomitrium concinnatum (*Lightf.*) *Corda*
" obtusum (*Lindb.*) *Pears.*
Gyrothyra underwoodiana *M. A. Howe*
Herberta adunca (*Dicks.*) *S. F. Gray*
Jamesoniella autumnalis (*DC.*) *Steph.*
Lophocolea heterophylla (*Schrad.*) *Dumort*
Lophozia alpestris (*Schleich*) *Evans*
" barbata (*Schreb.*) *Dumort*
" marchica (*Nees*) *Steph.*
" mildeana (*Gottsche*) *Schiffn.*
Marsupella sullivantii (*De Not.*) *Evans*
Mylia anomala (*Hook.*) *S. F. Gray*
Odontoschisma elongatum (*Lindb.*) *Evans*
" prostratum (*Sw.*) *Trevis*
Pellia neesiana (*Gottsche*) *Limpr.*
Plagiochila sullivantii *Gottsche*
Porella rivularis (*Nees*) *Trevis*
Preissia quadrata (*Scop.*) *Nees*
Reboulia hemisphaerica (*Linn.*) *Raddi*
Rectolejeunea phyllobola (*Nees & Mont.*) *Schiffn.*
Riccardia sinuata (*Dicks.*) *Trevis*
Riccia americana *M. A. Howe*
Ricciella crystallina (*Linn.*) *Warnst*

Scapania bolanderi *Austin*
" nemerosa (*Linn.*) *Dumort*
" paludosa *C. Mull.*
Sphaerocarpus texanus *Austin*
Sphenolobus exsectus (*Schmid.*) *Steph.*

Miss Ann Hibbard, West Roxbury, Mass.

Clavaria obtusissima *Peck*
Leptoglossum luteum (*Peck*) *Sacc.*
Panus rudis *Fries*

Mrs M. W. Hill, Minneapolis, Minn.

Piptoporus suberosus (*Linn.*) *Murrill*

H. D. House, Biltmore, N. C.

Abies fraseri *Pursh*
Amelanchier laevis *Wiegand*
Andromeda floribunda *Pursh*
Asplenium montanum *Willd.*
Azalea lutea *Linn.*
Azalea vaseyi (*Gray*) *Rehder*
Cerrena unicolor (*Bull.*) *Murrill*
Clintonia umbellulata (*Michx.*) *Torrey*
Coriolus nigromarginatus (*Schw.*) *Murrill*
" prolificans (*Fries*) *Murrill*
" pubescens (*Schum.*) *Murrill*
" versicolor (*Linn.*) *Quel.*
Cornus florida rubra *Temple*
Daedalea aesculi (*Schw.*) *Murrill*
" confragosa (*Bolt.*) *Persoon*
Dendrium prostratum (*Loudon*) *Small*
Dionaea muscipula *Ellis*
Eriocaulon compressum *Lam.*
Fomes ungulatus (*Schaeff.*) *Murrill*
Fothergilla carolina (*Linn.*) *Britton*
Hapalopilus gilvus (*Schw.*) *Murrill*
Hexagona alveolaris (*DC.*) *Murrill*
Hydatica petiolaris (*Raf.*) *Small*
Juncoides bulbosum (*Wood*) *Small*
" pilosum *Coville*
Laetiporus speciosus (*Batt.*) *Murrill*
Piptoporus suberosus (*Linn.*) *Murrill*
Polyporus arcularius (*Batsch.*) *Fries*
Pycnoporus cinnabarinus (*Jacq.*) *Karsten*
Pyropolyporus fulvus (*Scop.*) *Murrill*
" robiniae *Murrill*
Rhododendron catawbiense *Michx.*
" punctatum *Andr.*
Spongipellis borealis (*Fries*) *Pat.*
Utricularia fibrosa *Walt.*
Viola affinis *LeConte*
" blanda *Willd.*
" cucullata *Aiton*
" emarginata x septemloba *House*
" hastata *Michx.*
" septemloba *LeConte*
" sororia *Willd.*
" villosa *Walt.*
Vaccinium corymbosum *Aiton*

Dr W. Haydon, Marshfield, Ore.

Achillea lanulosa (*Nutt.*) *Piper*
Anaphalis margaritacea occidentalis *Greene*
Boschniakia strobilacea *Gray*
Darlingtonia californica *Torrey*
Godetia quadrivulnera (*Dougl.*) *Spach*
Hydrastylus brachypus *Bicknell*
Iris tenax *Douglas*
Juncus effusus *Linn.*
Lilium parviflorum (*Hooker*) *Holzinger*
Limnorchis leucostachys (*Lindl.*) *Rydberg*
Menziesia ferruginea *Smith*
Myrica californica *Cham.*

Philadelphus gordonianus *Lindl.*
Platystigma oreganum (*Nutt.*) *Benth. & Hooker*
Polygonum paronychia *Cham. & Schlecht.*
Rumex acetosella *Linn.*
Sisyrinchium birameum *Piper*
Spiraea douglasii *Hooker*

W. A. Murrill, New York

Ceriomyces atkinsonianus *Murrill*
" housei *Murrill*
Ceriomyces vanderbiltianus *Murrill*

L. C. C. Krieger, Chico, Cal.

Gomphidus rhodoxanthus *Schw.*
Pluteus nanus (*Pers.*) *Fries*
Stropharia sp.
Volvaria speciosa *Fries*

A. Olsson, Gloversville

Acer nigrum *Michx.*
Agrimonia mollis (*Torr. & Gray*) *Britton*
Agrostis hyemalis (*Walt.*) *B.S.P.*
Amaranthus graecizans *Linn.*
Andropogon furcatus *Muhl.*
Arabis glabra (*Linn.*) *Bernh.*
" hirsuta (*Linn.*) *Scop.*
Artemisia annua *Linn.*
" vulgaris *Linn.*
Arrenatherum elatius (*Linn.*) *Beauv.*
Arisaema dracontium (*Linn.*) *Schott*
Arctostaphylos uva-ursi (*Linn.*) *Spreng.*
Aster cordifolius furbishiae *Fernald*
" " polycephalus *Porter*
" lowrieanus *Porter*
" macrophyllus sejunctus *Burgess*
Bidens beckii *Torrey*
Callitriche palustris *Linn.*
Calamogrostis canadensis (*Michx.*) *Beauv.*
Cardamine bulbosa (*Schreb.*) *B.S.P.*
Carex aenea *Fernald*
" arcta *Boott*
" arctata *Boott*
" asa-grayi *Bailey*
" bicknellii *Britton*
" bromoides *Schkuhr.*
" careyana *Torrey*
" canescens disjuncta *Fernald*
" communis *Bailey*
" comosa *Boott*
" complanata *Torrey*
" foeea *Willdenow*
" grisea *Wahl.*
" homathodes *Richi*
" houghtonii *Torrey*
" leporina *Linn.*
" leptalea *Wahl*
" lupuliformis *Sartwell*
" mirabilis perlonga *Fernald*
" pallescens *Linn.*
" prairea *Dewey*
" projecta *Mackenzie*
" laxiflora *Lam.*
" pauciflora *Lightf.*
" prasina *Wahl.*
" retrorsa *Schw.*
" rosea minor *Boott*
" scabrata *Schw.*
" setacea ambigua (*Barratt*) *Fernald*
" scirpoides *Schkuhr.*
" sparganioides *Muhl.*
" straminea *Willd.*
" stellulata *Good.*
" sprengelii *Dewey*
" sterilis *Willd.*
" swanii (*Fern.*) *Mackenzie*
" tenella *Schkuhr.*
" trisperma *Dewey*
" virescens *Muhl.*
Celtis occidentalis *Linn.*

Cladium mariscoides (*Muhl.*) *Torrey*
Conringia orientalis (*Linn.*) *Dumort*
Dianthus deltoides *Linn.*
Digitaria humifusa *Pers.*
Epilobium densum *Raf.*
Euphorbia marginata *Pursh*
Filapendula ulmaria (*Linn.*) *Maxim.*
Fragaria americana (*Porter*) *Britton*
Festuca elatior *Linn.*
" nutans *Spreng.*
" ovina var. capillata (*Lam.*) *Hack.*
Galium verum *Linn.*
" claytoni *Michx.*
Geum macrophyllum *Willd.*
Gnaphalium decurrens *Ives*
Glyceria canadensis (*Michx.*) *Trin.*
" borealis (*Nash*) *Batchelder*
" grandis *Wats.*
" nervata (*Willd.*) *Trin.*
Habenaria clavellata (*Michx.*) *Spreng.*
" hyperborea (*Linn.*) *Rydberg*
Heliopsis scabra *Dunal*
Hieracium florentinum *All.*
Ibidium gracilis (*Bigel.*) *House*
Ilex montana *Torr. & Gray*
Ilysanthes anagallidea (*Michx.*) *Robinson*
Isoetes echinospora braunii (*Dur.*) *Engelmann*
Juncus articulatus *Linn.*
" canadensis *Gay*
" dudleyi *Wiegand*
" militaris *Bigel.*
" pelocarpus *E. Mey.*
" torreyi *Coville*
Juniperus sibirica *Burgsd.*
Lepidium apetalum *Willd.*
Lobularia maritima (*Linn.*) *Desv.*
Lycopodium dendroideum *Michx.*
Melica striata (*Michx.*) *Hitchc.*
Milium effusum *Linn.*
Monarda mollis *Linn.*
Muhlenbergia foliosa *Trin.*
" sylvatica *Torrey*
Myriophyllum farwellii *Michx.*
" tenellum *Bigel.*
Najus flexilis (*Willd.*) *Roem. & Schul.*
Nardus stricta *Linn.*
Oenothera oakesiana *Robbins*
Ophrys australis (*Lindl.*) *House*
Origanum vulgare *Linn.*
Oryzophsis asperifolia *Michx.*
Panicum subvillosum *Ashe*
" tennesseense *Ashe*
" werneri *Scribn.*
Peltandra virginica (*Linn.*) *Kunth*
Peramium ophioides (*Fern.*) *Rydberg*
" pubescens (*Willd.*) *MacM.*
Phalaris canariensis *Linn.*
Poa alsodes *Gray*
Polygala verticillata ambigua (*Nutt.*) *Wood*
" viridescens *Linn.*
Polygonum amphibium hartwrightii (*Gray*) *Bissell*
" careyi *Olney*
" muhlenbergii (*Meissn.*) *Wats.*
Potamogeton alpinus *Balbis*
" confervoides *Reichenb.*
" dimorphus *Raf.*
" heterophyllus *Schreb.*
Phragmites communis *Trin.*
Pyrola uliginosa *Torrey*
Ribes oxyacanthoides *Linn.*
Rumex altissimus *Wood*
Rynchospora fusca (*Linn.*) *Aiton f.*
" glomerata (*Linn.*) *Vahl*
Sagittaria graminea *Michx.*
" heterophylla rigida (*Pursh*) *Engelmann*
Salsola pestifer *A. Nelson*
Salix rostrata *Richards.*
Scirpus rubrotinctus *Fernald*
" smithii *Gray*
" subterminalis *Torrey*
Sisyrinchium atlanticum *Bicknell*
Solidago macrophylla *Pursh*
" neglecta *Torr. & Gray*
Sparganium americanum androcladum (*Engel.*) *Fernald & Eames*
" simplex *Huds.*

Sphenopholis pallens (*Spreng.*) *Scribn.*
Sporobolus uniflorus (*Muhl.*) *Scribn. & Merrill*
Stellaria borealis *Bigel.*
Trisetum melicoides (*Michx.*) *Vasey*
Utricularia cornuta *Michx.*
" intermedia *Hayne*
Vicia angustifolia (*Linn.*) *Reichard*
" tetrasperma (*Linn.*) *Moench*
Viola arenaria *DC.*
" blanda *Willd.*
" conspersa *Reichenb.*
" rotundifolia *Michx.*
Xyris caroliniana *Walt.*

T. L. Smith, Worcester, Mass.

Marasmius subnudis (*Ellis*) *Peck*
Mitrula paludosa *Fries*
Polyporus admirabilis *Peck*

E. B. Sterling, Trenton, N. J.

Psilocybe spadicea (*Schaeff.*) *Fries*

L. F. Strickland, Lockport

Cylindrisporium padi *Karst*

H. L. Wells, New Haven, Conn.

Ceriomyces illudens (*Peck*) *Murrill*
" roxanae (*Frost*) *Murrill*

F. E. Willets, Glen Cove

Steganosporium piriforme (*Hoff.*) *Cd.*

NEW OR INTERESTING SPECIES OF FUNGI

BY HOMER D. HOUSE

Professor Peck's notes, at the time of his illness in the spring of 1913, contained the descriptions of the three following new species.

Inocybe euthelella Peck, n. sp.

Pileus thin, fragile, convex or expanded, umbonate, fibrillose or sometimes slightly squamulose, brownish tawny; lamellae adnate, sinuate, close, white at first, becoming brownish tawny; stem slender, equal, stuffed or hollow, shining, colored like the pileus; spores even, oblong or narrowly elliptical, 10–16 x 6–7μ, cystidia 60–70 x 15–20μ; pileus 1–2.5 cm broad, stem 2–5 cm long, .5–1 mm thick.

Gravelly soil, roadside. South Acton, Mass. August 1912. Simon Davis. A slight violet color is sometimes visible at the top of the stem.

Pileus tenuis, fragilis, convexus vel expansus, umbonatus, fibrillosus vel aliquando leviter squamulosus, brunneo-fulvus; lamellae adnatae, sinuatae, confertae, primum albae, deinde brunneo-fulvae; stipes gracilis, aequalis, farctus vel fistulosus, nitidus; pileo similis in colore; sporae leves, oblongae vel anguste ellipsoideae, 10–16 x 6–7μ; cystidia 60–70x 15–20μ.

Clitocybe phyllophiloides Peck, n. sp.

Pileus thin, 2.5–6.5 cm broad, broadly convex or nearly plane, soon centrally depressed or subumbilicate, glabrous, pure white or sometimes with a slight yellowish tint in the center, flesh white, taste mildly farinaceous, odor none; lamellae thin, narrow, close, adnate or subdecurrent, white becoming pallid with age; stem short, equal, solid, white with a white mass of tomentum at the base, 2.5–4 cm long, 2–4 mm thick; spores 4–5 x 2–4μ.

Scattered among fallen leaves in spruce woods, Constableville. C. H. Peck, September 19, 1911.

Separated from C. phyllophila because the margin of the pileus does not differ perceptibly in color from the rest of the pileus, nor is the stem hollow, nor the lamellae subdistant nor becoming yellowish. Neither is the base of the stem villose, but is rather spongy-tomentose. The pileus is also sometimes moist becoming more white in drying, while C. phyllophila is dry.

Hebeloma palustre Peck, n. sp.

Pileus thin, convex, glabrous, viscid, yellowish or buff, sometimes tinged with red in the center; flesh whitish; lamellae plane, slightly sinuate, minutely crenulate on the edge, close, brownish ferruginous; stem equal, hollow, silky, pruinose at the top, whitish; spores brownish-ferruginous. Pileus 1.5–2.5 cm broad; stem 2–4 cm long, 1–2 mm thick.

Gregarious or subcespitose. Wet places in the margin of woods. Remsen, Oneida county, August 5, 1911. C. H. Peck.

The viscidity of the pileus is very tenacious.

Mycena polygramma (Bull.) Fr.

Vaughns, Washington county, S. H. Burnham, June 12, 1913.

The specimens seem to agree with the description of this species fairly well except that the stem does not seem to be distinctly striate as in that species, and merely the margin of the pileus is striate. Mr Burnham also remarks that the specimens seem to revive somewhat upon being moistened which is a characteristic of Marasmius. The amount of revival which they show, is scarcely sufficient to connect them closely with Marasmius.

Marasmius bellipes Morgan.

According to Dr L. H. Pennington, Professor Peck's Marasmius glabellus belongs to this species. The New York State collections are numerous, among them being Ithaca (Atkinson), Lyndonville (Fairman), Rensselaer, Saratoga, Albany, Essex, Hamilton and Warren counties (Peck).

Marasmius delectans Morgan.

Vaughns, Washington county, S. H. Burnham, August 1912. The species has also been collected at Ticonderoga and at Bolton by Professor Peck, and reported by him as Marasmius calopus Fr. in the Thirty-first Annual Report, page 36. 1879.

Pyropolyporus everhartii (Ellis & Gal.) Murrill

On oak near Round Lake, Saratoga county. C. H. Peck, August 1909. The specimens were doubtfully referred by Professor Peck to P. igniarius, to which it bears some resemblance.

Piptoporus suberosus (L.) Murrill

(Polyporus betulinus *Fr.*)

The white birch polyporus is common throughout the northern states on Betula papyrifera, B. populifolia, B. lutea and more rarely on B. lenta. It has been known as far south as New Jersey and Iowa. It was recently collected, however, on Yellow Birch, near Sunburst, Haywood county, North Carolina, at an altitude of over 5000 feet, on the slopes of Richland Balsam, next to Mitchell, the highest mountain in the state (H. D. House, *No. 13.10.* June 10, 1913).

Daedalea quercina (L.) Pers.

This is a characteristic fungus on logs and stumps of the oak in European forests where it frequently attains a very large size. In America, it seems to be both smaller, as a rule, and less abundant. Small but excellent specimens were collected on stumps of white oak at Sylvan Beach, Oneida county (House, *no. 13.37.* July 22, 1913).

Coniophora arida (Fr.) Cooke

Near Albany, on dead branches of Pinus rigida. House, *no. 13.84.* November 2, 1913. Not previously reported from New York.

Corticium mutatum Peck

Near Albany, on dead branches of Robinia pseudoacacia. House, *no. 13.76.* November 2, 1913.

NOTES UPON LOCAL FLORAS

BY HOMER D. HOUSE

I FULTON COUNTY

A recent collection of over 400 specimens of Fulton county plants, presented to the State herbarium by the collectors, Messrs A. Olsson and Alexander, of Gloversville, contains many interesting and rare species, not a few of which are new to that region and a few were previously unknown in this State. Nearly one-third of the collection consists of grasses and sedges which forms a valuable addition to our knowledge of those plants in the region covered by their collections.

Artemisia vulgaris Linn.

Gloversville, June 7, 1913. Like several other species of Artemesia, this one, commonly called mugwort, is frequently a common weed in waste places.

Arisaema dracontium (L.) Schott.

Vlei, August 6, 1913. *No. 104.*

Aster macrophyllus Linn.

Summit of Mount Pinnacle, August 31, 1913. *No. 122.*

The specimens are intermediate between A. macrophyllus and A. multiformis Burgess. They possess the reddish, angular stems, broad basal leaves cordate with deep irregular sinus, thick rough texture and the short, rigid, thickish peduncles characteristic for A. macrophyllus. Neither the inflorescence nor the stems, however, possess any prominent capitate glands but under the lens are seen to possess a densely and minutely glandular character, which is almost hidden in a dense soft pubescence.

Acer nigrum Michx.

Exact locality not given, July 3, 1912. *No. 230.*

Agrimonia mollis (T. & G.) Britton

Gloversville, August 15, 1913. *No. 180.*

Aster lowrieanus Porter

Gloversville, September 11, 1912. *No. 261.*

Berteroa incana (L.) DC.

Near Vlei, August 16, 1913. In flower and fruit. A native of Europe and a rather recent arrival in this country where it is said to be already common in certain parts of New England.

Bidens beckii Torrey

Vlei, August 6, 1913. *No. 103.* In flower. The other specimens in the State herbarium are from Schenectady, by L. C. Beck, after whom the species was named; Stissing pond, Pine Plains, Dutchess county; and Dresden Station, northern part of Washington county, both by Doctor Peck and Harris bay, Lake George by G. D. Hulst.

Carex bicknellii Britton

Carex arctata Boott

Carex aenea Fernald

Carex arcta Boott

Carex careyana Torrey

Near Gloversville, June 10, 1913. *No. 93.* A rare species in New York State, ranging from New York and Ontario to Michigan and the District of Columbia.

Carex prairea Dewey

Carex foenea Willdenow

Carex houghtonii Torrey

Near Gloversville, June 14, 1912. *No. 13.* This rare sedge has been previously collected in Essex county by Dr C. H. Peck and in Saratoga county by E. A. Burt.

Carex homathodes Richi.

Carex pauciflora Lightf.

Austral bog, September 18, 1913. *No. 45.* Not an uncommon species in sphagnum bogs throughout the northern counties but often overlooked because of its small size. It has been found in nearly all the large typical sphagnum bogs of Oneida, Oswego, Madison, Onondaga and other northern and western counties.

Carex sprengelii Dewey

West of Gloversville, June 17, 1912. *No. 20.*

Carex projecta Mackenzie
(C. tribuloides reducta *Bailey*)

Johnstown, August 3, 1912. *No. 31.*

Carex setacea ambigua (Barratt) Fernald

Carex swanii (Fernald) Mackenzie

Bleeker, June 22, 1912. *No. 293.*

Carex complanata Torrey
(C. triceps hirsuta (*Willd.*) *Bailey*)

Gloversville, June 13, 1912. *No. 12.*

Carex retrorsa Schwein.

Gloversville, July 17, 1913. *No. 47.*

Carex sterilis Willd.

Celtis occidentalis Linn.

While the Hackberry is said to range from western Quebec southward and westward, it must be regarded as a rare tree throughout northern and central New York. Along the banks of the Sacandaga river above Northampton are a number of gigantic Hackberry trees, varying in diameter from 10 to 25 inches. They appear to be native trees but if they were planted there it must have been fully a century ago.

Euphorbia marginata Pursh

A western species, often cultivated for its ornamental petaliferous bracts, and tending to become established eastward. The Fulton county station is apparently the first report of its naturalization east of Ohio.

Filipendula ulmaria (L.) Maxim.

Established from specimens which were probably introduced and cultivated for ornamental purposes. The species is already established in various localities in New England, Quebec and New York.

Glyceria borealis (Nash) Batchelder
(Panicularia borealis *Nash*)

Vlie, Fulton county. Collected by Mr Olsson. This species occurs throughout the northern counties of the State, and is probably more abundant than the few collections would seem to indicate. It was collected near Lansingburg many years ago by E. C. Howe and more recently in the Adirondacks by Doctor Peck.

Ilex montana Torr. & Gray

(Ilex monticola *A. Gray*)

Mountain Lake. *No. 195.* In flower. Also collected at the same place in 1912 by Mr C. P. Alexander. This station for the species is unique in being far north of the previously known range which was from the Catskills southward through the Appalachians.

Juncus dudleyi Wiegand

Gloversville, June 29, 1912. *No. 249.* Not an uncommon species in the calcareous districts of the State farther west, and formerly regarded as a variety of Juncus tenuis. The Fulton county station appears to form the eastern limit of its range so far as known.

Juncus torreyi Coville

(J. nodosus var. megacephalus *Torrey*)

Rather local, but not especially rare throughout the State. The Johnstown locality seems to be the only known station in Fulton station. It is common at some places about Oneida lake and in marshes along the shores of Lake Ontario.

Juncus pelocarpus E. Meyer

Sacandaga river, 1913. *No. 329.*

Myriophyllum farwellii Morong.

Sacandaga river, August 6, 1913. *No. 348.*

Myriophyllum tenellum Bigelow

Sacandaga river, August 6, 1913. *No. 354.*

Lobularia maritima (L.) Desv.

(Alyssum maritima *Lam.*, Koniga maritima *R. Br.*)

Gloversville, 1913. *No. 118.* The sweet alyssum, the common name under which this is usually known and cultivated, occasionally becomes established as a weed in waste places.

Nardus stricta Linn.

An adventive species coming from Europe. Said to have been introduced into Newfoundland and to have become established at Amherst, Mass. How the species reached Canada lake in Fulton county, where it was found by Mr Olsson, is difficult to imagine, as that locality is not close to any main lines of travel or transportation.

Oenothera oakesiana Robbins

Collected near Gloversville by Mr Olsson. This species was formerly considered to be a variety of O. biennis by Dr Asa Gray, but recent books have given it specific rank. Its range is given as "sandy fields, etc., eastern Mass. to Conn." In 1902 Professor Peck collected it at Port Jefferson, Long Island, but made no report of it, and with the Fulton county station extends considerably the known range of the species.

Ophrys australis (Lindl.) House

(Listera australis *Lindl.*)

This is a common but inconspicuous member of the orchid family throughout the southern states and has been found as far northward as near Camden, N. J. (reported by Barton in 1818), and near North Hammonton, N. J., where it was collected in 1908 by G. W. Bassett.

From here its distribution takes a broad jump and the species reappears at several widely separated localities in central New York and northward to Ottawa, Canada, which is the most northerly station known for the species. It was recently collected at Fine, St Lawrence county, by Dr C. H. Peck, and was found many years ago in the Lily marsh near Oswego, by Rev. J. H. Wibbe, where it still occurs abundantly. In Onondaga county it has been found near Baldwinsville by Doctor Beauchamp and by Prof. L. M. Underwood, in Cicero swamp by Mrs L. L. Goodrich, author of the "Flora of Onondaga County." In Fulton county it was collected by Mr C. P. Alexander in 1912, and by Mr A. Olsson in 1913 (*No. 287*) at Canada lake.

Panicum subvillosum Ashe

Berkshire, June 19, 1912. *No. 394.* Only one other collection of this species in New York outside of Long Island, where several collections of it were made by Bicknell, is cited by Hitchcock and Chase in the Revision of North American Panicums. That collection was made at Verona, Oneida county, by Dr J. V. Haberer in 1900.

Panicum tennesseense Ashe

Sacandaga Park, July 5, 1912. *No. 98.* The Tennessee Panicum ranges from Maine to Ontario, Minnesota, Mississippi and Georgia.

Although new to the State herbarium, Hitchcock and Chase cite specimens in the national herbarium from the Thousand Islands, Ausable Chasm, Appalachin and several places on Long Island.

Panicum werneri Scribn.

Gloversville, June 29, 1912. *No. 259.* A rare species, ranging from Maine to Minnesota, Ohio and Texas. Although new to the State herbarium, it has been collected previously in New York, according to Hitchcock and Chase, at Tripoli, Washington county, by S. H. Burnham, in 1897, near New York City, by E. P. Bicknell, in 1895, and near Ithaca, by Ashe and Rowlee, in 1892.

Pyrola uliginosa Torrey

(P. asarifolia incarnata (*Fisch.*) *Fernald*)

Cold Springs, Gloversville, 1913. *No. 409.* The purple-flowered shin-leaf is a subarctic species ranging from Newfoundland to Alaska, in cold sphagnum bogs. In New York it is confined to the northern and central counties. Besides the Fulton county station here recorded it occurs at several localities in Oneida, Madison, Oswego and Onondaga counties.

Phragmitis communis L.

Gloversville, September 1912. *No. 281.*

Polygala viridescens Linn.

Peck's pond, September 18, 1912. *No. 286.*

Persicaria careyi (Olney) Greene

Jackson's summit, August 22, 1912. *No. 292.*

Sagittaria graminea Michx.

Sacandaga river, August 6, 1913. *No. 335.*

Sagittaria rigida Pursh

Vlei, August 6, 1913. *No. 102.*

Scirpus smithii A. Gray

Northville, August 10, 1913. The specimens are not quite mature, but recognizable by the terete stems, flattened achenes and erect involucral leaves. Rare and local in distribution from Maine to

Pennsylvania, Ontario, Michigan and Illinois. It has been previously collected in this State on the shores of Cayuga lake, Sodus bay, and the eastern shore of Oneida lake.

Scirpus subterminalis Torrey

Bellow's lake, July 20, 1913. *No. 324.*

Trisetum melicoides (Michx.) Vasey

(Graphephorum melicoides *Desv.*)

Canada lake, July 19, 1913. *No. 396.* The range of this species is usually given as "gulf of St Lawrence to the Great Lakes, south to New Brunswick, Maine and Vermont." To this range should now be added Fulton county, New York.

Viola rotundifolia Michx.

Johnstown, June 18, 1912. *No. 196.*

Viola subvestita Greene

Gloversville, June 15, 1912. *No. 232.*

Rynchospora glomerata (L.) Vahl

Banks of Sacandaga river, Northville, Dr J. V. Haberer. August 1896.

2 HERKIMER COUNTY

Calamagrostis pickeringii Gray

Abundant, border of Hardscrabble lake, Wilmurt. July 12, 1902. Dr J. V. Haberer. *No. 2876.*

Carex canescens disjuncta Fernald

Shaking sphagnum bogs at Wetmore's pond, Frankfort hill, June 21, 1901. Dr J. V. Haberer. *No. 1019.* Also collected by Doctor Haberer at Boonville, Oneida county (*No. 3761,* June 21, 1912).

Carex gynandra porteri (Olney) Britton

Border of swampy woods, Frankfort hill, Dr J. V. Haberer, June 20, 1901. *No. 1598.*

Carex gynandra simulans (Fernald) Haberer

(Carex crinita var. simulans *Fernald*)

Bogs along trail to Punky pond east of North lake, Wilmurt. Dr J. V. Haberer, July 13, 1902. *No. 3072.* Also in boggy woods bordering Otter lake, Forestport, Oneida county. Dr J. V. Haberer, July 11, 1900. *No. 1599.*

Carex michauxiana Boeckl.

Abundant in bogs bordering Punky pond and Hardscrabble lake, east of North lake, Wilmurt. Dr J. V. Haberer, July 12–14, 1902 *No. 1075.*

Hypopitys lanuginosa (Michx.) Nutt.

Barren soil, south side of Dutch hill, 6 miles east of Utica, Dr J. V. Haberer, July 26, 1906. *No. 3329.*

Onosmodium hispidissimum Mackenzie

Common on sterile and stony hills and along the West Canada creek, 2 miles north of Herkimer. Dr J. V. Haberer, October 3, 1912. *No. 622.*

Panicum huachucae Ashe

Barren fields, Frankfort hill. Dr J. V. Haberer, June 30, 1912. *No. 1747a.*

Scirpus lineatus Michx.

Inundated shores of Grafenberg reservoir, Frankfort. Dr J. V. Haberer, July 25, 1912. *No. 3765.*

Senecio obovatus Muhl.

Rocky soil at summit of Falls hill, south of the Mohawk river at Little Falls. Dr J. V. Haberer, June 1, 1912. *No. 493.*

3 MADISON COUNTY

Blephariglottis blephariglottis (L.) Rydb.

Mossy surface of Fiddlers' Green, Pecksport, near Eaton. H. D. House. *No. 1246.*

Botrychium obliquum elongatum Gilbert & Haberer

Sandy soil under the shade of maples, near Oneida. H. D. House, September 1, 1913. *No. 5364.*

Carex aurea Nutt.

Castle swamp, Oneida. H. D. House. *Nos. 1095* and *1131.* Also common on Fiddlers' Green, Pecksport.

Carex arctata Boott

Fiddlers' Green near Eaton. H. D. House. *No. 1278.* Other rare sedges in this locality are Carex paupercula Mx., Carex pauciflora Lightf., Carex trisperma Dewey, Carex tuckermanii Dewey, Carex interior capillacea Bailey, Carex laxiflora patuliflora (Dewey) Carey, and Carex laxiflora blanda (Dewey) Boott.

Eriophorum paucinervum (Engelm.) A. A. Eaton

Castle swamp, Oneida. H. D. House. *No. 1134.*

Daphne mezereum Linn.

This attractive shrub seems to have become established as a permanent member of our flora. It has been reported two or three times by Doctor Peck from various parts of the State and specimens have been sent in for identification from several widely separated localities within the past two years. It appears to be well established on the edge of the Castle swamp near Oneida, where it has been known to the writer for over ten years and recently collected (*no. 5205;* 1913).

Dryopteris goldiana (Hook.) Gray

Low, moist, deciduous woodlands near Oneida. H. D. House. *No. 1169.*

Hieracium florentinum All.

Near Oneida. H. D. House. *No. 5215;* 1913. This yellow-flowered Hawkweed, following in the footsteps of its congenors which arrived earlier, is fast becoming an obnoxious weed in many places.

Hydrastis canadensis Linn.

Common in low woodlands near Oneida. H. D. House. *No. 5347;* 1913. The Golden Seal has been largely exterminated in many localities for its roots, which are valuable in medicine, and it is a pleasure to find still untouched a large patch of this rare plant where I first found it several years ago (*no. 1163;* 1905).

Isotria verticillata (L.) Raf.

Fiddlers' Green, Pecksport, near Eaton. H. D. House. *No. 1248.* Doctor Bradley found this species here about 1840 and it is one of the two localities known to Doctor Torrey (see Torrey, Fl. N. Y. 2: 281. 1843). The species seems to be abundant here, growing in moss under the shade of tamarack trees and their undergrowth of Viburnum, Vaccinium and Nemopanthus, surrounding the open sphagnum center of the " Fiddlers' Green."

Morus rubra Linn.

Alluvial soil along Oneida creek, near Valley Mills. H. D. House. *No. 5252;* 1913. The Red mulberry is not only rare in central New York but is small and seemingly unknown to those who are supposed to be well acquainted with the native trees. This isolated station undoubtedly marks one of the outlying limits of the northern distribution of the species.

Oxybaphus hirsutus (Pursh) Sweet

(Allionia hirsuta *Pursh*)

Along the New York, Ontario & Western Railroad on the banks of the Oneida creek at Oneida Castle, Madison county. Dr J. V. Haberer, August 2, 1909. *No. 3316.*

Pyrola uliginosa Torrey

(P. asarifolia var. incarnata (*Fisch.*) *Fernald*)

Common in a sphagnum bog near Oneida (House. *No. 5213;* 1913), where it has been known for several years (House. *No. 1091;* 1905). It also occurs at Mud lake, Warren, Herkimer county, where it was collected by C. H. Peck several years ago.

Viburnum opulus americanum (Mill.) Ait.

Abundant in the cedar swamps near Peterboro, 1300 feet altitude. House, August 31, 1913. *No. 5357.* Also in cedar swamps near Bouckville, Oneida county. Having seen the V. opulus Linn. of Europe growing wild in the mountains of southern Germany, I must confess that there seems little difference between it and the American form. The latter appears to have usually narrower leaves more wedge-shaped at the base, than is the case in the leaves of the European form.

Eleocharis intermedia (Muhl.) Schultes, var. **habereri** Fernald

Sandy shores of Oneida lake at Lewis Point. Dr J. V. Haberer, August 16, 1900. *No. 1149a.* Also occurring on the east end of the lake in Oneida county.

Thalictrum revolutum DC.

Castle swamp, Oneida. H. D. House, July 19, 1913. *No. 5201.*

Triglochin palustris Linn.

Castle swamp, Oneida. H. D. House, July 19, 1913. *No. 5209.* This species is abundant in nearly all open boggy or sphagnum places. It has been collected also at Pecksport and Peterboro, in Madison county, and at Green lake near Kirkville, Onondaga county.

Typha angustifolia Linn.

Castle swamp, Oneida. H. D. House, July 19, 1913. *No. 5219.* The narrow leaved Cat-tail is more abundant in the swamps of the coastal plain and is rarely met with inland. This is the only central New York station known.

Sanguisorba canadensis Linn.

Border of a sphagnum bog near Peterboro. H. D. House, August 31, 1913. *No. 5353.* Evidently a rare species in central New York as this is the only collection known from the region.

4 ONEIDA COUNTY

Antennaria canadensis Greene

Along the border of woods in a pasture, near Willowvale. Dr J. V. Haberer, June 8, 1910. *No. 3151.* Graefenberg hill, Herkimer county. Dr J. V. Haberer, June 10, 1910. *No. 3145.*

Antennaria neodioica Greene

East of Clayville. Dr J. V. Haberer, May 26, 1910. *No. 3123.*

Antennaria grandis (Fernald) House
(Antennaria neodioica var. grandis *Fernald*)

Steep hillside pasture, north slope of Paris hill, town of New Hartford. Dr J. V. Haberer, June 8, 1910. *No. 3122.*

Antennaria oneidica Greene

Border of sandy woods, Whitestown. Dr J. V. Haberer, June 4, 1904. *No. 2600.* Duplicate type collection.

Apocynum pubescens R. Br.

Sanquoit. Dr J. V. Haberer, July 22 and August 26, 1912. *No. 5354.* Usually referred to A. cannabinum as variety pubescens DC. and differing from that species chiefly in its pubescent calyx and pedicels and the leaves white-pubescent beneath.

Artemisia stelleriana Bess.

Sandy shore of Oneida lake at Sylvan Beach. House, 1905. *No. 1286.* Also collected here by Doctor Haberer. A native of Europe sometimes cultivated in gardens. Well established at Sylvan Beach where it has doubtless escaped from cultivation many years ago. As a sand-binding plant it possesses unusual qualities.

Carex alopecoidea Tucherm.

Alluvial swales and ditches, Mohawk flats near Utica. Dr J. V. Haberer, July 1, 1912. *No. 1013.*

Carex bushii Mackenzie

Meadows and fields, south of the Erie canal, Yorkville. Dr J. V. Haberer, June, 1912. *No. 1125.*

Carex castanea Wahlenb.

Very abundant in a small swale, 2 miles north of Alder Creek, town of Boonville. Dr J. V. Haberer, June 23, 1912. *No. 2546.* A rare species, known also in central New York from Fort Bull, near Rome, and from Cedar lake, Herkimer county.

Carex conjuncta Boott

Swales, meadows and ditches of the Mohawk flats near Utica. Dr J. V. Haberer, July 1, 1912. *No. 1548.* Little Falls. Dr J. V. Haberer, June 4, 1904. *No. 3051.* These not only constitute a new record for the State but mark a considerable eastward extension of the known range of the species. Doctor Haberer also reports the species from Oriskany and Trenton Falls, Oneida county.

Carex diandra Schrank

Small sphagnum swale, 2 miles north of Alder Creek, town of Boonville. Dr J. V. Haberer, June 23, 1912. *No. 3759.* From the same swale, appearing from the nearby highway to be but a mud hole, Doctor Haberer reports the following rare sedges:

Carex kneiskerni *Dewey*
" castanea *Wahlenb.*
" gracillima *Schwein.*
" rostrata *Stokes*
" schweinitzii *Dewey*

Carex hirta Linn.

Abundant in a boulder strewn pasture (1200 feet altitude) along a cold spring stream about 1 mile north of Boonville. Dr J. V.

Haberer, June 20, 1912. *No. 1912.* Growing with Carex schweinitzii and apparently native. The soil here has probably never been in cultivation, being too stony and wet. If the species is introduced, and all specimens heretofore found in this country have been regarded as introduced, it is difficult to imagine how it has reached this out of the way place, unless it has migrated into this pasture from some nearby meadow where it was originally introduced with grass seed.

Carex kneiskernii Dewey

Swale near Alder Creek, town of Boonville. Dr J. V. Haberer, June 23, 1912. *No. 1058.* This species should, as Doctor Haberer points out in a note attached to his specimens, be restored to the company of valid species. The specimens contain good achenes and no specimens of Carex arctata, with which species and Carex castanea it is suspected of being a hybrid, was growing near it. The type of Carex kneiskernii was probably collected by Doctor Kneiskern somewhere near Fort Bull, in company with Dewey, but of this we can not be certain. (See Paine's Catalogue of Plants of Oneida County.) Specimens of Carex are often sterile and it is possible that some of the earlier collections of this species were sterile, which led to its being regarded as a hybrid. Doctor Haberer's specimens are fertile and match exactly the description by Dewey in Wood's Classbook of Botany (page 764. 1868).

Carex paupercula Michx. var. **pallens** Fernald

Sphagnum bog near Oriskany. Dr J. V. Haberer, June 1904. *No. 3053.* A rare form, native of subarctic America from Quebec to British Columbia.

Carex projecta Mackenzie

Rocky woodlands near White Lake, Forestport. Dr J. V. Haberer, July 23, 1904. *No. 3521.*

Carex schweinitzii Dewey

Boggy soil in pasture along a cold spring stream, about a mile north of Boonville. Dr J. V. Haberer, June 20, 1912. *No. 1099.* Doctor Haberer remarks that this sedge is not so rare in Oneida county and vicinity as is commonly thought. It is rather abundant at Franklin Springs, Capron, Litchfield, Paris, Cassville, Richfield Junction, Oriskany, Trenton Falls, south of Utica, Alder Creek and Sauquoit.

Carex suberecta Britton

Sandy exsiccated swamp, Whitestown. Dr J. V. Haberer, August 22, 1912. *No. 3760.*

Centaurea maculosa Lam.

Abundant along roadsides, eastern part of the town of New Hartford, 5 miles south of Utica. Dr J. V. Haberer, September 16, 1912. *No. 3757.* A native of Europe and apparently well established in many places. (See Annual Report of State Botanist 1911, page 23.)

Dryopteris simulata Davenport

Sylvan Beach. H. D. House. *Nos. 1183* (1905) and *5259* (1913). This rare fern was first reported from central New York in the Fern Bulletin and in Torreya several years ago and seems not to have been discovered in any other central New York locality since then. At Sylvan Beach the fern grows in low, moist thickets of hardwoods in sandy soil overlaid by a thin black humus. Its companion species are Dryopteris noveboracensis, D. thelypteris, Osmunda cinnamonea, Vaccinium atrococcum, Cornus stolonifera, Acer rubrum, Betula populifolia, Alnus rugosa, etc. The only other New York localities are Long Island (G. D. Hulst) and Staten Island (P. H. Dowell).

Galium verum Linn.

The European yellow bedstraw seems to be common and well established in fields south of Utica. Dr J. V. Haberer, July 5, 1912. *No. 3629.*

Hypericum ascyron Linn.

Alluvial clay banks of the Mohawk river near Marcy and Whitestown. Dr J. V. Haberer, August 2, 1912. *No. 145.*

Lychnis alba Mill.

Common in thickets on sand hills and meadows, Whitestown. Dr J. V. Haberer, July 2, 1912. *No. 3574.*

Lepidium campestre (L.) R. Br.

Meadows, fields and along railroads near Utica. Dr J. V. Haberer, May 25, 1912. *No. 2596.* A recent introduction and becoming very common.

Lycopodium habereri sp. nov.

Rootstocks buried, stout, yellowish; branches 30 to 50 cm; long, widely divergent, procumbent but superficial and very leafy throughout; pale green or slightly glaucous, not crowded, dorsi-ventral; the divisions 1 to 4 cm long, 1.5 to 2.5 mm wide, all clothed with distant, minute, scarcely imbricated-appressed awl-shaped leaves in 4-ranks with decurrent adnate bases, the lateral ones with spinulose spreading tips, the ventral ones almost obsolete, subulate, 1 mm long; the lateral leaves averaging 4 mm distant on the leafy branches; peduncles elongated, 12 to 18 cm long, 2 or usually 4-spiked, with a few distant subulate scales which are in whorls of 4 (approximately), about 1.5 cm distant, subulate, 2-3 mm long: sporophyls pale green, orbicular-ovate, 1.5 to 2 mm broad with thin scarious margins, the apiculate tips spreading when mature.

Rich soil, shade of hemlocks, town line between New Hartford and Kirkland, Oneida county (7 miles south of Utica). Dr J. V. Haberer, October 24, 1907. *No. 3022.* Type in the herbarium of the New York State Museum.

This species has been known to Doctor Haberer for several years as very distinct in habit and general appearances from either L. tristachyum or L. flabelliforme (Fernald) Blanchard, its nearest relatives. From L. flabelliforme, it differs chiefly by its distant leaves with spreading tips and its green, orbicular, apiculate sporophyls with scarious margins. The late Mr Gilbert, an authority on ferns and fern allies, considered it a good species, as did Prof. L. M. Underwood, to whom a specimen was submitted by Doctor Haberer shortly before Professor Underwood's death. According to Doctor Haberer, duplicates of this collection are in the National Herbarium and the Gray herbarium.

Lycopodium inundatum Linn.

This species occurs at several localities throughout central New York although its range is given in the books as sandy shores from eastern Massachusetts to Maryland. It is particularly abundant in the low, sandy pine and oak barrens east of the head of Oneida lake, near Rome, east of Oneida, town of Gray (Herkimer county) and reported from Centerville, Onondaga county, by Mrs Goodrich. Also occurring in the "Lily marsh" near Oswego (Sheldon, 1880, and House, *no. 5800,* 1914). Sand Lake, Rensselaer county (Peck) and Mount Skylight, Adirondack mountains (Peck).

Lycopodium sabinaefolium Willd.

Hinckley, valley of the West Canada creek, Oneida county. Dr J. V. Haberer, October 28, 1911. *No. 2550.*

Scarcely glaucous; rootstocks close to the surface but buried in the leaf mold; stems erect, divided from near the base into numerous erect subsimple lax branches, 5–7 cm long, equally leafy all round; leaves equal, few-ranked, ascending, about 2 mm long, slender, very acute, appearing as though the tips were incurved: spikes solitary on few-scaled peduncles scarcely exceeding the leafy branches by more than the length of the spikes; sporophyls green with very thin scarious margins, crenulate with age, the tips spreading.

This rare club moss ranges from Prince Edward island to northern New England, Quebec and Ontario, usually in cold, mountain woods. Figured and described in Britton and Brown's Illustrated Flora, second edition, 1: 47, figure 110. 1913. According to Gray's Manual, this species has also been collected on Staten Island by Buchheister.

Lycopodium tristachyum Pursh

An abundant and easily recognized species in the sandy oak woods about the head of Oneida lake, where it has been collected by Haberer and by House. Also reported by Doctor Haberer from Grant, Ohio, Trenton and Grand View (*no. 2547*) in Herkimer county, and from Remsen, Hinckley (*no. 2547*) and Forestport (*no. 1543*) in Oneida county.

Panicum addisonii Nash

Sandy fields at Sylvan Beach, head of Oneida lake. Dr J. V. Haberer, June 22, 1906. *No. 3293.*

Panicum huachucae silvicola Hitchc. & Chase

Near Utica. Dr J. V. Haberer, June 1899. *No. 1735.* Deerfield. Dr J. V. Haberer, June 1907. *No. 1743.* Dutch hill, June 24, 1907. *No. 1741.*

Panicum tsugetorum Nash

In the shade of sumachs near Whitesboro. Dr J. V. Haberer, July 8, 1905. *No. 3282.*

Pentstemon laevigatus Ait.

Well established but probably adventive from the west and south, its natural range being from Pennsylvania to Florida and westward.

Doctor Haberer's specimens are from Roscoe Conkling park, Utica (*no. 1821*), hills near Deerfield (*no. 1822*) and pastures and meadows along the Erie canal east of Utica (*no. 653*).

Sanicula trifoliata Bicknell.

Rich woodlands in deep shade, Roscoe Conkling park, Utica. Dr J. V. Haberer, June 27, 1912. *No. 1402.*

Scirpus lineatus habereri var. nov.

Stouter in every way than S. lineatus. Spikelets larger, one-fourth to one-third inch long and one-third as thick; scales longer, more costate, sharper pointed and achenes larger.

Cold spring soil, Whitestown. Dr J. V. Haberer, July 2, July 11 and August 22, 1912. *No. 3764.* Type in the herbarium of the New York State Museum.

Scirpus atrocinctus Fernald

Sylvan Beach. H. D. House, 1904. *No. 1224.*

Sedum ternatum Michx.

Abundant in a rich stony woodland, Sauquoit. Dr J. V. Haberer, June 2, 1910. *No. 308.* According to Doctor Haberer, having the appearance of being unquestionably native and not known to occur native elsewhere in central New York.

Eriophorum alpinum Linn.

(Scirpus hudsonianus (*Michx.*) *Fernald*)

Limestone cliffs of Black river, Boonville, and at Leyden, Lewis county. Dr J. V. Haberer, June 22, 1912. *No. 3758.* This species has also been collected by Doctor Peck at Hidden lake, Herkimer county, Elm lake, Hamilton county, and Aiden Lair, Warren county.

Physostegia latidens sp. nov.

Related to P. virginiana (Linn.) Benth. Stems .5 to 1 m tall, terminated by a single, densely flowered, stiff, erect, slender spike, or by a few panicled spikes, glabrous and strongly 4-angled below, puberulent or finely pubescent above and in the inflorescence; leaves thick textured, lanceolate or the upper ones linear-lanceolate, sessile and broadly attached at the base, sharply serrate with rather distant teeth, pale green, the leaves gradually or sometimes rather abruptly reduced above; flowers subsessile; calyx puberulent, 6–8 mm long, the teeth triangular with acute or abruptly acuminate tips, not acerose, 1–1½ mm long, not over one-fifth the length of the calyx tube; corolla about 2 cm long, pink or rose-purple.

Near Utica. Dr J. V. Haberer, August 10, 1912. *No. 3084.* Type in the herbarium of the New York State Museum.

Distinguished from P. virginiana by its short, triangular, acute calyx lobes which are not acerose, and from P. parviflora by its acutely pointed calyx lobes, thick leaves and larger corollas. Following the nomenclature of Britton & Brown's Illustrated Flora, second edition, this would be called Dracocephalum latidens House.

Eleocharis diandra Wright

Sandy shores of Oneida lake. Dr J. V. Haberer, August 2, 1900. *No. 1356.*

Fimbristylis geminata (Nees) Kunth.

(F. frankii *Steud.*)

Sandy shores of Oneida lake. Dr J. V. Haberer, August 16, 1900. *No. 1370.*

Hemicarpha micrantha (Vahl) Pax.

Sandy shores of Oneida lake. Dr J. V. Haberer, August 18, 1900. *No. 1168.*

Woodwardia virginica (L.) Sm.

Sandy swamps near Sylvan Beach. H. D. House, July 22, 1913. *No. 5258.* A species, abundant on the coastal plain but one of the rare ferns of central New York.

5 ONONDAGA COUNTY

Achroanthes unifolia (Mx.) Raf.

Carpenter's pond. H. D. House. *No. 1347.*

Carex bebbii (Bailey) Britton

Carpenter's pond. H. D. House. *No. 1345.*

Carex cephaloidea Boott

Jamesville. H. D. House. *No. 1296.*

Carex filiformis Linn.

Carpenter's pond. H. D. House. *No. 1324.*

Carex sparganioides Muhl.

Jamesville. H. D. House. *No. 1293.*

Cythera bulbosa (Linn.) House

(Calypso borealis *Salisb.*)

One of the rarest of our native orchids, occurring in but few localities. It was discovered at Jordanville swamp, Herkimer county, by J. A. Paine, jr, in 1866, and collected there many years later by Dr J. V. Haberer; near Rome many years ago by Mr Bingham and near Otisco, Onondaga county, several years ago by Samuel Cole. The other Onondaga county station is or was Lodi swamp near Syracuse (House, *no. 1108,* 1905). The latter station is probably now obliterated by the encroaching manufacturing district, and with its passing, which is sincerely regretted by many botanists, disappears one of the most interesting localities, botanically known in the State. It was the home of many rare species, among them being:

Carex aurea *Nutt.*
Parnassia caroliniana *Michx.*
Lonicera oblongifolia *Goldie*
Galium tinctorium *Linn.*
Azalea nudiflora *Linn.*
Valeriana uliginosa (*T. & G.*) *Rydb.*
Viola lanceolata *Linn.*
Juniperus horizontalis *Moench.*
Triglochin palustris *Linn.*
" maritima *Linn.*
Cypripedium candidum *Muhl.*
Arethusa bulbosa *Linn.*
Liparis loeselii (*L.*) *Richards*
Cythera bulbosa (*Linn.*) *House*
Tofieldia palustris *Huds.*
Zygadenus chloranthus *Richards*
Lobelia kalmii *Linn.*
Pyrola americana *Sweet*
Linnaea americana *Forbes*

Campanula aparinoides Linn.

Carpenter's pond. H. D. House. *No. 1327.* Also at Green lake near Kirkville.

Ophrys convallarioides (Sw.) Wight

Carpenter's pond. H. D. House. *No. 1341.* Not reported by Mrs L. L. Goodrich in her list of Onondaga county plants.

Ophrys cordata Linn.

White lake near Jamesville and Manlius. H. D. House. *No. 1242.*

Eleocharis palustris vigens Bailey

Carpenter's pond. H. D. House. *No. 1326.*

Potamogeton amplifolius Tuckerm.

Carpenter's pond. H. D. House. *No. 1329*

Potamogeton zosteriaefolius Schum.

Carpenter's pond. H. D. House. *No. 1328.*

Puccinellia distans (L.) Parl.

Low shores of Onondaga lake, Salina. Dr J. V. Haberer, July 5, 1884. *No. 3301.* The range of this species in America is usually given as salt marshes and on ballast along the coast from Nova Scotia to Delaware. The Salina locality seems to be the only report of its occurrence inland. The species is not regarded as native to America, but there is apparently some doubt upon this point. Mrs L. L. Goodrich (Plants of Onondaga county, page 42, 1912) records Puccinellia maritima from the Salt marshes at Solvay in 1887.

6 SCHENECTADY COUNTY

The northwest side of Featherstone lake in the town of Duanesburg exhibits a wonderfully fine gradation from lake to bog and bog to woodland. The shallow water of the lake on the side toward the bog contains the following water-loving plants:

Castalia odorata (*Ait.*) *Woodville & Wood*
Nymphaea variegata (*Engelm.*) *G. S. Miller*
Brasenia schreberi *Gmel.*
Scirpus americanus *Pers.*
Pontederia cordata *L.*
Eriocaulon articulatum (*Huds.*) *Morong*
Potamogeton natans *L.*

Between the water and the woodland is a strip of sphagnum from 15 to 30 feet broad, which is the home of many characteristic bog plants, such as:

Drosera rotundifolia *L.*
Andromeda glaucophylla *Link.*
Menyanthes trifoliata *L.*
Oxycoccus macrocarpus (*Ait.*) *Pers.*
Eriophorum virginicum *L.*
Sarracenia purpurea *L.*

Limodorum tuberosum *L.*
Pogonia ophioglossioides *L.*
Carex paupercula *Michx.*
Kalmia polifolia *Wang.*
Chamaedaphne calyculata (*L.*) *Moench.*
Chiogenes hispidula (*L.*) *T. & G.*

Farther back from the edge of the water appear young spruces and tamaracks which merge abruptly into a dense stand in which the principal species are:

Picea mariana (*Mill.*) *B. S. P.*
Larix laricina (*DuRoi*) *Koch.*
Nemopanthus mucronata (*L.*) *Trel.*
Acer rubrum *L.*
Ilex verticillata (*L.*) *Gray*
Viburnum cassinoides *L.*
Alnus incana (*L.*) *Moench.*
Pinus strobus *L.*
Viburnum dentatum *L.*
Aronia nigra (*Willd.*) *Britton*
Ulmus americana *L.*
Sorbus americana *Marsh.*
Spiraea latifolia *Borkh.*
Viola pallens (*Banks*) *Brainerd*
Ribes glandulosum *Grauer*
Salix pedicellaris *Pursh*
Betula lutea *Michx. f.*
Fraxinus nigra *Marsh.*
Acer spicatum *Lam.*
Coptis trifoliata (*L.*) *Salisb.*
Mitella nuda *L.*

The opposite shores of this small pond are abrupt and rocky, thus presenting a striking contrast. The bog on the northwest side of the lake is in many respects similar to the numerous bogs and boggy lake borders farther west and northward in the State, and hence worthy of particular notice, representing, as it does, an outlying station of the typical northern bog flora and perhaps the only typical sphagnum bog in Schenectady county.

7 SUFFOLK COUNTY

Panicum wrightianum Scribn.

(Plate A.)

U. S. Dept. Agr., Div. Agrost., Bul. 11, p. 44. f. 4. 1898. Cuba (C. Wright, no. 3463, 1865). Type in the National Herbarium.

P. strictum Bosc.; R. & S. Syst. Veg. 2:447. 1817. Not R. Br. 1810.

Plate A

Panicum wrightianum Scribner (one-half natural size)
From the type specimen of Panicum deminutivum Peck

P. minutulum Desv. Opusc. 87. 1833. Not Gaud. 1826.
P. deminutivum Peck, N. Y. State Mus. Bul. 116, p. 27–28. 1907.

Moist or wet muddy soil. Shore of Little pond about 2.5 miles south of Wading River, Suffolk county. August. Type collected by Dr C. H. Peck, in the herbarium of the New York State Museum.

The range and habitat of this rare, diminutive Panicum is given by Hitchcock and Chase, as "along the margins of streams and ponds in sandy or mucky soil, southern New Jersey to Florida and west to Texas, also in Cuba." According to a recent communication from Professor Hitchcock, the northern range of this species is now known to be Cape Cod, and the identification of the type of Doctor Peck's Long Island species, Panicum deminutivum, as indentical, adds a New York locality to the known range of the species.

Fimbristylis castanea (Mx.) Wahl.

Orient Point. Roy Latham, September 20, 1909.

Acer tomentosum Desf.

(A. rubrum var. tridens *Wood*. A. microphyllum *Pax*)

A tree with smooth gray bark, small, subcoriaceous leaves, rounded or somewhat wedge-oblong in shape, three-lobed, 1½ to 2½ inches long and as broad or somewhat narrower, margins crenately toothed, deep green and lustrous above, white and tomentose beneath; petioles short; fruit resembling that of A. rubrum, but smaller and with broader wings.

By some authors referred to Acer carolinianum Walter, the description of which is too indefinite to distinguish it from A. rubrum.

Orient Point, Long Island, Roy Latham, Sept. 30, 1910.

Carex haydeni Dewey

(C. stricta var. decora *Bailey*. C. aperta *Carey*)

Collected at Islip, by C. H. Peck in May.

Anthemis tinctoria Linn.

Meadows, Orient Point. Roy Latham, June 24, 1912.

Aristida purpurascens Poir.

Orient Point. Roy Latham, September 30, 1912.

Crepis setosa Haller f.

Orient Point. Roy Latham, September 13, 1909.

Cyperus ferax Richards

Orient Point. Roy Latham, September 30, 1912.

Hypochaeris radicata Linn.

Orient Point. Roy Latham, July 22, 1910. Also collected at Cedarhurst, Nassau county, by G. D. Hulst, June 1897.

Ibidium praecox (Walt.) House

Salt marshes, Orient Point. Roy Latham, September 16, 1912.

Onopordum acanthium Linn.

Orient Point. Roy Latham, September 30, 1912.

Plantago decipiens Braneoud.

Orient Point. Roy Latham, August 1, 1909.

Plantago elongata Pursh.

Orient Point. Roy Latham, May 23, 1910.

Salix caprea Linn.

Roadsides, Orient Point. Roy Latham, May 23, 1910.

Cyperus grayii Torrey

Orient Point. Roy Latham, August 8 and October 3, 1910. Also collected several years ago at Coney Island by C. H. Peck. There is in the State Herbarium, in addition, a specimen collected many years ago on Long Island by Mr H. Young. New Jersey is usually given as the northern range of this species.

Plate B

Hypertrophy of the Arbor Vitae (one-fifth natural size)

AN ODD FORM OF HYPERTROPHY IN ARBOR VITAE

BY HOMER D. HOUSE

Plate B.

Hypertrophic growths on the trunks or limbs of trees in the form of burls, abnormal accretions, etc, are familiar sights to everyone who gives any attention to trees. Rarely, however, is there seen so remarkable a case of hypertrophy as is shown in the accompanying illustration, which was taken from an Arbor Vitae (Thuya occidentalis) in Canada, by Dr J. M. Clarke, Director of the State Museum.

Various causes are ascribed to hypertrophic growths, the most usual being:

a Injury to the inner bark or cambium resulting in a stimulated production of abnormal tissue, the abnormal growth once started continuing to produce successive layers about its core.

b Insect or fungus attack, stimulating the growing tissues into abnormal growth at or about the affected portions.

c Parasitic mistletoe attack, causing hypertrophy of the affected tissues.

Any of these causes might be suspected as the origin of certain malformations of wood and bark upon trees. In the absence, however, of definite evidence, which is the usual case, such growths might be due to other agencies, purely physiological in character, which might cause a disarrangement of the normal growth of the tissues. Practically all observations, however, seem to agree on the initial presence of some sort of injury, preceding the hypertrophic growth, evidence of which can sometimes be detected at the origin of the growth.

In the case of the hypertrophic growth here shown there is little evidence as to its cause. The grain of the wood within the trunk and beneath the seat of the growth is straight and normal. About 74 annual rings of growth (less than two inches of wood) intervene between the origin of the hypertrophic growth within the trunk and the present surface of the bark. A marked cup-shaped depression in the fiber of the trunk shows where the growth apparently originated, and it is evident that this abnormal growth on the outside of the trunk has obtained its present dimensions of over two feet in diameter within the last 75 years. Slight traces of decay only are apparent in the fiber of the trunk close to the central core of the hypertrophic growth:

Not the least curious feature of this growth is the character of the bark, which consists of a number of symmetrical pyramidal projections, small at the top and large at the base, which show by their even growth and adhering layers of bark a marked contrast to the thin, fibrous character of the normal bark of the arbor vitae.

CERTAIN FEATURES OF GERMAN FORESTRY

BY HOMER D. HOUSE

German forestry, perhaps because it is the most scientifically developed of any in Europe, has been for many years a source of deep interest and profitable study on the part of American students of forest management and utilization. There are those who predict for America, before many decades shall have passed, forestry conditions similar to those now existing in Germany. That we may in time develop in America a scientific as well as practical scheme of forestry, no one can doubt, but that it will in any way resemble German methods seems wholly improbable, unless we can make over our methods of taxation and administration of public lands. German forestry pays its way. Forestry is a sort of government trust in Germany. Without the connivance of the government it would no more pay to grow timber for any purpose other than for firewood in Germany than in the United States. Germany imports vast quantities of timber, but the duty is so adjusted that it is a paying proposition for the German states to invest money in long-time rotations of forest crops. With a high stumpage value, the owners of the German forests, either private or state, can afford to make a more complete utilization of all the products of the forest, can afford more careful methods in logging, and can afford the expense of replanting and protection. The entire expense is put where it belongs, that is, on everybody, because everybody is directly or indirectly a consumer of forest products. I wonder how many advocates of conservation of our forest resources in the United States realize that low tariff on imported timber means low stumpage values in our own forests and that low stumpage values mean waste and high speed in lumbering?

The German forests present an almost endless variety of conditions with respect to management and utilization, and the observant forester will find therein much food for thought in connection with forest conditions which prevail at home and he will discover therein many new ideas that will be of benefit to him in coping with American problems in forestry.

The following sketches are taken at random from my notes with a view of presenting characteristic and interesting methods of procedure in sylviculture, management and utilization, particularly of such ranges in the German forests as may well pay any student of forestry to visit who has the opportunity to travel.

1 THE PINERIES OF EBERSTADT NEAR DARMSTADT

The forest range of Eberstadt consists of both town and state (Hesse-Darmstadt) forests, some 2500 acres, under the direction of Geh. Forstrat Joseph, an elderly man of kindly and delightful personality. The activity of the state in buying up odd or unproductive strips of privately owned land has resulted in the same policy by the town of Eberstadt, so that there are few privately owned forests here. Natural seed regeneration of the Scotch pine, which is the principal tree here on the sandy plains of the Rhine valley, has not done well. This is in striking contrast to the pineries of Ysenburg, 20 miles north, where the luxuriant natural regeneration is depended upon almost wholly for reforestation.

The rotation at Eberstadt is approximately 120 years, at which time the larger trees attain an average diameter, breast high, of 12 to 16 inches. The cuts are made in winter and in the succeeding winter the ground is dug over to a depth of about 14 inches, the best soil of the forest floor being turned under and the poor sand from below placed on top. This will force the roots to go deeper for their food. In April, one year old seedlings of Scotch pine are planted, and between the rows, in May, potatoes will be cultivated. This method of "tongya" gets rid in a large measure of the weeds and soil fungi which might be harmful to the young pine, especially Hysterium pini. At the time of the logging operations there were left standing, in the majority of cases, about eight of the best trees to an acre, to run through the next rotation as "veterans." In addition to the increment yield of these trees, which takes place practically without injury to the growth of the next rotation, the price increment of these veterans rises from a stumpage value of under $40 to over $60 a thousand.

The cost an acre of reforestation at Eberstadt is:

To dig over the soil	$27.50
For plants and planting	10.50
For potatoes	4.00
For planting and cultivating potatoes	6.00
For weeding, paris-greening, etc	8.00
Making a total gross expense of	$56.00

About 1400 pine seedlings are planted to the acre and about 6 hundredweight of potatoes are used on each acre. The net returns from the potatoes usually average about $20 an acre, which leaves a net planting expense of $36 an acre. Adding this to the value of the land, which is here as high as $100 to $150 an acre, to obtain

Plate I

Various stages of Scotch pine regeneration as practised at Eberstadt

the amount of the original investment, and figuring at 6 per cent compound interest and including also taxation and protection, one can imagine that at the end of 120 years the value of the Scotch pine produced will scarcely yield a profitable return upon the investment, not even with the present high value of timber in Germany.

As the oberförster, however, is required by regulation to replant, the net planting expense of $36 is charged by him to the logging expense of the last rotation and the new growth starts with a clean bill of health, financially. It is burdened with only the soil value, taxation and protection expense upon the books; and the deduction of $36 from the receipts of the sale of timber does not seriously effect the profitable appearance of the forest accounts. In other words, the unique thing about this range is that merely by the method of bookkeeping the forest investment represented at Eberstadt is a profitable one instead of a loss, and the planting expense does not hang with its accruing interest as a burden upon the financial success of the next rotation, to be eliminated, possibly, only by the first or second thinnings.

Because of the abundance of rabbits and deer, all the young plantations must be fenced. Woven wire fences are necessary, for which the annual expense on this range of 2500 acres is $500, but the item does not appear in the planting expense. There is an annual revenue from hunting privileges of $2000, and here again the oberförster shows his keen business ability in keeping down the value of the investment by charging this fencing expense to the revenues received from hunting privileges, rather than to the cost of reforestation. As a result of all this the range yields an annual net revenue of something over 3 per cent. It must be borne in mind, however, that the gross receipts are very large and that the cause of the low net revenue which prevails in practically all German forests (rarely rising to 6 per cent) is due to the relatively high valuation placed upon the soil in estimating the value of the investment.

2 THE PINERIES OF YSENBURG

Ysenburg is situated on the level, sandy plain of the Rhine valley, a few miles south of Frankfurt. Three or four centuries ago the holdings of the princes of Ysenburg constituted one of the hundreds of small principalities of the old German empire. Napoleon reduced these to but a few in number and the Landgraf (now Grossherzog or Grand Duke) of Hesse-Darmstadt received dominion over Ysenburg. The princes, however, retained their land, if not their political importance, until they were forced, in order to satisfy their creditors, to sell out to the government in 1890 at a price of $300 an acre. Their forest lands embraced about 4000 acres within a solid boundary and the event was notable in being one of the few large sales of timber land in Germany. A few years later the state government sold a slice of this land containing 125 acres suitable for villa sites at a price of $3000 an acre, the stumpage not included. This strip is a fine stand of Scotch pine, bordering the macadam road leading west from the station of Ysenburg. It was seed planted on very poor sandy soil, some 70 years ago.

Some of the former princes of Ysenburg apparently realized the importance of careful forest management. The records of this particular forest show that in 1761 it consisted of decrepit beech and oak woods, the remnant of the primeval Rhine valley forest which was entirely oak and beech with no pine, the pine being introduced to reforest the drifting sand which followed the deforestation of the Rhine valley in many places a century and a half ago. These stands of Ysenburg in 1761 had been ruined by continuous cutting and pasturage. In 1762 regulations were promulgated which provided that:

The best oak and beech be conserved;
Restocking areas must be fenced against grazing;
Seed planting of conifers be made in blank places;
Cutting be done only in winter;
Use of wooden fences forbidden because of the threatened fuel famine (in 1762 observe!);
The villagers ordered to plant willow and alder along their streams;
Only invalids allowed to keep goats by grace of a medical certificate.

At that time one-third of the land was without timber and regeneration failed continuously because of mice, drought, insects, late frosts, etc. The annual production between 1762 and 1784 was one-eighth of a cord an acre, which shows how extremely decrepit these forests must have been.

Today the pineries of Ysenburg are among the finest and yield about the highest net revenue of any in the Rhine valley. The method used to secure regeneration is totally unlike that employed at Eberstadt and yet the type of soil seems about the same. When the pines are about 80 years old and about 10 inches in diameter, cuttings (seed cuttings and preparatory cuttings) are made in such a way as to open up the crown. There results a luxuriant natural regeneration which indicates that there must be more fertility present than in the soil of the Eberstadt pineries. When this regeneration underneath the old stand is well established a heavy, final cut is made, leaving only a few trees to the acre to run through the next rotation as " veterans." The regeneration at this time is particularly thick, estimated to consist of fully 30,000 young trees to the acre and forming almost impenetrable thickets. In the resulting struggle among these 30,000 seedlings for dominance, clean and slender boles result. In taking out the final cut, naturally considerable damage is done to the young stand, but it is surprising how quickly these gaps close up even where no planting is done to " doctor " them up. The German forester dislikes to see a vacant patch of ground in the woods and usually plants something there immediately, although in many cases it is unnecessary and the results of his planting may be choked to death by the rapidity of the growth of the surrounding forest.

Conditions sometimes get the best of even the German forester, for in some compartments either too much delay has been exercised in making the final cut or the regeneration came faster than was expected, for it is so high and dense that irreparable damage will result when the final cut is made. Young trees can stand much abuse, but not when they are 15 feet tall. The last cut before the final one leaves about 75 fine standards to the acre, so that the regeneration takes place by no means under conditions that could be called " open."

All compartments, however, of the Ysenburg range are not so fine as the ones described above and which happen to be the ones nearest to the station. Some compartments are very poor and the pines are porcupinelike and scattered, having suffered from unusually sterile soil, mice, grubs, and other enemies. The white pine, where used under these conditions, seems to be making a better showing than the Scotch pine, but the expense of replacing the Scotch pine by white pine is high and out of keeping with any results that will be obtained for a long time to come.

A particular compartment at Ysenburg has been given over for many years to the experiment upon Borgrave's method of thinning. Thinnings, properly speaking, are for the purpose of reducing the investment or for the improvement of the remaining stand, and if a regeneration results it is merely incidental. Seed cuttings and preparatory cuttings (often miscalled thinnings in the United States) are for the purpose of regeneration, absolutely and only, and are not properly to be called thinnings, but cuttings.

Borgrave would take out one-fourth of the volume in one-seventh of the trees every ten years. By this means he would reduce the investment and extend the rotation. The obvious advantages are: the reduction of the investment; greater remunerativeness of the cuttings; the rotation is extended perhaps 200 years; sylvicultural charges are reduced to a minimum; the smaller trees left are cleanest and will produce constantly better and better logs.

On the other hand is the fact that he takes the trees nearest the saw-log size and which will have the greatest price increment in the next few years. He cuts away the money makers, for these large trees (one-seventh of the total number) will furnish 90 per cent of the increment if left. If gaps result, some of the possible increment of the next largest trees will escape, weeds will result and the soil run wild.

Under conditions as they existed in Germany a few years ago, his method had, from a financial standpoint, much to recommend it, and it happens that at Ysenburg even now the difference between the price of saw logs and mine props is not very great. As the Scotch pine, however, sold at an average of $6 a thousand twenty years ago and sells for $14 today (on the stump), few German foresters are anxious to reduce their investment, so that Borgrave's system, pure and simple, as is being carried out here to its logical end as a matter of experiment, is not apt to be seen elsewhere, although the influence of his reasoning is frequently to be noted in the system of management practised in many places.

Another small compartment of the Ysenburg range shows that the German forester, like all of us, sometimes makes sad mistakes. Oak and Scotch pine in alternating rows, fully 5 feet apart, were planted by the "Tongya"[1] method 35 years ago. They wanted oak, and the pine was meant to be merely an usher growth to protect the oak against the frost, which is bad here (the frost level being 9 to 10 feet above the level of the soil), and expected to cut out the pine as the oak gained a position of independence. Today the oaks are nearly gone, having been choked out by the pine in spite of attempts to favor the oak by lopping off many of the pines. As they are 10 feet apart, they look today like a thicket of Appalachian scrub pine.

The oberförster has also been troubled severely in some compartments by the work of the cutworm upon young plantations, but he

[1] *Tongya:* a term introduced by Schlich, indicating the cultivation of potatoes, beans etc., between the rows of young trees for two or three seasons to aid the growth of the trees and help offset the expense of planting and weeding.

Plate 2

A primeval oak on the Mittledick range near Ysenburg, which measures 52 inches in diameter 6 feet above the ground

Plate 3

Advanced growth of beech artificially induced under Scotch pine in the city forest of Darmstadt

noticed that this damage was always slight, for some unknown reason, in the vicinity of mature stands. He has largely obliterated that damage by making his cuttings in strips from 75 to 100 feet in width, leaving stands more or less mature upon either side, until the planted strip has attained a safe size. These strips, in various stages of development, present a curious appearance, and they are of course on soils that will not yield the luxuriant natural regeneration that obtains in the compartments nearest the Ysenburg station. Under such impoverished soil conditions, the oberförester may eventually be forced to adopt the expensive method in vogue at Eberstadt.

At Ysenburg is one of the few, if not the only one, of the strictly forest railroads in Germany. It consists of a narrow gauge line running from Ysenburg down through the Mitteldick range to the river Main. Its poor success is evidence of the uselessness of railroad transportation in a large range where the woods products go out in many different directions and which is traversed by excellent stone roads, as are the Ysenburg and Mitteldick ranges which adjoin.

3 MITTELDICK FORESTS

The Mitteldick range adjoins the Ysenburg ranges on the west and was, originally, under the dominion of the princes of Ysenburg, but is now a state (Hesse-Darmstadt) forest. The Scotch pine stands here are similar in every respect to those described on the Ysenburg range. The object of particular interest on this range are the oak stands; remnants of the primeval Rhine valley forests. They are maintained today in the form of "shelterwood group types of regeneration." The groups are particularly dense and thicketlike, and form an interesting sight, always highest in the middle, and spreading toward each other as the seed years and soil conditions allow. Forstmeister Hillerich aims to join these groups at a time when he shall have finished cutting out the remaining 15 to 20 old oaks for each acre of the original stand. All stages are to be seen from the beginning of tiny groups in the openings of the medium aged oak forests to large masses of groups now fully united and from which the last of the old oaks have been removed.

Where the shelterwood group method of regeneration has not been a success, and it is not always a success because of unfavorable soil conditions in some places, the Forstmeister has resorted to other means of securing an oak stand. One large strip was planted, 16 years ago, to oak acorns, very densely; and it appears that this method is particularly successful just here, and would seem to be preferable and cheaper than waiting for the uncertain and slow shelterwood method.

On other compartments of the Mitteldick range the growth of oak has been induced under pine standards, about 120 years old. The pines are fine, but the oak is generally crooked in spite of its relative density. It is planned gradually to remove the pines, which number about 20 to the acre, and see if the oak improves in quality.

The German forester as a rule loves beech, which is in youth a shade-loving species, and one finds a great variety of methods by which the beech is utilized in German sylviculture. The German forester calls the beech the "mother of the soil," possibly because it forms an alkaline litter instead of an acid litter as results from the fall of the oak foliage. At Mitteldick is to be seen several methods of handling beech growth, two of which are rather noteworthy. In certain compartments an abundance of beech seeds have been sown in drills or furrows beneath rather dense stands of Scotch pine about 60 years old. The result is rather startling to the American accustomed only to seeing our native forests of pine or spruce with only a scanty undergrowth. A dense thicket of beech springs up, almost impenetrable in places, and wherever gaps occur in the forest crown overhead or where cuttings are made the beech rapidly assumes the dominant position, but under the thicker pines it remains in suppression for many years, in this respect not unlike the spruce. A similar management of beech is to be seen in the Darmstadt city forests (plate 3) and in other ranges of the Rhine valley.

Another compartment of mixed oak, beech, hornbeam, and other hardwoods had been likewise underplanted with beech seeds in furrows, and after an interval of about three years, at which time I saw the compartment under a light coat of snow (plate 4), it looked not unlike a vast collection of nursery beds containing tiny beeches all about of a size. Such operations must naturally follow good seed years.

4 THE FRANKFURT TOWN FORESTS

The Frankfurt town forests adjoin the Ysenburg and Mitteldick ranges on the north and are therefore most easily reached from Ysenburg station. The line separating these ranges is also the boundary here between Prussia and Hesse-Darmstadt, so that the effects of radically different forest administrations can be seen on

Plate 4

Beech seedlings under Scotch pine at Mittledick. Following a good seed year of the beech, the ground was broken up here and sown thickly to beech seeds, which had been gathered on another part of the range.

Plate 5

Products (ties, slabs, cordwood and fagots) of thinning operations in the pineries of the Rhine valley

Plate 6

Stand of American white pine in the Frankfurt town forest, containing 35,000 board feet to the acre, 60 years old. Originally planted with oak and spruce. Only a few spruce are left and no oak. As a result, the white pine has not produced very clean timber, but the stand is valuable for the seed produced from it.

these adjoining ranges. Like the former ranges, most of the Frankfurt range lies in the frost dells of the Rhine valley, but within short distances there is much diversity in the quality of the soil, and in consequence a corresponding diversity of stands.

Along a small stream close to the suburban villa colony of Neu-Ysenburg is a stand of hardwoods which contains some fine alders up to 2 feet in diameter, not very straight but about the best seen anywhere in Germany. This stand also contains some excellent maple, ash, basswood, hornbeam, oak and beech. The hornbeam logs sell, in the woods, on the ground, for $35 a thousand feet, board measure, and are used in the manufacture of waterwheel cogs. The oak, which is here of fair quality, brings $31 a thousand feet for ties and veneers. The best veneer logs of oak in this compartment were about 24 inches in diameter and contained about 350 board feet, on the average, and sold at auction there in the woods for about $82 each.

A mixed hardwood forest of this type is the best place to see the attention to detail and order which the German forester brings to his operations (plate 5). The firewood resulting from the trunks and limbs of the trees unsuitable for timber, is piled into neat cubic meter piles of split oak, split maple, split alder, round oak, round maple, etc. The smaller and more crooked branchwood and rootwood of each species is also piled separately, and for each and every one of these " grades " of firewood the forest administration receives a different price. The small limbs and twigs are also gathered up and tied into bundles which are sold for a small sum, but apparently not at a profit. That genius is an infinite capacity for taking pains finds here a visible demonstration in forestry.

The Frankfurt town forests also contain an interesting stand of American white pine (plate 6), about 60 years old. It was originally made with alternating rows of spruce and oak. The oak is now nowhere to be seen, and the spruce has survived only in part. The white pine having dominated the situation from the start is very branchy and unfit for a high grade of lumber, and yet the revenue from this stand is very large, but from the sale of cones to seed establishments rather than from timber. The pines number about 150 to the acre, and spruce less than half as many, out of an original 1500 pines and spruce to the acre. The total sectional area of the white pine alone is 153.6 square feet, which with a form height of 150 means a stand of 35,000 board feet to the acre. This is far from being the best stand of white pine in this part of

Germany but it is of particular interest as showing the results of mistaken ideas in regard to the management of white pine with spruce and oak, mistakes which are not being repeated in later plantation of white pine throughout this part of Germany. The yield of cones for seeds alone saves the plantation from being a complete failure and from having been removed long ago.

Several compartments of the Frankfurt woods still maintain the stands of beech with oak and other hardwoods which comprised the primeval timber of this region. The beech is about 120 years old and about the best, considering the large acreage devoted to it, to be seen anywhere in the Rhine valley. In the depressions (frost dells) alone are there any signs that the beech is not vigorous, and there the abundance of hornbeam makes up for it. Underlying limestone, close to the surface, probably accounts to a large extent for the good growth of these hardwoods upon a surface soil which seems unusually sterile. The German forester judges the fertility of the soil largely by the relative growth of wild grasses thereon, and in most cases that appears to be an excellent index of the quality of the soil.

Not the least interesting feature of the Frankfurt forests is the existence here of the oldest artificially planted stand of Scotch pine in Germany. This stand is now a little over 200 years old and looks wonderfully fine. There are about 60 trees to the acre, averaging over 20 inches in diameter, and some are as thick as 36 inches, breast high. A single tree recently cut, contained 4100 board feet of lumber. In 1876 a violent wind storm took down many of the trees and since then the previously suppressed beech and hornbeam have made a vigorous growth which shows that nature without aid will not reproduce the Scotch pine where it is not native. Only by carefully opening up the crowns, as practised on the Ysenburg range, can a pine regeneration be induced. A sudden and large opening of the crowns brings on the hardwoods again as in the primeval type. The old pines, as a result of the storm, all lean toward the northeast. The stand contains from 25,000 to 30,000 feet an acre, which is good considering the relatively few trees per acre and the large quantity which has been removed in the past according to the records of this department. The remaining stand will produce lumber of an exceptionally high grade. From the logs upon the ground it was impossible to determine their form height, but it certainly exceeded 200.

From observations previously noted in connection with oak planted

Plate 7

Lindenfels in the Odenwald, showing the complete utilization of all of the land. Lindenfels is situated upon an elbow of the hills some 500 feet above the main valley so that this view does not indicate the extreme hilliness of the region.

Plate 8

A stand of spruce on the "Throm," one of the high summits of the Odenwald north of the little town of Wald-Michelbach

with pine on the Ysenburg range and in the Frankfurt forests one might suppose that oak is usually a failure here, but such is not the case. Above the frost dells it succeeds very well, and indeed, the primeval forests of this region contained some of the largest and finest oaks of the world, a few of which are still to be seen on the Mittledick range. The Frankfurt forest contains a plantation of oak, nearly 100 years old, with subservient natural undergrowth of beech and hornbeam which looks as good as any of the natural regeneration of oak seen in the Spessarts, so famous for its oaks. Here in the Rhine valley, however, the beech shows a tendency to become the dominant tree if not held in check. This stand of oak contains, including the beech, some of which are of merchantable size, 19,000 board feet to the acre.

The annual net revenue of the Frankfurt town forests is $16 a hectare, or about $6.50 an acre, in spite of the fact that many a sacrifice is made for landscape and recreation purposes.

5 THE ODENWALD

The Odenwald (plate 7) is a hilly or semimountainous region of considerable extent lying east of the Rhine valley and north of the Neckar river and Heidelberg. The underlying formation is granite at lower elevations and chiefly sandstone at the highest elevations, a factor which, taken in connection with the absence of limestone, has played a very important part in the development of forestry in some parts of the Odenwald.

The deep, broad valleys of the Odenwald are devoted largely to agriculture, while the steepest slopes and higher summits are given over to forests. The primeval growth of this region was entirely hardwoods, but the region is rapidly changing in aspect as the extensive planting of conifers (spruce, fir and pine) which has been going on for the past hundred years begins to dominate the landscape (plate 8).

Out of the many interesting ranges in the Odenwald it would be hard to pick any one which is typical of the whole region. Each range, in which some particular policy has been carried out for a long term of years, presents features peculiarly different from every other range.

The policy of the state has been to acquire by purchase the small woodlands belonging to the farmers. The latter, however, finding the raising of Christmas trees remunerative, are not anxious to sell, and it is quite curious that within the state of Hesse, which includes the northern part of the Odenwald, the government is buying woodlands at a minimum price of $360 an acre, while in the adjoining grand duchy of Baden, where the state is not so eager to acquire private holdings, there is paid not over $120 an acre for woodlands, under otherwise equal conditions.

The growth of white pine is particularly good everywhere in the Odenwald, and on the better classes of soil and on northern slopes some very successful results have been obtained with hickory, black walnut, red oak and other foreign hardwoods. Beautiful pole-woods of silver fir and spruce are seen everywhere and Scotch pine is not uncommon. On good soils, however, it is usually the policy to make every effort to retain and build up the mixed hardwood stands of oak, ash, maple, basswood and cherry.

One of the interesting ranges of the Odenwald forests is that of Affoltenbach, under the administration of Forstmeister Strack, consisting of about 8000 acres, one-half being state forests, and the other half communal forests, owned by ten different towns and hamlets. That of Affoltenbach contains about 1000 acres, and the sale of material is conducted by the town council or by the Bürgermeister.

By 1870 the price of oak tan bark had reached such a high figure that many towns were tempted to convert their forests into coppice, which yielded large returns in short rotations. By 1885 the price of oak tan bark had declined to an unprofitable figure and these towns were confronted with the problem of reconverting their practically valueless coppice into "seed" or "high forests." The poverty of the soil and the aggressive growth of heather (Calluna vulgaris) in the coppice forests have made this a very difficult and slow as well as expensive process. Here can be seen as nowhere else the relative ability of different tree species to conquer the heather, for they have tried almost every conceivable combination to overcome its aggressive growth.

Prior to the oak coppice forests, heather was not a serious menace in the forests of this range, and the factors which have brought about its domination of the soil, while they could not have been anticipated at that time, are now well enough understood. The best explanation of this ecological condition which we have in English is F. V. Coville's investigations on upland heather soil. He found that oak leaves do not only decay very slightly but that they are decidedly acid in reaction even when two or three years old. In these forests of the Affoltenbach range the introduction of the coppice system permitted much sunlight to reach the litter upon the

Plate 9

Redwood (*Sequoia washingtoniana*) and Douglas fir (*Pseudotsuga taxifolia*) in the arboretum of Count von Bergheim at Weinheim in northern Baden

ground, which retarded more than ever the natural course of decay with the result that an acid litter developed which favored the enormous development of heather which is now troubling the foresters in many places. The absence of any limestone in the rock formations of the region, which might serve as a source of possible neutralization of the acid litter, has produced conditions upon the introduction of the oak coppice system not unlike the upland heather character of much of the southern Appalachian soils.

Spruce is the species most desired just now, by reason of its comparatively high value and wide range of utilization, but it has a slow initial growth and nowhere has it conquered the heather unaided by man, to any marked degree. In some places where the heather is not too dense the spruce is slowly forging ahead, but the process is slow and thus expensive, and these tracts will yield no returns for a long time to come. On a small experimental tract of one-fourth acre, with spruce 15 years old, and their tops, or some of them, barely showing above the dense mat of heather, the oberförster has grubbed out the stems and roots of the heather, obtaining the enormous quantity of a dozen large loads of the dried heather. This was done to see if it would give the spruce a chance to get well ahead of the heather before it completely dominates the soil again. Shade is fatal to the heather but it is difficult for any species unaided to reach a height where it will overshade the heather.

White pine alone shows any marked ability to overcome the heather by its rapid height growth and the heavy humus which it speedily forms and which seems to choke the heather out of existence without much aid from the foresters in charge. Even where there is left for the heather under the white pine some overhead light the thin layer of needles cast over the heather seems fatal to its growth, and it is soon replaced by a smooth carpet of pine needles. On the other hand the white pine will not yield any considerable returns by thinnings and is considered too weak for poles and mine props and too soft for firewood. In fact these are probably the principal reasons why white pine is not more extensively planted in many other places abroad. In the case of the Affoltenbach range the foresters in charge plan to get rid of the heather by means of the white pine and then to replace that by more desirable species.

In the small hamlets of the vicinity some characteristic home industries which depend upon the forests are to be observed. Handmade split oak shingles are still used to a large extent for roofs and sides of houses. The villager buys his oak logs from the state or communal forest, paying about $50 a thousand feet for good grade material. He dissects the logs into suitable lengths and then splits them by hand with a sharp, straight blade to which is attached at right angles a wooden handle. The work is facilitated by the use of a heavy beech mallet. The villager engaged in this occupation sells the shingles for $8.10 a thousand shingles 3 by 10 inches, and can cut about 700 shingles a day. It is claimed by them that they can cut 4500 shingles from 36 cubic feet of oak, which would be equivalent to 1000 shingles from every 50 feet board measure. One may well doubt this unless the material is uniformly perfect, which did not seem to be always the case. Five hundred shingles from every 50 feet board measure seems a better estimate, but even at this they make excellent returns if they are able to cut 700 shingles a day.

Another home industry is the manufacture of split hoops. Thinnings of oak, beech, hazel etc., three-fourths of an inch to an inch in diameter and 6 feet long, are used, being purchased by the villager from the forest for about $2.25 a cord, the price varying slightly according to the species and quality. The strips are steamed and then split into halves by the use of a draw shave, tied into bundles containing 600 linear feet each and sold for an average price of 50 cents each. They are used very largely for boxes and slack cooperage. The refuse and cut ends supply the family with fuel. The manufacture of these hoops, while on a small scale, is profitable as a side issue to these agricultural people.

A visit to the Odenwald region is scarcely complete without seeing the arboretum on the private estate of the Count von Bergheim at Weinheim, the northernmost town of Baden. The climate of most of Europe, and in particular that of the Rhine valley, seems to be especially adapted to the growth of the Pacific coast conifers. Many forest gardens and botanic gardens of Europe contain a large variety of trees but none of them have so many foreign trees in large sized plantations as in the estate of Count von Bergheim. These steep hillsides were at one time devoted largely to vineyards, but about 60 years ago the cultivation of the grape was considered a failure here, either from changes in the climate or soil, so that the vineyards were abandoned and the estate planted to trees, in small compartments from one-eighth to one-fourth of an acre each. On each compartment was planted a different species, and in some cases a mixture was used, as, for example, with the Sequoia washingtoniana (plate 9) was planted Douglas fir (Pseudotsuga taxifolia). The largest of the redwoods are now 30 inches in diameter and bear an abundance of cones nearly every year. According to information from an employee of Conrad Apple's seed firm in Darmstadt, the seeds from these redwoods possess less than 4 per cent of germination. As producers of timber, most of the American conifers in cultivation on this estate must be regarded as failures, not because of slow growth, for most of them have made phenomenal growth in the past 60 years, but because they were planted too far apart and are covered with branches nearly to the ground in addition to possessing more than the usual taper at the base.

On this estate are to be seen some fine plantations which, aside from the faults noted above, give an excellent idea of the wide range of species which can be grown in the climate of the Rhine valley. They include:

Pinus monticola *Dougl.*
" lambertiana *Dougl.*
" ponderosa *Laws.*
" jeffreyi *" Ore. Com."*
" austriaca *Hőss.*
Picea sitchensis (*Bong.*) *Trautv. & Mayer*
Abies concolor (*Gord.*) *Parry*
" cephalonica *Lond.*
" pinsapo *Boiss.*
Tsuga heterophylla (*Raf.*) *Sarg.*
Pseudotsuga taxifolia (*Lam.*) *Britt.*
Sequoia washingtoniana (*Winsl.*) *Sudw.*
Libocedrus decurrens *Torr.*
Thuya plicata *Don*
Chamaecyparis lawsoniana (*Murr.*) *Parl.*
" nootkatensis (*Lamb.*) *Spach.*
Tumion californicum (*Torr.*) *Greene*

Many other trees are represented by groups or scattered individuals. While most of the species are American, there is a good representation of oriental and Japanese conifers. The coast redwood (Sequoia sempervirens (Lamb.) Endl.) would hardly be expected to succeed in Germany, in spite of which fact there is a clump of half a dozen trees in a sheltered situation at Weinheim which might be said to be existing, as they show little vigor and some have died. The largest one has produced a few cones.

6 TRIPPSTATT IN THE PALATINATE

The Palatinate is a beautiful rolling country west of Mannheim and the Rhine and belongs to Bavaria. The eastern portion is chiefly agricultural while the western portions are semimountainous and densely wooded. Trippstatt is reached by carriage from Kaiserslautern, which in turn is about two hours train ride west from Worms.

At Trippstatt the underlying rock is soft, red sandstone of Triassic origin, and the soil, except the alluvial flats, is of a reddish color and contains a large amount of clay. The region was originally covered with a hardwood forest and the pine, spruce, fir and larch, now perfectly at home and very abundant, are all introductions.

The Trippstatt range consists of about 10,000 acres, half of which is under the direct management of the forstmeister and the other half under the management of the forstassessor. Many years ago this range was the private property of the Hache family, which constituted one of the countless little principalities similar to the princes of Ysenburg. The highways in the Palatinate are built and maintained by the forest department, a fact which doubtless results in a serious lowering of the net revenues. The roads around Trippstatt were constructed by the Tellfort method and the complete cost was about $5000 a mile. Having charge of the roadways, the forest department secures some advantages in return by placing many of their little tree nurseries along the roads. A beautiful valley, traversed by a winding macadam road, leads from Kaiserslautern up to Trippstatt, and along this road there occurred a few years ago one of the few forest fires of recent years. Some fifteen acres were burned over and it is said that only a change of wind prevented the fire from doing greater damage. The growth was beech with clumps of spruce. Curiously enough, it appears as if many of the clumps of spruce escaped destruction because they had conserved enough moisture in the soil to check the intensity of the ground fire, while the beech were entirely killed.

On the summits of the hills the soil is very poor. Here are some quite interesting stands of beech fully 100 years old, the trees small, crooked and far apart, while close by are artificial stands of white pine 25 years old, in rows, already with an average diameter of 6 inches and truly fine in appearance. In fact, the excellent appearance of the coniferous stands here, whether pure or mixed, of even or of uneven age, in contrast to the native growth is most surprising.

Trippstatt, however, has other points of greater interest to the forester than these old stands of beech. There is located here a Scotch pine experimental garden, where were raised from seed, in the same nursery, planted on the same day, and transferred to the garden and outplanted in rows the same distance apart and on uniform soil, Scotch pine from Hungarian seed, French seed, Belgian seed, Finnish seed and native Pfalzian seed. The experiment is now twelve years old and may be briefly summarized as follows:

The Hungarian pines show many failures, a heavy death rate, many of wolfy, unsymmetrical and uneven rate of growth, frequent loss of top shoots, not uniform, unhealthy in color, averaging slightly over 3 feet in height.

The French pines are darker in color and more healthy in appearance, but show, nevertheless, many failures and a strong inclination to grow wolfy and unsymmetrical. They average about 5 feet in height.

The Belgian pines form a stand particularly dense and in which there are practically no failures. The trees are now 11 to 13 feet tall and have fully conquered the soil. A carpet of needles has begun to form beneath them and they are self-pruning their lower branches. This stand is the darkest green of all.

The Pfalzian pines, from seed gathered nearby, average about 11 or 12 feet in height, with very little death rate, are dark green and healthy, but owing to the vigor of growth there has been a little snowbreak. They seem to differ in no important particular from the Belgian trees unless they are a little more symmetrical and slightly shorter.

The Finnish pines are of a uniform light yellow color, averaging about 4 feet in height with considerable death rate. The needles are short and the whole appearance of the stand indicates slow yet uniform and symmetrical growth, which are the features to be expected from pines coming from a region with so short a growing season as Finland.

The results of this interesting experiment are already forecasted, and they show that seed for forest planting should come from a source with a climate, at least, similar to that in which the seeds are to be grown, especially if it be a species with as wide a climatic range as the Scotch pine.

Future visitors to this range will also be interested in the experiments recently started with seed from (1) crooked, (2) wolfy, (3) symmetrical mature, and (4) young trees, to determine whether the parentage has any influence on the progeny in the transmission of such characters as crookedness, unsymmetrical growth, vigor etc.

Fully as interesting as these experiments, especially to the American visitor, is the famous Hacke stand of white pine 120 years old, the first made in Germany for forest purposes. These stands are upon abandoned pastures. The Baron von Hacke was an officer in the Hessian regiments under George III, and after the American Revolution returned to his impoverished soil bringing with him a quantity of white pine seed. The trees of the original stand average today 32 inches in diameter, breast high, and finer white pines are not now often seen in our own land. Up to 30 years ago the abundant regeneration was not preserved, but since that time, under a different forest management, the natural stands have been preserved and look as thrifty as those so frequently seen upon abandoned fields in New England.

At the head of a picturesque ravine near the village of Trippstatt, the forestry associations of the Palatinate, Alsace, and Lorraine have erected a tablet commemorating the introduction of white pine by Baron von Hacke. From a window of the Hacke baronial mansion, a fine old standstone structure, there is obtained a beautiful view overlooking a small valley in which there were at one time iron mines and furnaces and above which looms some old castle ruins dating back into the middle ages. With this view before him, Schiller is said to have composed the poem, "Der Gang nach dem Eisenhammer," in 1797, upon the occasion of a visit. The old baronial mansion is now devoted to the uses of a forest ranger school where boys are educated along general and technical lines beginning at the age of 14 years. For its purpose it is well equipped, containing excellent mineral and geological collections, wood specimens, fungi, stuffed birds, insects etc.

The following table shows the prices which were received for cut timber on the ground in the woods at Trippstatt. It will be noticed that white pine here, as elsewhere in Germany, commands a high price only when the logs will produce a very high grade of lumber. For mine props, pulp, poles and firewood the white pine is not highly esteemed.

GRADES	1	2	3	4	SPECIES
Price in dollars per 1000 feet b. m.	25	20	15	......	Scotch pine
	27	22	19	11	Spruce
	26	20	17	11	Fir
	30	23	19	12	Larch
	45	26	16	9	White pine
Diameter in inches...	12 and up	8 to 12	6 to 8	5 to 6	

Plate 10

The Saxony Forest Academy at Tharandt

7 THE THARANDT FOREST ACADEMY

Tharandt is about 30 minutes ride on the cars from the central station of Dresden and well repays a visit by one interested in forestry education. The school is purely technical and is not attached to any university, but is under the direction of the forest department of Saxony. The equipment is excellent in every way and especially fine is the instruction and equipment of the departments of surveying and sylviculture. Well equipped also are the physical and chemical laboratories. The history of the Tharandt school is inseparably associated with the name of Heinrich Cotta, who died here in 1844 and is buried in the forest garden above the valley surrounded by 80 oaks planted there by his pupils prior to his death.

The forest garden at Tharandt is a sort of arboretum and is interesting on account of the fairly large number of foreign trees of large size which it contains. It is not a "made" or refilled garden and has in consequence several varieties of soil and exposure. For the most part the specimens are well labeled, but occasionally one sees some errors which are not unexpected in a large garden with a small staff and a head gardener better trained in the care and raising of trees than in their nomenclature. The Garden also contains a small museum filled with various dendrological curiosities. The history of the garden dates back to the beginning of the nineteenth century, but most of the American and Asiatic species are of comparatively recent introduction.

Adjacent to the forest garden are several hundred acres of forest under the direction of the school and in which the students find their practical demonstrations. The original working plans were made by Cotta in 1811, who laid out the compartment lines in rectangles, not a very convenient method for such a hilly range. More recently there has been a reestablishment of roads and lines which meander according to the topography so as to facilitate the separation of the cove forests from the plateau forests and to facilitate forest transportation. The plateau forest of the school range consists almost entirely of spruce, the best stands of which are about 110 years old and contain some 105 cords to the acre.

Among certain introduced species for forest planting they have tried Douglas fir mixed with spruce. A 25 year old stand of this sort shows considerable injury to the fir from heavy snow.

8 SCHWARZENBERG IN SAXONY AND VICINITY

The town of Schwarzenberg, like many of the towns in the more hilly or semimountainous parts of Saxony on the northern edge of the Erzgebirge, has shown a wonderful industrial development within very recent years and a consequent increase in population. The city of Lauter increased in population from 5000 to 15,000 in fifteen years.

The forest range about Lauter is under the charge of Oberförster Dittmann. Another home industry, quite as interesting as those seen in the Odenwald, is carried on to a large extent in this vicinity. This is the making of split spruce baskets. The only tool used is a strong-handled knife with which the villager splits the wood with the medullary rays, for strong pieces, or with the annual rings, for finer pieces. The smallness and uniformity with which spruce can be split with a sharp knife is truly remarkable. The bottom of the basket is first made out of thin strips and then the sides are constructed. At the top are used strips specially prepared for bending by drawing them between a wheel and a round billet of wood, in one direction only. The baskets are very light and measure about 4 feet by 4 feet by 3 feet deep, and sell for 18 to 25 cents each. They eventually find their way for the most part to dealers who ship in them straw hats, flowers, plants etc. The children of the family are taught this trade from earliest youth, but it appears that the main profit in this as in the beautiful lace made by the women of this region goes to the dealer or middleman. The spruce logs used in the home basket industry cost, delivered to the house, about $38 a thousand feet board measure. Different families produce baskets of different sizes and quality, some of which sell as low as 3 cents.

The city of Lauter owns about 6000 acres of land upon which the growing stock of timber has increased from 54,000 cords in 1847 on one district to over 100,000 cords today. The other district of the city forests shows even a greater increase.

On the hills above Lauter is the forest known as "Burkhardtswald," facing the factories at Aue and Lauter. The rapid development of the industries at these places and especially the metal-ware industry, has played sad havoc in these woodlands. The former owners (city of Zwickau) took no protective measures but brought suit against the state of Saxony, which is part owner of certain dye and metal-ware works in the valley below and which was held responsible in a large measure for the destruction of the forests

Plate 11

A Black Forest stand of spruce which contains upward of 60,000 board feet to the acre. No preparatory cuts have been made as yet which accounts for the entire absence of undergrowth.

Plate 12

A Black Forest stand of spruce showing the luxuriant advanced growth following the preparatory cuts made some ten years previously. The stand is now ready to be cut clean and the next rotation of trees is already well started.

by fumes and gases issuing from their chimneys. The state of Saxony, in order to avoid further litigation, bought the tract in 1900 for $125 an acre.

All sorts of experiments have been tried here to secure a forest growth which will not be killed by the fumes. The spruce is suffering badly all around here from the work of a weevil, so much so, that in one fine pole-wood seven out of every ten trees had been removed for this cause alone. Of mixed plantations of conifers and hardwoods it appears that here the native birch (Betula pendula) is most resistant to the fumes, that Japanese larch does better than the German larch, that Scotch pine and Jack pine are more resistant than white pine.

The Antonsthal range, for nearly a quarter of a century in charge of Oberförster Gleier, is reached by a short train ride from Schwarzenberg. Like most of the Saxon Erzgebirge, the slopes are steep and the soil, except in the bottoms, thin and sterile. It is rare to find any regeneration of spruce or fir from self-sown seeds, although considerable effort has been made to bring about that result. Replanting with 3 year old spruce is the common practice. The spruce are raised in shifting nurseries close to where they will be outplanted. Transplanting of the spruce before outplanting is apparently not practised.

The forests of this region reflect the character of the recent economic development of this part of Saxony. The abundant water power has encouraged the development of paper pulp mills, with a corresponding demand for spruce pulp wood. The result has been a rapid transformation of the old stands of large sized spruce and fir into spruce forests of short rotations, of 35 to 45 years. This means a smaller investment and a correspondingly higher net revenue. The pulp mills, of which there are several in the vicinity of Antonsthal, derive their supply of pulp wood from the home range or from Bohemia by rail.

The Breitenbrunn range, in charge of Oberförster Thomas, adjoins the Antonsthal range and presents about the same features. Spruce is the prevalent species everywhere except upon a few more fertile spots where ash, maple and beech are planted. In 1908 this range was visited by a particularly severe wind and snow storm so that 30,000 cubic meters of timber were broken down by the snow and wind. As a consequence the net revenue on this range for that year was the highest in Saxony, or 5.1 per cent.

9 THE BLACK FOREST

I dare say that no one who has ever visited the region of the Black Forest fails to look back upon that visit as one of the milestones upon life's journey. A semimountainous region extending from the Neckar at Heidelberg to the Swiss border and from the valley of the Rhine across Baden and most of Württemberg, for the most part covered with forests of spruce or fir and with small farms and villages in the valleys, with its fine roads reaching to every portion of the forest, presents a picture of beauty that does not fade quickly from the mind.

In the days of the primeval Black Forest the conditions were somewhat like those prevailing on the Pacific coast 20 years ago, as regards lumbering operations. The timber most accessible was cut first. The operations were reckless, timber rights were sold cheaply or were given away. The logging camps were established where there was a little tillable soil, and from such beginnings have come the numerous little villages of the Black Forest. The men worked in the woods, and during periods when woods work was slack they cultivated their little tracts of ground, built roads, wove baskets and carved wood. The government received, on the average, only 6 cents a log in those days. No working plans existed, as all the timber was mature; but with the development of railroads and new markets and the enlargement of the market from a local one to a far-reaching one, the value of the Black Forest rose by leaps and bounds in spite of the rapid cutting away of the primeval forest.

The Black Forest covers 500,000 acres in Baden and 600,000 acres in Württemberg. Much of it is now private (such as the enormous holdings of the princes of Fürstenberg), communal, state and stock companies.

The early method of marketing the timber was to raft the logs down the streams to Holland or intermediate markets, but prior to 1718 the existence of many little principalities through which the logs must pass to a market made it expensive or unremunerative in spite of the low cost of the stumpage. After 1718, by means of a treaty between the various small states, the rafting of logs became possible upon a large scale.

No good records exist of the forest conditions of the Black Forest prior to 1758, when the region is said to have contained more than 80,000 feet of timber an acre, and many trees contained as high as 28,000 board feet each.

The companies rafting logs to Holland in some cases acquired

Plate 13

Tower on the summit of Badener Höhe, one of the high subalpine points of the Black Forest. The native growth consists largely of Pinus montana.

Plate 14

A typical winter scene in the Black Forest, from the lower slopes of the Hornisgrunde, one of the highest points in this region. Severe storms are largely responsible for the failure of the spruce stands on some of these exposed subalpine summits.

Plate 15

Numerous " roads " which are rarely used except for the transportation of woods products and for winter sports, often serve at the same time as " compartment lines "

tracts of timber which they still hold and operate. That their early operations consisted in taking only the best is testified by Jägerschmidt who, in 1828, writes that the tracts over which they had logged contained still many fine trees over 1 foot in diameter and 100 feet tall. Only the very best trees were taken out in the same way that the early lumbering operations in this country were conducted.

The lowest and easiest slopes were logged first and hence today we find for the most part the best and oldest stands (second growth) closest to the streams and in the most accessible places, while at the higher altitudes and most inaccessible places where the good roads have only penetrated within the past 50 years we find the youngest stands, for it was here that the primeval growth was cut last.

Stumpage prices in the Black Forest have risen very rapidly, even recently. In the past 5 years from $13 to $17, and from $20 to $26 for the better stuff. Only since there has come to be a market for any and all products of the forest have working plans come to be a feature of Black Forest operations. Formerly the working plans were made for periods of 100 years, but with the increasing realization that conditions of market and transportation and demand change rapidly, these working plan periods have been made shorter and shorter, until plans for 10 year periods are considered quite sufficient in most places.

A working plan of a German forest is an interesting document and consists of:

a Inventory of values at hand (statement of facts); and includes timber, pasture, hunting rights, value of land, minerals, water power, mill property, roads, logs cut and on hand, nursery sites, agricultural land, etc.

b Boundaries, organization, means of logging, etc.

c Market and relative demand for the various products, local or foreign.

d Working plan (that is, changes of fact to be made or provided for). Herein is outlined the work to be carried out on the forest in the future.

What a working plan provides is of course largely governed by the owner's opinion. An optimistic owner will cut little; hence changes will be toward increasing the investment. A pessimistic owner will want heavy cuts, discarding all but what commands the highest price (as pulp wood in Saxony). In Saxony they did not rely on an increase in stumpage; in the Black Forest they did and have accumulated timber capital. Again, Saxony's method has created their highest present values and they have the highest present returns on their invested capital (which is relatively small). In Saxony, neither the demand nor the price of large logs has increased. The rise has been greatest for the small material and hence Saxony has reaped and continues to reap today the highest returns, while the Black Forest has the highest value in forest capital with the smallest returns.

The larger logs are sawn into lumber at the mills, in or near the forest, while most of the other forest products, such as poles, mine props, railroad ties, Christmas trees and pulp wood are assembled at a railroad station for shipment to centers of consumption of such products. (Plate 16)

10 GRAMSCHATZ FOREST, BAVARIA

The Gramschatz district is situated in a great bend of the Main river in northern Bavaria, 15 kilometers north of Würzburg. There is a fine automobile road through the forest, over which during the summer there are run for the benefit of visitors automobile buses to a little inn known as the "Einseidel" in the heart of the woods.

The Gramschatz district is administered by Forstmeister Gleich, who has his headquarters at Thungen, to the west of the forest. The forest comprises two districts of about 5000 acres each. The eastern district, containing the best timber, is in charge of Assessor Friedrich.

The underlying rock is fresh limestone and cupar limestone, the disintegration of which results in a deep and fertile soil. In some of the quarries from which stone for the roads is taken are found large petrified shells, some of which have a diameter of 10 inches, while petrified mollusks and fishes are common in the rock of this section. The rich soil is responsible for the prosperous agricultural communities here. The 400 inhabitants of the village of Gramschatz are said to be very wealthy. The village, however, owns no timber land as do most other German villages, but is forced to obtain its supplies from the state forests. This may explain the high price of fuel wood, for which is being paid as high as $15 a cord in the woods.

In 1806 the Gramschatz forest was owned by the archbishop of Würzburg, who used it as a hunting park. Old ponds made for the deer to bathe in and ditches used for the drives are still to be seen here and there in the woods. The forest was formerly managed

Plate 16

Forest products (poles, mine props, ties, Christmas trees and logs) assembled at a railroad station in the Frankenwaldof northern Bavaria

Plate 17

A Spessart oak, estimated to be about 700 years old, containing 9 cords of wood, including veneer logs which will sell for over $500

as coppice under standards, the coppice being treated in rotations of 32 years, and consisting of hornbeam, basswood, birch, oak and beech. The white oaks and beech were the standards for the former coppice and there is still left an enormous number of these prime white oaks, which are being gradually cut.

The Gramschatz administration receives for its timber, prices ranging from $15 to $100 a cubic meter, the latter price for the best veneer oak. The gross receipts obtained at the auctions of timber aggregate over $60,000 a year for this range.

The coppice under standards system began in 1806; when the archbishop was deprived of his possessions, which were then made over to the " Reichsverweser." In 1814 the lands were turned over to the kingdom of Bavaria, which continued to cut down the coppice woods and to replace them by a high forest. The pole woods of beech, now over 90 years old, are particularly fine, excelling in straight trunks and rapid growth. The heavy mast years for oak which occurred in 1897 and in 1900 were taken advantage of for the planting of large areas to oak. There is probably nowhere in Germany, unless it be in the Spassart region famous for its oaks, a better second growth of oak than in the eastern part of the Gramschatz forest. The oak timber of the Gramschatz forests is but little inferior in quality to that of the more famed Spessarts, where several giants of the primeval forest still exist (plate 17).

The last working plan advanced has been a return to the coppice system. As a matter of fact, however, the coppice system here has been very much overdone and it is noteworthy that the management has agreed to reproduce hornbeam, having complained so much of the plague of mice, which has caused wholesale destruction of the hornbeam and also of basswood and beech, while oak remains intact. The resultant usurpation of the weeds and grasses make is necessary to obtain regeneration from self-sown seeds of hornbeam or beech and to adopt the planting of spruce. The spruce seems to do particularly well. A plantation of spruce 55 years old, planted originally in alteration with elm, is as fine a stand of spruce as obtains anywhere in Germany. The beech mast of 1909 has been spoiled by a plague of black snails which are said to feed at night, defoliating the beech seedlings absolutely.

Such portions of the range as are not allotted to oak are regenerated in beech and hornbeam, which are meant to make up two-thirds of the growing stock. The remainder consists of pine and spruce, planted, or, in the case of pine, raised from seed. In addition to these, larch is being planted on a larger scale than formerly.

The oak trees dating back to the early coppicing system have a very coarse grain and seem to heal the scars of old branches particularly well. The growth of the oak is very uniform and fine. For the oak timber, a very high price is realized, especially for logs showing a pinkish color at the ends, and further for straight logs of small taper. The highest grade of veneer oak brings from $300 to $400 a cubic meter, while the second class of oak brings from $90 to $180 a cubic meter. This is equivalent to an average price of $30 a thousand feet for timber of all grades. The average price received for cord wood of all grades is $9.

The estimate of a fairly typical strip through a stand of beech and oak showed 102 beeches an acre with an average diameter of 10 inches (beech being 100 years old), and 2508 board feet of lumber. The oaks on the same strip numbered 23, with an average diameter of 26 inches, and a total of 13,189 board feet. The average annual increment is about 160 board feet an acre.

The roads throughout the Gramschatz range are rather poor, owing to the deep soil and the poor grade of stone available for road building within the forest. About $4000 is being spent annually for the construction of permanent roads.

11 HEIDELBERG CITY FOREST

The city of Heidelberg owns about 7000 acres of forest land. Originally the mountain sides and plateaus about Heidelberg were covered with decrepit hardwood forests, but now most of the forests situated more than 800 feet above the city are softwoods. The spruce stands, 50 to 65 years old, are excellent but have suffered considerably from drought in 1910, and also from snow and ice. A thinning was made in the 50 year old spruce in 1903 which netted $30 an acre. Then came severe damage resulting from snow and ice which made it necessary to remove the damaged trees, netting another $30 an acre, and the thinnings made necessary by the more recent drought yielded a further $10 an acre. In spite of this the spruce forests look dense enough and one would scarcely believe that so much material had been removed. The soil itself is valued at $50 an acre. The growing of spruce on these high slopes of the Heidelberg forest appears to be particularly remunerative to the city, as peeled pulp wood brings in the woods a price of $8.75 to $9.50 a cord.

The plateau portions of the forests contain considerable Scotch pine of inferior quality which, however, is sold for box material at $11.50 a cubic meter with bark. This material is in great demand for the manufacturer of ammunition boxes and the recent wars and the preparations for war seems to have caused a great increase in the price for the lower grades of Scotch pine.

At the base of the mountain slope just above the city is an old chestnut orchard, planted privately about 125 years ago for the production of chestnuts. Cheap transportation from the south has ruined the local chestnut market and this orchard, on a slope too steep for agricultural purposes, was purchased by the city about 60 years ago. The trees were originally in rows about 20 feet apart. The chestnut logs obtained from this stand are cut into large billets and exported to Holland where they bring about $20 a thousand board feet and from them is manufactured tight cooperage for the export of brandies. Following the removal of the largest trees there occurred a wonderfully fine regeneration of chestnut, which seemed to the local authorities an unheard of thing. They are now cutting the chestnuts downward from the top of the stand as fast as the regeneration progresses. Mixed with the chestnut regeneration is some maple.

Black locust, of which there is quite an abundance scattered along the lower slopes, brings a price of $10 a cubic meter for spokes and hubs.

On the higher slopes and plateau to the north of the city the forest was originally all hardwoods, but with centuries of misuse they became unprofitable and were for the most part transformed into coppice hardwoods, while the soil became dried and sterile. With the beginning of the last half century these slopes were planted mostly by seed planting to Scotch pine below and spruce or fir above with considerable larch intermixed. This was done because it was believed that the more modest conifers would have a chance to succeed and to become profitable here where the hardwoods had failed. That they have paid is doubtless true, but the result has been the formation of a vast even-aged stand of conifers, often subject to severe snowbreak, windfall, and the ever present danger of a vast forest fire. The general tendency, now that the conifers are well established, is to break up these even-aged stands into small compartments of varying age and species and wherever the soil and exposure warrants it, the introduction again of hardwoods.

On one of the upper slopes is to be seen the present day result of the planting of the so-called "Jäger's mixture." Fifty years ago or more there was planted here a mixture of seeds of Scotch pine, spruce and larch. Today it looks like a pure Scotch pine stand from a distance, the pines being 8 to 10 inches in diameter, a few of the larch have succeeded, but the spruce have remained suppressed from the first and are but 2 or 3 feet tall beneath the pines. That they have all lived shows the wonderful power of spruce to withstand suppression. Beginning at the top, Oberförster Krutina, who is in charge of the Heidelberg forests, started a few years ago gradually to take out the pine, with the result that the spruce has developed rapidly and has apparently lost nothing in vigor due to its half century of suppression.

The growing stock of the Heidelberg city forest has more than doubled in the past 75 years, as has also the annual cut. It is a startling surprise to read in detail, from the working plans, the amount and variety of forest products that this city forest produces annually, with the maximum production apparently not yet in sight.

On the brow of the high plateau to the south of the city and looking toward the Rhine river valley is a forest experimental tract which contains even-aged stands of Douglas fir, Engelmann spruce and other exotic species. The arboretum contains many interesting groups of trees and shrubs, among them being Juniperus sabina, Juniperus virginiana, Tsuga canadensis, Cedrus atlantica, Sequoia washingtoniana (36 inches in diameter and 37 years old), Nyssa sylvatica, Ginkgo biloba, Abies polita, Abies pinsapo, Pinus peuce, Pinus monticola, Pinus lambertiana, Thuya plicata, Thuya occidentalis, Chamaecyparis lawsoniana, Cedrus deodar, Hicoria alba, and many others.

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MUSEUM BULLETIN 171

Geologic map of the Syracuse quadrangle

MUSEUM BULLETIN 172

Geologic map of the Attica-Depew quadrangles

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ATTICA–DEPEW QUADRANGLES BULLETIN 172

Scale $\frac{1}{62500}$

Miles

Kilometers

Contour interval 20 feet.

Field work by D. D. Luther
1909

Scale 1/62500
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Geology by T. C. Hopkins

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