New York State Education Department

NEW YORK STATE MUSEUM

64th ANNUAL REPORT

1910

In 2 volumes

VOLUME 2

APPENDIXES 1 (*continued*), 2-5

TRANSMITTED TO THE LEGISLATURE JANUARY 30, 1911

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STATE OF NEW YORK

No. 55

IN SENATE

JANUARY 30, 1911

64th ANNUAL REPORT

OF THE

NEW YORK STATE MUSEUM

VOLUME 2

To the Legislature of the State of New York

We have the honor to submit herewith, pursuant to law, as the 64th Annual Report of the New York State Museum, the report of the Director, including the reports of the State Geologist and State Paleontologist, and the reports of the State Entomologist and the State Botanist, with appendixes.

ST CLAIR MCKELWAY
Vice Chancellor of the University

ANDREW S. DRAPER
Commissioner of Education

Appendix 1 (*continued*)

Geology

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148 Geology of the Poughkeepsie Quadrangle

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Education Department Bulletin

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New York State Museum

John M. Clarke, Director

Museum Bulletin 148

GEOLOGY OF THE POUGHKEEPSIE QUADRANGLE

BY

C. E. GORDON

PAGE

New York State Education Department

Science Division, November 5, 1910

Hon. Andrew S. Draper LL. D.

Commissioner of Education

Dear sir: I beg to transmit to you herewith a manuscript entitled *The Geology of the Poughkeepsie Quadrangle,* accompanied by a geological map which has been prepared under my direction by Professor Clarence E. Gordon. The work has been executed with circumspection and accuracy and I recommend the publication of the matter transmitted, in the form of a bulletin of this Division.

Respectfully

John M. Clarke

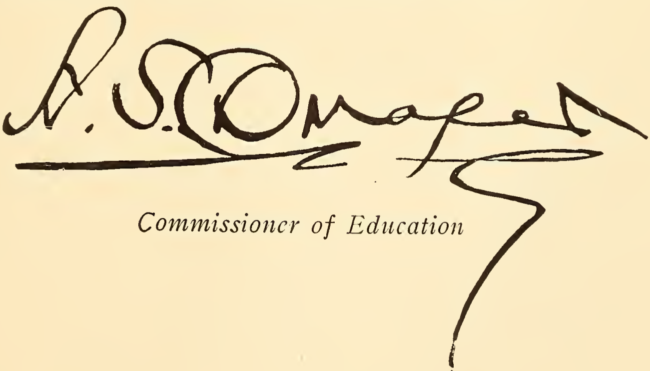
Director

STATE OF NEW YORK

EDUCATION DEPARTMENT

COMMISSIONER'S ROOM

Approved for publication this 7th day of November 1910



Commissioner of Education

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 148

GEOLOGY OF THE POUGHKEEPSIE QUADRANGLE

BY

CLARENCE E. GORDON

INTRODUCTION

The preparation of this paper was begun at the suggestion of Professor J. F. Kemp. The field work was carried on at intervals during the summers of 1906–7–8–9. During the intervening winters the extensive literature dealing with the geology of eastern New York State, western New England and the areas of similar rocks at the south was read with care.

A preliminary map of the quadrangle was prepared by a summer school party of Columbia University at work for a week under the direction of Professor Kemp, Professor A. W. Grabau and Dr C. P. Berkey. This was of great assistance in the field.

The writer owes much to Professor Kemp for kindly criticism. Dr Charles P. Berkey has offered important suggestions. Particular thanks are due Professor John M. Clarke for a generous interest which has made some of the field work easier of execution.

LOCATION AND OTHER GENERAL FEATURES OF THE QUADRANGLE

The Poughkeepsie quadrangle lies in the Hudson river valley about midway between New York city and Albany. It falls between parallels 41° 30′ and 41° 45′ north latitude and meridians 73° 45′ and 74° 00′ east longtitude, and is therefore 17.5 miles long by about 13.2 miles wide. It embraces an area of about 230 square miles. The Hudson river crosses the quadrangle from north to south near the western boundary. The river is slightly deflected to the west at New Hamburg and forms the quadrangle boundary at the southwest corner.

The larger portion of the area lies east of the Hudson in the southwestern part of Dutchess county. At the very southeast corner is a triangular bit of the township of Kent in Putnam county. West of the river is a strip of Ulster county and a block from the northeastern portion of Orange county.

Poughkeepsie, the county seat, is a city of about 25,000 inhabitants. Wappinger Falls on Wappinger creek, Matteawan on Fishkill creek and Fishkill Landing on the Hudson, opposite Newburgh, are important villages. Wappinger Falls and Matteawan are manufacturing towns and each owes its size and importance to the stream on which it is located. East of the Hudson the region is chiefly a farming country and is well adapted to tillage, grazing and fruit growing. West of the river the topography, soil and drainage are peculiarly adapted to the growing of fruit, for which the proximity of the river affords excellent climatic conditions.

Dutchess county was settled very early in the history of the State. The country is attractive. It is easy to imagine that immigrants voyaging up the Hudson through the inhospitable region of the Highlands would have been attracted by the stretches of open country which lay north of the rugged mountains.

The quadrangle is easy of access. Boats plying between New York and Albany stop at Newburgh and Poughkeepsie. The New York Central and West Shore lines, connecting with Albany and the West, follow the banks of the Hudson. The former joins with the Newburgh, Dutchess and Connecticut division of the Central New England at Dutchess Junction and Fishkill Landing, and at Poughkeepsie with the main line division of that road. At Poughkeepsie it also crosses the Highland division of the New York,

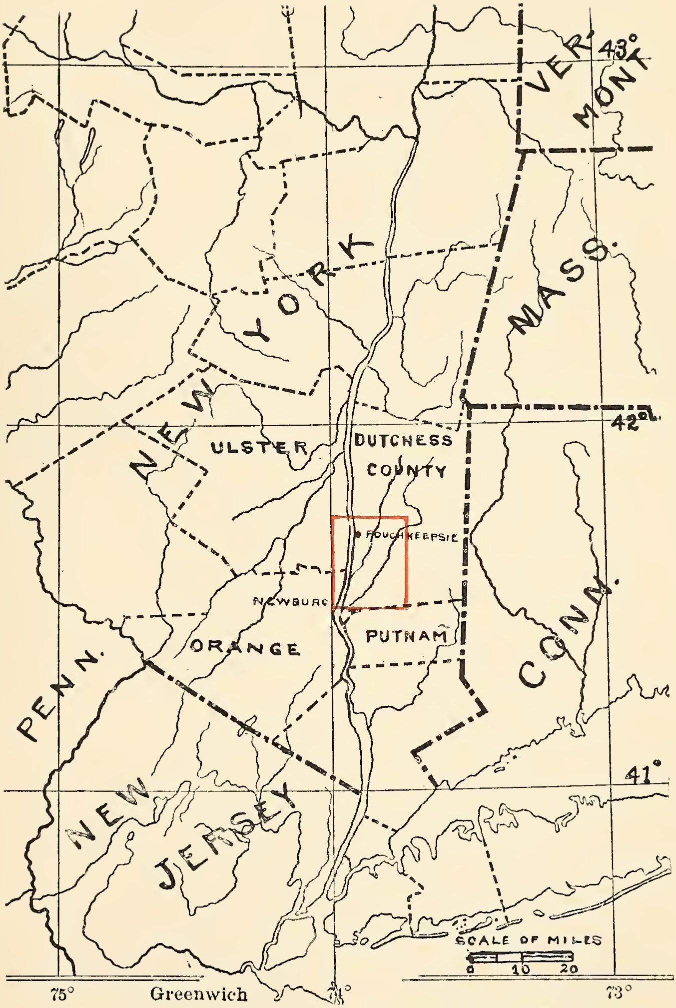

Fig. 1 Sketch map showing location of Poughkeepsie quadrangle

New Haven and Hartford. Ferries cross between Fishkill Landing and Newburgh and between Poughkeepsie and Highland on the West Shore Railroad.

TOPOGRAPHY

East of the Hudson the topography is chiefly that of a rolling upland of moderate elevation, which is due in part to the nature and structure of the underlying rock formations as affected by erosion, and in part to the mantle of glacial deposits.

Along the southern margin of the quadrangle are several rugged spurs of the Highlands. These are bold, often precipitous, and usually wooded. They are known as the Fishkill mountains, receiving their name from old Fishkill township, of which they are a part. These mountains are made up chiefly of Precambric gneisses and are flanked by and faulted with the Paleozoics of the valley.

The westernmost Highland spur is the northern extension of Breakneck mountain ridge and the part within this quadrangle is known as Bald hill (see plate 1). It has a maximum elevation of 1540 feet. The Mount Honness spur next east has an elevation of 840 feet at its northern extremity, Mount Honness proper, but reaches a height of 1300 feet near the quadrangle boundary (see plate 2). A short spur east of Honness, with an elevation of 885 feet, separates it from Shenandoah mountain, which has a maximum height of 1115 feet. East of Shenandoah mountain the Highland mass attains an elevation of 1232 feet at "Looking Rock," which is at the summit of the steep northwestern slope. This spot is widely known because of its fine view.

North of the Fishkill mountains the rocks within the quadrangle are principally shales, slates, grits, phyllites and limestones. The more metamorphic character of these strata as they are followed eastward from the Hudson finds expression in the higher elevation of the slate and graywacke in the northeastern part of the area. Here the hills in places reach a height between 700 and 800 feet. West of the Hudson the average elevation in the slates and grits is greater than on the east of the river, often attaining 400 to 600 feet. "Illinois mountain," the northern extremity of Marlborough mountain, is 1105 feet high.

In contrast to the heights is the gorge of the Hudson, which borings have shown reaches a depth near Storm King of over 700 feet.

DRAINAGE

The Hudson river is the dominating factor in the drainage of this area. The principal tributaries of the master river within this quadrangle come in from the east. The most important are Wappinger and Fishkill creeks; of lesser importance are Casper and Fallkill creeks.

Wappinger creek has its source near Pine Plains, some 16 or 17 miles northeast of Pleasant Valley, on the southwest of a narrow divide that separates its headwaters from the valley of Shekomeko creek. It has a general southwest course along a narrow limestone belt, and finally enters the Hudson at New Hamburg. At present it bears away somewhat from the limestone along its lower reaches and flows across the slates, over which it cascades gently in several places. At Wappinger Falls it makes a descent of about 60 feet over the slates, and from this village to the Hudson, a distance of about two miles, it occupies a drowned valley. It receives a few small tributaries within the quadrangle, the largest of which drains the slates southeast of Wappinger Falls and empties into the main stream below the village.

Wappinger creek furnishes power at Pleasant Valley, near Titusville, and at Wappinger Falls, and formerly was utilized at Rochdale.

Fishkill creek is a somewhat larger stream and has a greater watershed. It also drains a large part of the area just to the east, where the main stream has its source on the western slope of Chestnut ridge, a high mass of schist separating the Clove and Dover-Pawling valleys. East of the quadrangle it receives an important tributary with its source in Whaley pond. Sylvan lake sends a small tributary into this stream near the eastern edge of the quadrangle.

Several good-sized brooks join the main stream from the north. Of these Whortlekill creek is a small brook which enters the quadrangle just east of Arthursburg, about a mile from its source. It joins the Fishkill about a mile south of Hopewell Junction. Jackson and Sprout creeks are larger. The former drains the western slope of the ridge between Lagrangeville and the Clove valley, while the headwaters of Sprout creek extend to the narrow ridge northeast of Verbank, whose eastern slopes drain into the Dover-Pawling valley. Sprout and Jackson creeks join north of Fishkill Plains and the stream formed by their union flows into Fishkill creek, two miles north of Brinckerhoff.

Plate 1

A view of Bald hill, shown in the left half of the picture, as seen from Mount Beacon

Plate 2

View of the Mount Honness spur of the Fishkill mountains, as seen from near the village of Glenham. The eminence on the left of the picture is Mount Honness proper

Several brooks which drain the northern slopes of the Fishkill mountains and the valleys between them join Fishkill creek from the south. Of these, the largest are those leaving the Highlands through Shenandoah hollow and the valley of East Fishkill Hook, and " Clove creek " south of Fishkill Village. Fishkill creek furnishes power at Hopewell, Brinckerhoff and Matteawan.

Casper creek rises near the northern boundary and flows southwest in a rather wide valley to the Hudson which it joins two and one-half miles north of New Hamburg.

Fallkill creek drains a large area to the north. It flows in a general southwest course to Poughkeepsie where it turns on itself, and, making a large loop, flows north for one-half of a mile and then west to join the Hudson.

Several brooks, but none of any size, drain the slopes on the west of the Hudson.

There are no natural lakes or ponds of conspicuous size within the quadrangle. Those of any consequence apparently date from the time of the retreat of the ice sheet from this region.

GENERAL GEOLOGY

The Fishkill mountains belong to the Highlands province of Precambric rocks. These have their greatest development in Putnam county just to the south. The spurs that have been mentioned are the northern terminations of ridges of gneisses which have a general northeast-southwest trend. Above Peekskill these gneisses are continued across the Hudson into New Jersey. Eastward they extend into Connecticut.

The summits of the Fishkill mountains, with those of neighboring ones at the south, present a fairly even sky line which may be followed northeastward along the crests of the ridges of the younger rocks. This general uniformity of level is believed by many to mark a former peneplain in this region toward the close of Cretacic time (see plate 3).

North of the Fishkill mountains are the younger rocks of the area. In general, these do not now tend to climb far up the flanks of the older masses. In most cases the two are faulted against each other and the rocks of the mountains reach close to their bases. In a few places the younger strata extend up a moderate distance on the older rocks and are disturbed relatively little.

These younger strata rest unconformably upon the Precambric. They are the southwestward representatives of the rocks of western Massachusetts and Vermont and are now known to include strata which range in time from the base of the Paleozoic to the upper part of the Ordovicic period. Northeastward these rocks extend into Massachusetts and Vermont and southwestward into New Jersey, Pennsylvania and beyond.

Within the quadrangle they are of considerably lower average elevation than the gneisses of the mountains. This reduced elevation is believed to represent the erosion that has taken place in these rocks below the Cretacic level after the peneplain had been elevated at the close of Cretacic time.

So far as now known, these younger strata have no later rocks older than the Quaternary overlying them within the limits of the quadrangle.

PREVIOUS GEOLOGIC WORK

Because of the extensive geographic development of these rocks and their difficult geology there has appeared, during the last fifty years or more, a large body of literature dealing with them throughout their length and breadth. The work has been carried on under the auspices of State and federal surveys and by private enterprise. Work within this quadrangle was undertaken early in the history of serious geological investigation in this country.

In 1843 W. W. Mather submitted his quarto report on the Geology of the First District of the State of New York. This dealt with southeastern New York and was the first important contribution bearing on the geology of this area. With the exception, perhaps, of an excursion by Sir William Logan and James Hall in 1864, which resulted in the assignment of the younger rocks of this and neighboring areas to Logan's Quebec Group, and which introduced much confusion at the time, no other important contribution was made until 1878.

In that year T. Nelson Dale discovered fossils in the slates at Poughkeepsie. The fossils were assigned by Hall to the "Hudson River Group." The find attracted the attention of Professor J. D. Dana to the strata of southern Dutchess county. This eminent geologist, what the time was working at the difficult stratigraphy of western Massachusetts and the neighboring portion of New York State, now traced the limestones from the north to the Hudson river, discovered fossils in them at Pleasant Valley, and discussed their general geologic significance.

Apparently through the influence and encouragement of Dana, Professor W. B. Dwight began his fruitful investigations in the Wappinger limestones of Dutchess county. Professor Dwight's papers were published at intervals from 1879 to 1900. His investi-

Plate 3

A view from Mount Beacon southwestward along Breakneck mountain, across the Hudson river, showing the dissected Cretacic peneplain. The rounded dome of Storm King is shown on the right of the picture in the distance

gations greatly extended our knowledge regarding the age of the Wappinger limestones, particularly those of the Wappinger creek belt.

In 1886 J. C. Smock, as a part of a preliminary report on the Precambric rocks of the Highlands east of the Hudson, discussed the gneisses of the Fishkill mountains. But notwithstanding these contributions, the areal geology has not been mapped in detail up to the present time.

STRATIGRAPHICAL TABLE

PERIODS	SEDIMENTARY		ERUPTIVES
	Formations	Terranes	
Quaternary	Alluvium	Recent	
	Terraces Kames Drumlins (Unconformity)	Glacial	
Ordovicic	"Hudson River" slates, grits and phyllites	? Utica? Trenton	Hortontown hornblende rock
	Wappinger limestones and dolomites, in part	Trenton (Disconformity) Beekmantown	
Cambric	Wappinger limestones and dolomites, in part	(Disconformity?) Potsdam ? Georgian	
	Poughquag quartzite (Unconformity)	Georgian	
Precambric	Gneisses of the Fishkill mountains and inliers of these rocks	"Grenville"	Shenandoah granite Bald Hill granite gneiss

THE PRECAMBRIC GNEISSES

DISTRIBUTION

Within the Fishkill mountains the boundary of these rocks, as shown by the map, follows closely the lower contour lines of the spurs.

The Glenham belt is an inlier of these rocks. It has the same trend as the ridges of the gneisses in the Highlands and extends as a narrow strip from a point just north of the carpet mill at Glenham northeastward to "Vly mountain."[1]

[1] The hill marked Fly mountain on the map is just southeast of what, in this vicinity, is called Vly mountain, corrupted to Fly mountain. The swamp just south of the eminence doubtless suggested the name (Vly-swamp).

South of the Glenham belt, in the town of Matteawan, are two smaller inliers of the gneisses connecting the Glenham belt with the Highlands.

Between the rocks of the Highlands and those composing the masses of inliers there are some differences which help to throw light on the history of both. There are also marked resemblances which apparently serve to clinch their relationship.

PROBLEM OF THE GNEISSES

The study of the gneisses speedily develops very puzzling problems, which in all cases may not admit of satisfactory solution. In some way these rocks must express the several successive changes which they have experienced. A complex history is suggested, but all its events are not easy to trace.

PROMINENT STRUCTURAL FEATURES

The most impressive feature of the gneisses is the northeast-southwest alignment of the ridges which constitute their outcrop. Between the ridges are parallel longitudinal valleys. From the published descriptions, these features, with some exceptions, seem to hold for the entire Highlands and to extend southward into Westchester county.

The gneisses are uniformly banded or foliated throughout their entire breadth from west to east, and the strike of the foliations in general follows the trend of the ridges. In a few places only does the foliation approximate schistosity in any degree.

Over most of the area there is an easily distinguishable arrangement in parallel stratalike masses which also follow the topographic features. These do not show an orderly repetition, though masses of very similar mineralogy are irregularly repeated. Occasionally more massive types occur, but these, too, seem to follow the structural features just mentioned. The prevailing dip of the foliation planes to the southeast imparts a strongly isoclinal character.

The ridges clearly date from Postcambric time. It seems reasonable to infer that the other structural features just outlined have a common origin and belong to an earlier epoch.

There is much evidence of extensive faulting which is developed chiefly, or at least most prominently, along the strike. Such faulting might easily account for the lack of orderly repetition of characteristic rock types. Most of this faulting belongs to the disturbance that produced the ridges. The gneisses clearly show the effects of repeated orogenic disturbances.

In some places it is clear, from the position and structure of the overlying younger rocks, that most of the features of the gneisses date from Precambric time. Where the relationship of the basal quartzite to the underlying gneiss is most plainly seen, as in the West Fishkill Hook,[1] the latter stands at a high angle with a uniformly northeast-southwest strike, while the quartzite dips at a low angle with varying strike. In other places the discordance between the dips and strikes is plainly discernible. The quartzite has been folded relatively little in many places, and never within this quadrangle to the extent shown by the gneisses. Faulting, instead of extreme folding, occurred in connection with Postcambric movements within the gneisses.

The early crystalline condition of the gneisses would have favored faulting and shearing and would have prevented much later folding within them. It is certain that the isoclinal character is of Precambric age.

It seems possible, therefore, in a large way, to apportion the structural features of these gneisses as seen in the field among orogenic movements of Precambric and later time. It is quite uncertain how many different disturbances may have occurred in Precambric time and whether all the later structural features are of similar age.

The lines of foliation, as seen in outcrops, are usually rectilinear. When wavy, they are only slightly so. This latter feature seemed most noticeable on Shenandoah mountain. Crinkling is rare. Two or three instances of it were noted in the Glenham belt. Jointing is common and frequently gives the appearance of thick exfoliation.

Faults are divisible into two kinds, reversed and normal. It seems most likely that the normal faults followed the compression that produced the thrusts and are therefore of the nature of adjustments. All the faults that have been noted appear to belong to the great mountain building process of Ordovicic time which elevated the Paleozoics of the Green mountain belt. This is indicated by the relations which exist between the younger and older rocks and by the fact that the fault lines of the mountains are projected north-

[1] The recesses east and west of the short spur that separates Mount Honness from Shenandoah mountain are respectively known as East and West Fishkill Hook.

ward into the younger strata, where they show features that leave their age unmistakable.

Doubtless in some cases what now appear to be reversed faults of moderate displacement within the gneisses, or along contacts, are truncated thrusts of large size. This inference is borne out by the presence of large thrusts in the Paleozoics at the north.

It would appear that not only did distinct normal fault breaks occur as the result of adjustments following the elevation of the Green mountains, but that normal slips occurred along the planes of the earlier thrusts.

This feature is best shown in the relations now existing between Bald hill and the Mount Honness spur, and in similar ones between Shenandoah mountain and the mass of gneiss at the east of it. In these two instances the Paleozoics have clearly been dropped back between the gneiss spurs with a large throw on the west, marked in one case by the scarp on the east of Bald hill, and in the other by that on the east of Shenandoah mountain.

The two spurs in each case tended to act as a single block. The normal fault intersects the thrust at an acute angle forming a triangular valley narrowing southward. Some backward movement along the thrust plane must have accompanied the slump. Diminishing tension faulting eastward is marked by small scarps on the west of the Honness spur but is not noticeable on the eastern gneiss mass.

The Hook spur shows these features imperfectly developed.

PETROGRAPHY

General. The gneisses show much similarity in their mineralogy. Distinctive characters are furnished by the structure, the preponderance of some minerals, or the degree of alteration in the rock. A few composite types may thus be defined. It will be convenient to describe these first, while the variations in many instances may best be indicated in discussing their outcrops. The thin sections may be reviewed as a whole later. Possible ancient surface alterations must always be carried in mind.

Bald hill granite gneiss. This rock is prominently developed within and south of the quadrangle. There is great uniformity in its general color, mineralogy and texture. It shows a few variations, but as a whole is remarkably homogeneous. In outcrops it is commonly drab colored and granitelike in appearance. The thin section of the usual variety shows quartz in large and small anhedrons. Orthoclase and plagioclase are abundant, with the former slightly in excess. There is some microcline and hornblende is plentiful. Irregular grains of magnetite are frequent. There are a few scattered zircons.

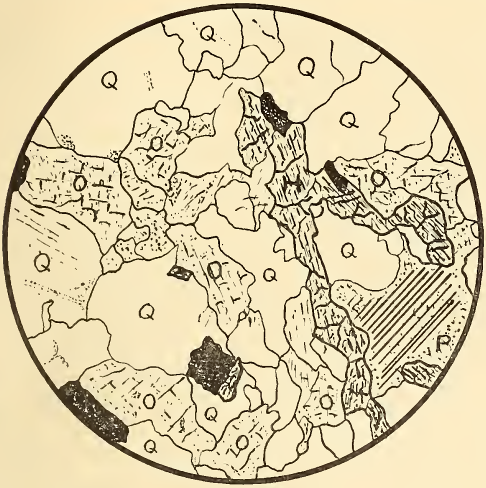

Fig. 2 Bald hill granite gneiss. Actual size 3 mm. *Q*, quartz; *O*, orthoclase; *P*, plagioclase; *H*, hornblende; black, magnetite

In some instances, even where the hand specimen appears rather massive, the thin section shows a stringer-like arrangement of the hornblende (see figure 2). The magnetite is often hydrated, giving surface exposures a rusty color.

The principal variation is a rock of coarser texture, with the mineralogy of a diorite. It shows hornblende, abundant plagioclase and a very little quartz (see figure 3).

In one case where the rock was extremely fresh the magnetite formed a perfect pseudomorph after the amphibole and was abundant in the section, while the hornblende was greatly bleached.

Fig. 3 Diorite variation of the Bald hill gneiss. Actual size 3 mm. *P*, plagioclase; *H*, hornblende; *Q*, quartz

There is utter lack of evidence to show that the rock has undergone a complete change from an earlier condition. It would seem that, so far as the rock has just been discussed as to mineralogy and texture, we are dealing with primary features. On the whole, the sections indicate a rock of plutonic habit which took on a gneissic character and underwent certain other changes at the time of its formation. The gneissic character is best regarded as primary, justifying the use of the term gneissoid granite to qualify the name granite gneiss.

The restlessness of the magma at the time the minerals were forming seems to find expression in the stringerlike arrangement of the hornblendes and in parallelly arranged pellets of quartz occurring in the feldspars, which do not appear to be secondary and of later introduction. These features, with the rounded character and smaller size of some of the grains and the absence of micropegmatitic intergrowth, point to conditions hampering crystal formation.

The thin sections also show certain dynamic effects of later date, in common with all the gneisses of these mountains, in the form of strain phenomena of different kinds. There are one or two instances of comparative freedom from such in which the quartz always gives sharp, decisive extinction and in which prominent cracks and bent lamellae are absent.

Hornblende gneisses. The outcrops of these rocks are much alike and the thin sections which have been examined agree very closely. Exposures are dark in color. The essential minerals are chiefly plagioclase and hornblende, with some quartz and a little orthoclase. Magnetite is rather common as irregularly-shaped particles, or as dustings. Zircons are occasional. Some sections show biotite in addition to hornblende, but the former is decidedly subordinate and usually has every appearance of being secondary. It apparently belongs to that period of metamorphism which more usually found expression in strain phenomena of different kinds but which sometimes resulted in new minerals among the "primary" ones, especially in those cases where the rock had previously been exposed to unusual alteration. The feldspars also frequently show evidence of former decay. The indurated and general compact

Fig. 4 Sketch of a hornblende gneiss. Actual size 3 mm. Q, quartz; *P*, plagioclase; *H*, hornblende; black, magnetite

condition indicates that the alteration is an ancient character. Figure 4 gives a sketch of a thin section of typical hornblende gneiss.

Fig. 5 Sketch of a micaceous gneiss. Actual size 3 mm. *Q*, quartz; *O*, orthoclase; *P*, plagioclase; *B*, biotite

Micaceous gneisses. These may be passed over briefly. Except that biotite plays the rôle of hornblende, they are very similar in their mineralogy. In some cases magnetite is associated with a mineral whose identity is lost or obscured. The thin sections often suggest that the prominent biotite is secondary and in these cases the outlines of another mineral, possibly, hornblende, may be faintly traced. In these instances it is possible that the biotitic gneiss was first a hornblende rock and that it was subjected to more than usual alteration before recrystallization.

Microcline is rather abundant. Biotite occurs abundantly as a "primary" mineral independent of hornblende. Sometimes these gneisses show much quartz and are finegrained, strongly suggesting altered sediments.

Fig. 6 Shenandoah mountain granite. Actual size 3 mm. *Q*, quartz; *O*, orthoclase; *P*, plagioclase; *M*, microcline; *Mu*, muscovite

Shenandoah mountain granite. A coarse, white granite made up almost entirely of quartz and feldspar was noted on Shenandoah mountain at the summit of the steep northwestern slope, along the road from the East Hook to Hortontown. It is very massive in appearance in the ledge and hand specimen. The thin section shows quartz, orthoclase, microcline and plagioclase. A few small and scattered flakes of muscovite, which is probably a primary mineral, are present. Microcline is abundant. There is a tendency to microperthitic intergrowth of plagioclase and orthoclase. It has the earmarks of a plutonic rock and bears little evidence of gneissoid structure, so that if it is of Precambric age it must be thought of as having escaped any pronounced foliation. This seems remarkable, considering the prominence of foliation in the gneissic series. The effects of dynamic metamorphism are chiefly in the form of strain shadows in the quartzes.

Glenham gneiss. The prevailing and characteristic surface rock of the Glenham belt is a granitic gneiss. It appears to be an altered derivative of other gneisses which are entirely similar to those of the Highlands, and which are exposed in places within the belt. The surface gneiss is foliated in certain portions, while in others it is massive. There are minor variations in texture and in mineralogy which depend upon both an ancient and a more recent alteration. These varieties grade into one another. The gneiss is usually red from disseminated iron stains and over much of the belt is deeply chloritized.

Fig. 7 Glenham gneiss. Actual size 3 mm. *Q*, quartz; *M*, microcline; *P*, plagioclase; *Cb*, chlorite after biotite, carrying magnetite

The thin section shows abundant quartz with orthoclase, microcline, plagioclase, and biotite altered to chlorite. Magnetite is abundant and zircons are occasional.

Occasionally the rock consists of feldspar and quartz with very little or no mica.

OUTCROP OF THE FISHKILL MOUNTAIN GNEISSES

Matteawan. Gneisses which can be readily traced into those of the Fishkill mountains outcrop near their base in the eastern part

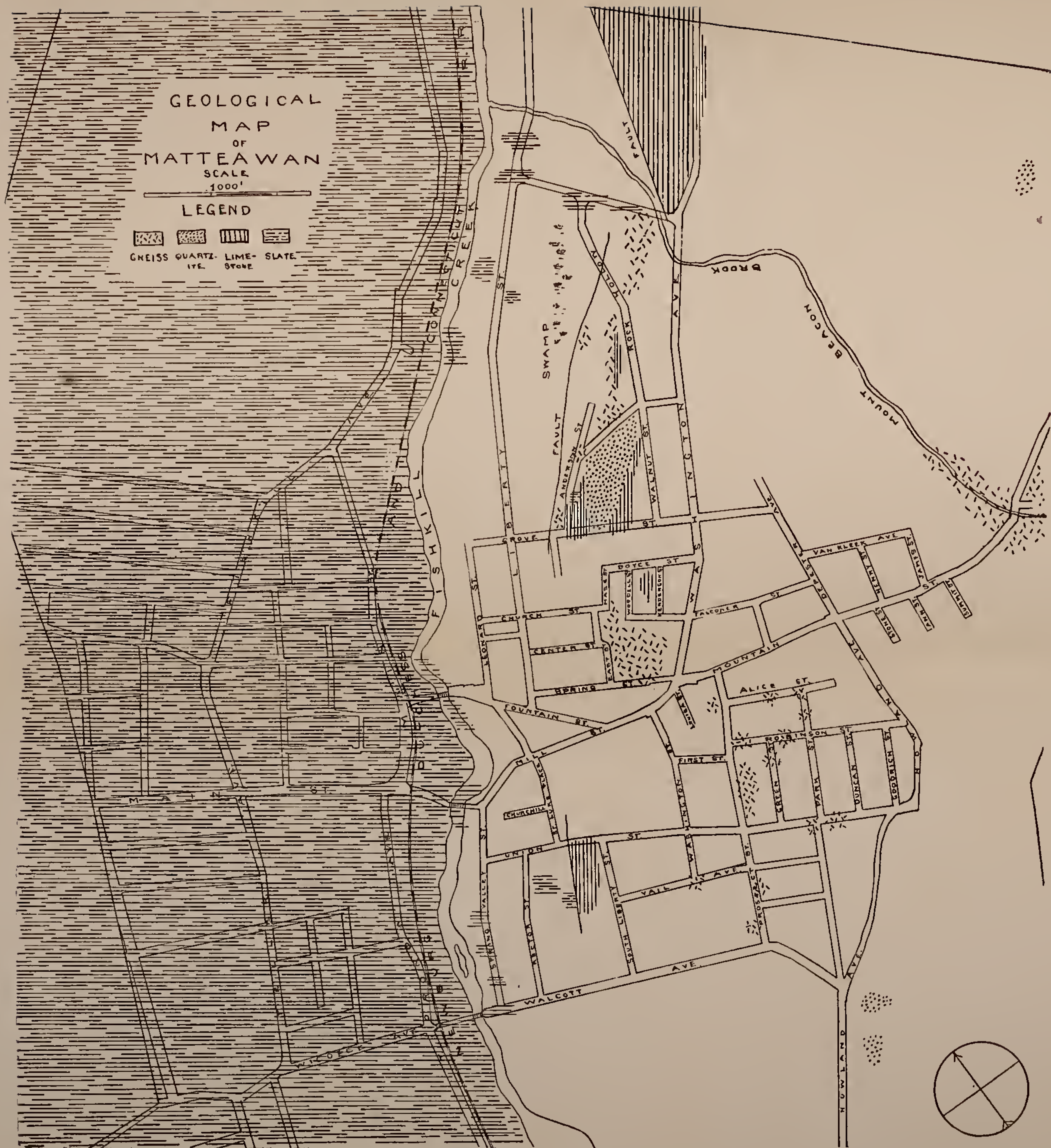
GEOLOGICAL
MAP
OF
MATTEAWAN
SCALE
1000'
LEGEND
GNEISS
QUARTZ-ITE
LIME-STONE
SLATE
FISHKILL CREEK
SWAMP
FAULT
BROOK
MOUNT BEACON
GROVE ST.
CHURCH ST.
CENTER ST.
SPRING ST.
FOUNTAIN ST.
MILL ST.
MOUNTAIN
ALICE ST.
ROBINSON ST.
FIRST ST.
UNION ST.
VAIL AVE.
WALCOTT AVE.
HOWLAND AVE.
VAN KLEEK AVE.
FALCONER ST.
BOYCE ST.
ROCK ST.
WALNUT ST.
LEONARD ST.
CHURCHILL ST.
VALLEY ST.
RECTOR ST.
SOUTH LIBERTY
PROSPECT
GREEN
PARK
DUNCAN
GOODRICH
MAIN ST.

Figure 8

of the town of Matteawan. The discussion of these may be followed by reference to the map of Matteawan (figure 8).

The most western outcrop which has been noted is at the corner of Vail avenue and Washington street. The gneiss at this spot is very similar to that which composes the two inliers shown on the map at the northwest. Another outcrop occurs at the junction of Prospect and Mountain streets. A line drawn between these two outcrops marks the western boundary of the gneisses of the mountains, so far as they can be followed by actual outcrops. East of Washington street along Prospect, Union, Robinson and Alice thoroughfares and along Green, Park, Duncan and Goodrich side streets, outcrops are numerous. North of Mountain street the gneisses pass beneath the drift. A quarter of a mile to the northeast they are exposed again in the gorge of Mount Beacon brook. The reddish and greenish colors, characteristic of the Glenham belt and the inliers farther west, and frequent epidotic gneiss, were noted among the surface exposures of the gneisses just described. Otherwise these exposures are similar to the rocks in the Mount Beacon brook section.

Mount Beacon brook section. Above and for a short distance below the bridge on Mountain street, near the foot of the mountain road, the brook has cut an interesting section in the gneisses. Just above the bridge the foliation and " bedding " planes strike n. 54° e. and dip about 75° s. e. Below the bridge the strike varies between this angle and 69° e. of north. The rocks in this section show an isoclinal arrangement in " beds " with high dip to the southeast.

Below the bridge, the lowest portion of the section involves some forty feet of dark hornblendic gneiss. This rock is banded, though in places for the width of several inches it is massive. When waterworn, such surfaces present a spangled appearance. This " stratum " is abruptly succeeded by a lighter colored one of much less uniformity of appearance. It is made up of imperfect alternations of granitic, quartzitic and composite " beds," which vary in thickness from the width of an inch or less to two feet. Some " beds " show light and darker bands. Others are uniformly light colored, often with little or no trace of a ferromagnesian constituent. This " stratum " continues up stream for a hundred feet or more and passes beneath the bridge. It is succeeded by the Bald hill gneiss with varieties that strongly resemble the rocks of the Glenham belt and the Matteawan inliers in texture and mineralogy.

In the upper portion of the gorge above the bridge the north wall for some distance is a rusty, pinkish rock of fine grain and rather massive appearance. It resembles certain phases of the basal quartzite which have been noted outside the quadrangle, particularly the outcrops in the brook crossed by the mountain road a mile south of Dutchess Junction. This rock is jointed, and rests upon the granitic derivative of the Bald hill gneiss.

Bald hill. The rock composing this spur of the Highlands was carefully examined along its base while tracing the quartzite, and also in two sections across its summit frcm west to east. One of these sections was made across the northern portion of the spur along an old wood road leading from the lane southeast of the Maddock farm near Glenham station. The other was taken partly along the road ascending Mount Beacon, then bearing to the left past the Graham place through " Hell Hollow " to the Cold Spring road. The rocks in the quarries near Mount Beacon reservoir, and in the excavations made for the new house at the summit of Beacon during the summer of 1908, as well as the section along the road descending from the reservoir to Matteawan, were studied. Comparisons were made with the outcrops along the base of the ridge to the quarry at Storm King station and in the railroad cuts from Storm King to Cold Spring. An examination of other parts of the ridge of which Bald hill is the northern extremity, was necessary in order to form a clear idea of the character of the gneiss.

Along the northwestern slope of the spur the gneiss is mainly a medium-grained, laminated hornblende rock with some micaceous variations. Along the basal portion of this slope the gneiss is usually rusty from included iron stains. Higher up it is commonly a drab or gray rock. The laminated character is more noticeable and the laminations are finer along the basal portion of the northwestern slope. Throughout most of the mountain the gneiss is rather coarsely or indistinctly foliated and in places is quite massive and granitic in appearance.

The characteristic rock of Bald hill, as just described, is identical in texture and mineralogy with the rock in the quarry at Storm King station and with the prevailing type in the railroad cuts between Storm King and Cold Spring. It is the chief variety in the quarries at Mount Beacon reservoir.

At the excavations for the new mountain house on Beacon, the drab-colored granitic gneiss passed into a variety composed of white feldspar and hornblende. In the hollow between Beacon and Bald hills, along the road descending from the reservoir, the granitic hornblende rock is often very dark in color, which corresponds with a greater freshness in the rock.

The presence of occasional micaceous variations has been noted. They are apparently confined to the more finely laminated portions of the gneiss and there is reason for thinking that the mica is secondary. The thin sections show abundant disseminated magnetite which has become hydrated in many places, giving surface exposures a rusty color.

The homogeneous character of the Bald hill granite gneiss is noteworthy. In areal extent, it covers about eleven square miles east of the Hudson. The general igneous character of the rock is very impressive. The varieties that have been described would appear to be explainable as normal variations from a common magma.

This rock is certainly of Precambric age. By its form and isolation it does not appear to have the character of a basal member. I have been unable to discover any other type which could reasonably be referred to this gneiss. If a basal formation, it should be of more frequent occurrence in these greatly eroded rocks. It therefore does not appear to be older than the other gneisses. All evidence of a possible unconformity would have been completely obliterated.

If contemporaneous with the other gneisses, on the assumption that they are sedimentary and that it is igneous and having the character of a sill, it should then occur also in other places to the east. It might be a laccolith, in which case it might have furnished the initial bulge at the time of folding. The more strongly banded character of the gneiss along the margin and the somewhat massive central portions might permit the interpretation of anticlinal structure.

The pronounced alignment which this granite has with the other gneisses favors the view that it was thrust up into the gneisses at the time of their folding. All possible exomorphic and endomorphic effects would have been neutralized by the agencies of regional metamorphism.

In addition to its other characters, the thickness of this formation is opposed to the idea that it is of sedimentary origin.

The Mount Honness spur. A short distance east of the Cold Spring road in the hollow between this spur and Bald hill the rock resembles the Bald hill gneiss. In some places it is granitelike, coarse-grained and only slightly foliated, looking like an altered derivative of the gneisses. The fault that borders Bald hill on the east may be within the Bald hill gneiss for a distance.

North along the road toward Fishkill Village the rock becomes more foliated. A thin section of this variety shows some biotite in addition to hornblende, but the former is decidedly subordinate and is apparently secondary.

Two mountain roads over this spur from the Cold Spring road to West Fishkill Hook give fair sections. There are also numerous outcrops in the fields to the north and south. Surface exposures are confusing both as to structure and petrographic characters. In some places the gneiss apparently dips to the northwest at low angles, but where the foliation planes may be detected, they dip to the southeast at high angles. The rock often has a granular and hybrid character that seems best interpreted as the condition resulting from the induration of a partially disintegrated rock which is primarily a very ancient character. The apparent northwest dip is accordingly best explained as a sort of exfoliation between the basal gneiss and the altered surface derivative.

On the whole, the section is across a series of "strata" showing tendency to definite alignment with each other and to variety of composition. In the main the rocks of this spur may be classified as micaceous and hornblendic gneisses forming rather thick "strata," which usually exhibit uniformity in mineralogy for some distance across the strike.

The road from Brinckerhoff to Johnsville crosses this spur north of Mount Honness proper. Fine exposures have been made in the dark colored hornblende gneisses along the road in the process of constructing the new State road, and in the quarries just south of Arvis Haight's, from which stone was removed. These sections show thick masses of the hornblende gneiss. Lighter colored gneisses have been noted interstratified with the hornblende varieties.

In connection with the question of the origin of the hybrid character of the gneiss along the northwestern slope of this spur it is interesting to note that the slope is gentle. Although it now lies in a faulted position against the limestone, the basal quartzite may have reposed on the gneiss along this slope subsequent to the elevation which brought the gneiss against the limestone.

More distinct "passage beds" overlying the inclined gneiss occur just beyond the point where the two mountain roads cross on the crest of the ridge. Between the eastern fork of the roads thus formed, west of the barn of Irving Knapp, thick masses, resembling both the gneisses and the quartzite in their mineralogy, dip to the north at a moderate angle. Farther along the road to the east of the house, ledges more closely resembling the quartzite were found. The woods and thick covering of drift, however, greatly obscure everything to and for a short distance beyond the west road into the mountains. South of the Carey farm, between the brook and the road, the quartzite was found grading downward into a hybrid rock.

The Hook district. South of the quartzite slope, back of the farm of Garrett Smith, the thick woods obscure the succession in the gneisses and good outcrops are scattered. The outcrops in the field southwest of Alonzo Smith's house (see plate 4) on the east road into the mountains and in the neighboring woods, are micaceous gneisses. Within the small space of the outcrop shown in the plate the gneiss passes from a rather coarse rock with quartz stringers through one with finer laminations into a purplish rock with still finer laminations.

A comparison of the thin sections of these varieties shows a similarity as to essential "primary" minerals with biotite as the ferromagnesian constituent. The feldspar is chiefly plagioclase. Quartz is abundant. The degree of alteration of the primary minerals varies much. It is severe both in the feldspars and the biotite, but shows itself chiefly in the latter. In the coarser gneiss the biotite is only slightly altered, while in the finely laminated purplish rock it is represented by masses of magnetite and a great abundance of finely granular material, probably sericite, with only occasional traces of the boundaries of the original mineral (see figure 9). The second variety mentioned shows a gradation between the

Fig. 9 Altered micaceous gneiss from the Hook district. Actual size 3 mm. *Q*, quartz; *P*, plagioclase; black, magnetite from biotite

other two. The purplish color of the darker rock is plainly due to the abundant magnetite.

Though apparently greatly decomposed, these rocks are firm and compact in the hand specimen. The magnetite is not altered into hematite or limonite. The conditions suggest that the alteration of these rocks dates back to an epoch preceding the deposition of the basal quartzite, which, as the proximity of this formation shows, formerly covered the gneisses, probably until glacial time.

East of the east road into the mountains the quartzite has been dropped by a fault. It extends farther to the south than on the west of the road, partly on this account and partly because of a syncline at this point. No peculiar variations were noted in crossing the Hook spur to East Fishkill Hook. The southward extension of the quartzite leaves comparatively few outcrops outside the thickly-wooded area of the spur.

Shenandoah mountain.[1] Above the drift-covered slope of the quartzite, along the northwestern slope of the mountain, dark, micaceous gneisses were noted in conspicuous ledges. Along the road from the East Hook to Hortontown, these were succeeded near the summit of the mountain by a light granite interbedded with the gneisses and estimated to be from forty to sixty feet thick. I have called this the Shenandoah mountain granite. With the exception of one or two quartzitic members, the usual succession of the gneisses is crossed in going from the granite "stratum" across the mountain to Hortontown. On the whole, the micaceous types seemed more abundant. Outcrops are numerous along the road and in the fields on each side.

The age of the granite can not be affirmed. It appears to have the strike of the adjacent gneisses; but it did not prove possible to trace it more than a few hundred feet. The quartzite formation, or its possible equivalent, was not found resting on the granite, so that its age could not be definitely assigned by showing an unconformity. If thrust up into the gneisses at the time of their folding, it has escaped foliation. It probably belongs to the Precambric series. If so, the absence of foliation indicates that Postcambric movements did not contribute to the characteristic foliation of the gneisses.

The eastern gneiss mass. The rocks along the northwestern base of the eastern gneiss mass in some cases suggest a continuation of those of Shenandoah mountain.

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[1] The spur next east is locally known as Shenandoah mountain, from the hamlet of that name at its northern termination. The Shenandoah of the map is East Fishkill Hook.

Plate 4

Showing the unconformity between the Precambric gneiss and the Lower Cambric quartzite. The glaciated gneiss beyond the wall dips to the east by southeast at a high angle, while the quartzite in the foreground dips to the northeast at a low angle. Photograph taken on the farm of Alonzo Smith in the West Fishkill Hook district

At Fowler's kaolin mine, east of Shenandoah, a rock was found beneath the kaolin deposits that was almost identical with the Shenandoah mountain granite, though coarser in texture. The decomposed rock, from which the kaolin was derived, is usually coarse, showing quartz chunks the size of a walnut in a mass of altered feldspar. Probably the kaolin is the product of the disintegration of a pegmatitic granite. The clay beds are apparently not very extensive, although their exact extent is obscured by glacial deposits along the slope. If the kaolin is thought of as the decomposition product of an arkosic, conglomeratic quartzite, it is difficult to account for the granitoid texture of certain specimens examined and the perfect resemblance which they have to the Shenandoah mountain granite. The quartz chunks are not rounded as one would expect in a conglomerate. A careful search failed to reveal the quartzite in the neighborhood.

The structural features suggest that certain gneisses of this mass probably are faulted portions of the Shenandoah spur. Their resemblance might, of course, be explained as due to repetition.

At Hortontown, near the quadrangle boundary, there were noted certain gneisses which had an almost unmistakable sedimentary appearance. Though firmly crystalline, the quartzes frequently show a granular character on the fresh surface of the hand specimen, and the thin interlocking and dovetailing light and dark bands and fine texture indicate an impure sediment. There is nothing about such varieties that points to an altered igneous rock.

The gneisses of the eastern mass were examined in their outcrops along the base of the northwestern slope, along the mountain roads and to some extent along the wooded summit. It did not prove possible to assemble them into an orderly series. They present irregular repetitions of hornblendic and micaceous gneisses with some few minor variations. The micaceous gneisses were the more abundant.

No decidedly massive types were noted. The thin sections are not conclusive as to the early condition of these gneisses, although in many cases they hint at altered sediments or ancient derivatives.

THE GNEISS INLIERS

The Glenham belt. The southern extremity of this belt is a few yards northwest of the dam at Groveville. Above the dam it forms the west wall of the gorge of Fishkill creek as far as Glenham. Northeastward it may be followed distinctly as a narrow belt as far as Vly mountain. North of this hill it disappears against the slates. The belt is bounded by the slates on the west throughout its entire length. Vly mountain is cut off from the main mass by a transverse fault which has offset the main belt to the west by its own breadth. This fault is occupied by a large swamp, to which the eminence probably owes its name. The mountain is bounded on the east by the slates and on the south by the Fishkill limestones. The latter border the main portion of the belt on the east to its southern extremity. The southern end of the strip is faulted against the slates.

Mather called this mass a " granite rock " in his description[1] and in his section the " Matteawan granite " (see plate 12, loc. cit.). He separated it from the gneiss of Bald hill, but apparently regarded it as a part of the Highlands.

E. Emmons[2] cited this rock as an example of the uplift of inferior rocks into the newer ones. He described the relations at Glenham. His section is given herewith.

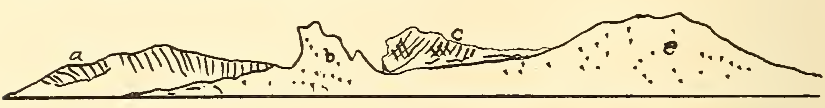

Fig. 10 *a*, slate; *b*, granite (of Glenham belt); *c*, limestone; *e*, Fishkill mountain. (After Emmons)

Hall and Logan, in 1864, called it an 'altered sandstone," [3] J. D. Dana, in 1879,[4] referred to it as " bastard granite " and described it as one of the " stratified deposits as is shown by its conformable position and by its taking the color of the slate near its junction." The Highlands were the source.

Smock in 1886[5] expressed doubts of its being stratified. He placed it with the Highlands, though the prevailing types of rock were unlike the characteristic varieties of the Fishkill mountains.

In the southern portion of the Glenham belt the prevailing rock is a massive variety of the granitic gneiss. This is exposed for some depth in the railroad cut west of Glenham station. It is of dark green color and shows scarcely any tendency to foliation. South of this cut and for some distance to the north, surface outcrops are almost always of this type of rock, though varying in

[1] Geology of the First District, 1843, p. 437.
[2] Agriculture of New York, Part IV, 1846, p. 103.
[3] Amer. Jour. Sci., Ser. 2, 39:97.
[4] Amer. Jour. Sci., Ser. 3, 27:386.
[5] Thirty-ninth Ann. Rep't N. Y. State Museum, p. 176.

the degree of chloritization of the mica. It is without evidence of bedding. This rock grades in places at the south into a laminated finer-grained variety which is common in the gorge of the creek below the railroad bridge at Glenham. At the north this type is more abundant, outcropping frequently between the road from Fishkill Village to Wappinger Falls and Vly mountain.

Vly mountain is composed of this variety. It grades into the coarser rock and, like the latter, is usually chloritized, though the red color of the iron usually predominates. The laminations strike between n. 12° e. and n. 15° e. As was noted in the petrographic description of this gneiss, it occasionally passes into a rock composed only of feldspar and quartz.

The varieties so far described make up the surface rock of the Glenham belt and are the ones which have been emphasized by most observers.

The road from Fishkill Village to Wappinger Falls crosses the Glenham belt diagonally about midway of its length. Several shallow cuts have been made in the gneisses along the road. Beginning at the first cut on the south, the section is through about one hundred feet of a coarse, granitic hybrid rock. This is followed by hornblende gneiss and at the top of the hill the latter is succeeded by a banded, slightly crinkled gneiss with pinkish red and dark green laminae. A hundred yards beyond to the north of this rock on the west side of the road is a massive, coarse granitoid gneiss with quartz, light colored feldspar and biotite as the chief minerals. The joints in this rock are filled or faced with epidote. Beyond this is a fine-grained pinkish rock carrying epidote in many places and very similar in essential mineralogy to that described in the Mount Beacon brook section as composing the wall of the gorge above the bridge. Beyond this the cut is for some distance through medium-grained hornblende gneiss exposed on both sides of the road. The last section, on the east side of the road, is mainly through this hornblende rock which shows slight variations and fairly distinct "bedding," with a southeast dip.

These gneisses of the Glenham belt show no distinct types, except as described above for the surface exposures. On the other hand, the hornblende and other gneisses show marked resemblance to the mountain rocks. Roughly correcting the section for the gradient, the bearing of the road and the angle of dip, which seems a little smaller than that of the mountain gneisses, the thickness of the gneissoid types is similar to those observed in the gneisses of the spurs.

The Matteawan inliers. The coarse granitic rock so characteristic of the southern portion of the Glenham belt forms a small inlier farther south in Matteawan. It begins in "Rock Hollow," just west of the intersection of Washington avenue and the road that connects the latter with Liberty street, and extends south across Rock Hollow road (Walnut street) to Anderson street, and then as a narrower strip to Grove street. (See map of Matteawan, fig. 8.) The rock here is not quite so deeply chloritized as in the Glenham belt.

Another mass of similar rock, about 700 feet long by 400 feet wide, lies to the south of this and forms the conspicuous knoll on which the Matteawan schoolhouse stands. The principal outcrops are between Spring, East and Falconer streets. This mass almost certainly connects with the gneisses in the eastern part of the town, but outcrops are concealed along Mill, Louisa and Washington streets and Mountain avenue between this mass and the westernmost outcrop of the gneisses at the east. Limestone may overlie the gneiss in this interval. The latter outcrops between Woodall and Henderson streets, and presumably has or had an eastward extension from here.

The first inlier described above is succeeded at the south by the basal quartzite which forms a knoll between Anderson, Walnut and Grove streets, and is separated from the Precambric on the north and west by Anderson street. The contact could not be found; it may be faulted. The quartzite is overlain by the limestone on the east and south and on the west for a distance of 75 feet north of Grove street. A small mass of slate has been faulted in between the limestone and the spur of the Precambric on the west of Anderson street, near the house of Mrs C. E. Phillips.

At the northern end of the Glenham belt on the southwest side of Vly mountain, north of the road at its base, a small knoll of quartzite, overlain by limestone, has been faulted with the gneiss of the mountain. It is separated from the main mass of foliated, reddish granitic gneiss by a narrow gully.

As noted above, a coarse granitic rock of a mineralogy quite similar to that of the coarse granitic variety of the Glenham belt and the inliers at the south, occurs in places in the bed of Mount Beacon brook above the bridge. It occurs in outcrops among the gneisses in the eastern part of the town and was noted on Prospect street, 50 feet north of its junction with Walcott avenue and at the corner of Vail avenue and Washington street.

The mineral epidote is of frequent occurrence in the Glenham belt and in places among the gneisses in the eastern part of the town of

Matteawan, and the rock which carries it in these different localities is often of very similar mineralogy and appearance in other respects.

Interpretation. The Matteawan inliers connect the Glenham belt with the Highlands in a very satisfactory way. Other field relations which are cited above, show that the rocks composing these inliers are of Precambric age. The banded gneisses seen in the section on the Wappinger Falls road across the Glenham belt, bear strong resemblance to many of the gneisses outcropping in the town of Matteawan along the base of the mountain. The hornblende gneiss in places is identical with those occurring on the road from Brinckerhoff to Johnsville across the Honness spur. When the dip may be observed in the gneisses along the Wappinger Falls road, it is practically the same as that of the Highlands rocks. The essential identity as to the age and fundamental likeness in mineralogy and relations of these inliers with the Highlands is almost certain.

The character shown by the rocks which make up so much of these inlying masses, and upon which most observers have dwelt, apparently admits of ready interpretation.

During the time the early Paleozoic sediments of this region were being laid down the sea was progressively transgressing upon and overlapping the old land mass from which its sediments were derived. This old land mass would doubtless have become decayed for moderate depths beneath the surface, or at least would have suffered some changes in the minerals composing the rock. Where subaerial disintegration actually took place, its products may have remained undisturbed in favorable places, and it is possible to imagine that they were finally covered by the advancing waters without having been much sorted. In other cases they would have been washed away, leaving only the firmer rock, which probably, however, had undergone some mineralogical changes, such as the alteration of its ferromagnesian mineral. In other instances the disintegrated rock would have undergone partial sorting. In other cases it would have been completely sorted and a pure sandstone formed. In some places the advance of the sea would have been rapid enough to leave most of the material unsorted and only a superficial layer of partially sorted stuff. All would probably have been covered finally by a thoroughly worked over quartzitic sand that deepened offshore as the sea advanced.

In the process of time burial in itself would have brought some changes in the subjacent altered gneisses; but the principal ones would have been effected by the same processes that changed the basal sandstone to a quartzite and metamorphosed the overlying limestone and slate. The partly disintegrated upper portions of the gneisses would have been thoroughly indurated into a compact rock and probably partially recrystallized. The less altered gneiss would also have been changed, although not necessarily in such a way as to form entirely new minerals. Chlorite would now appear in a firm rock as a pseudomorph after biotite, or hornblende, and the old iron oxids would have been preserved as magnetite or hematite. In places where alteration had not taken place, the practically unchanged gneiss would be preserved.

It is possible in this manner to account for the peculiar rock types of the Glenham belt and for the occurrence of such features as a coarse granitic "stratum" resting on upturned gneisses and followed by a somewhat foliated, finer-grained, quartzitic rock as shown in the gorge of Mount Beacon brook; or for the occurrence of such extensive surface developments of rock as the chief varieties of the Glenham belt, which so certainly rest upon and grade into the inclined gneisses. Conditions would have been very favorable for the interaction of feldspars and ferromagnesians, which now find expression in the abundant and widely distributed epidote that clearly belongs to an ancient period of alteration.

A relatively large proportion of the ancient altered gneisses has been preserved in the Glenham belt. The section along the Wappinger Falls road, with its assemblage of altered and unaltered types, seems intelligible from this explanation.

At places, as at Vly mountain, and near "Rock Hollow" in Matteawan, fragments of the quartzite have been preserved and these apparently grade into the underlying rock with which they are both unconformable and coextensive.

These principles of subaerial decay have been applied in the foregoing discussion to certain altered gneisses and hybrid rocks occurring in many places among the Fishkill mountains. They serve to account for an evident ancient alteration in these rocks and for the occurrence of certain types that are intermediate in character between the quartzite and the underlying gneiss.

SUMMARY OF THE MICROSCOPIC CHARACTERS OF THE GNEISSES

A microscopic examination has been made of about twenty-five sections of the gneisses of the Fishkill mountains, selected from types which were believed to show the principal variations in the gneissic series from west to east. A half dozen were also selected from the Glenham belt.

These sections, except perhaps, those of the Bald hill granite gneiss and the Shenandoah mountain granite, do not afford any convincing evidence of the original character of the gneisses. They give some support to the inference made as to their alteration and afford some ideas of the age of different characters in the rocks. In instances, they bear out the character as seen in the hand specimen and in the outcrop. In other cases, on account of the coarseness of the rock, they entirely fail to show the megascopic structural features.

There are no striking variations in the kinds of "primary" minerals present, except in the ferromagnesian, although the proportions vary. Quartz is usually present, frequently in large anhedrons only, but oftener both as large and smaller ones. Sometimes it is absent from the section or quite insignificant. Plagioclase is universal, often with orthoclase, but occasionally alone in types with much ferromagnesian content and little or no quartz. Orthoclase is occasionally in apparent excess of plagioclase and microcline is frequent. Biotite often appears alone as a primary constituent, being clearly of the same age as the other essential minerals. Hornblende often occurs alone in the same relationships. Biotite sometimes occurs with hornblende, but then often suggests a secondary character from its distribution and subordinate amount.

Magnetite is abundant and is evidently secondary. It occurs chiefly in irregular grains in bunches or as dust masses in or near the ferromagnesians, or scattered about the section within the feldspars and along fractures. It is occasionally pseudomorphic after the ferromagnesian. The latter are plainly very ferruginous in character. Zircons are numerous and widely distributed. Titanite apparently occurs as leucoxene about the magnetite at times. Chlorite is abundant, often replacing all or most of the ferromagnesians in the section, but this mineral is associated with the gneisses which, in the hand specimen, betray an ancient alteration. Muscovite or sericite occur only as secondary minerals in the feldspar, except possibly in the Shenandoah mountain granite.

The textural features present some variations, but they do not as a rule help much in deciding the question of whether the rock is sedimentary or igneous in origin. Very often the arrangement is very similar to that in plutonic rocks of the granitic or dioritic types and the modifications shown might readily be explained as due to conditions imposed on a magma. Other gneisses, either from a more granular character or from the abundance of the ferromagnesian mineral, suggest altered sedimentary types. But these features are plainly far from decisive. On the whole, the sections are less satisfactory than the field outcrops; but so far as they go they sustain the uncertainty of the field examination.

If these gneisses are mainly altered sediments they have been so thoroughly crystallized that they now often closely resemble igneous types. The hornblendes in their relation to the feldspars sometimes indicate a formation in the usual order of crystallization from a magma. If mainly of igneous origin, these gneisses were greatly squeezed in their formation and would now be more properly designated gneissoid eruptives than eruptive gneisses. In either case the primary minerals (that is, those plainly belonging to the last change that affected the whole rock) and their essential arrangement are of contemporaneous origin.

So far as examined, the sections are entirely free of the minerals usually found in areas of profound dynamic metamorphism. It is, of course, impossible to tell how many complete metasomatic or other changes these rocks may have undergone, but there appear to be no traces of any antecedent generations of minerals.

The sections sustain the belief that the primary features of the gneisses, as a whole, are of very ancient character and of Precambric age. They show, on the other hand, many evidences of subsequent metamorphism.

This later metamorphism is shown in the sections in several ways, but chiefly as pressure effects. In almost all cases the quartz crystals show pronounced strain phenomena, such as strain shadows and wavy extinction, and are often cracked. The plagioclases almost always show pinched-out, bent or broken lamellae. Fractures and long cracks are common. In places where the gneiss evidently had undergone an early alteration, the rock was indurated and occasionally new minerals formed. Some molecular movement is indicated by chloritic fillings, disseminated magnetite and secondary quartz injected into the feldspars. Some biotite very clearly belongs to this later metamorphism.

Some of the sections from the Bald hill gneiss and those in the bed of Mount Beacon brook show fewer apparent strain effects than those from the spurs farther east, which may be interpreted as the expression within these rocks of a somewhat lesser degree of metamorphism at the west. The conclusion that the primary gneissic characters were changed very little in Postcambric time seems inevitable. As the field relations show the gneisses had reached practically their present crystalline condition and gneissic structure in Precambric time. Because of their early crystalline condition, these gneisses would have undergone fewer changes and a relatively lesser degree of metamorphism than the sediments which overlay them, during the mountain building process of Ordovicic time. Such changes as they underwent from this cause should, however, show some correspondence with those in the younger rocks, as is perhaps afforded in the apparent lesser degree of metamorphism at the west. This difference is not, however, noticeable in the field unless the more clearly " bedded " strata in the bed of Mount Beacon brook and the more clearly definable nature of the altered Precambric gneisses of the Glenham belt are indications of it.

An examination of the thin sections of the gneissoid types from the Glenham belt entirely supports the assertion that these rocks are members of the Highlands gneiss series. In mineralogy, texture and metamorphic characters they are entirely similar. The thin sections of the more characteristic types of this belt afford the clue to their interpretation and seem to show their original nature. They also carry characteristic strain effects.

FAULTS IN THE GNEISSES

During the Green mountain uplift the Precambric gneisses apparently buckled somewhat, but seem to have yielded chiefly by breaking. These faults greatly complicate the problem of the configuration of the Precambric land mass while the quartzite was being laid down.

Beginning at the west, the first fault is that shown by the Glenham belt. A reversed or thrust fault has thrown the gneisses against the slates on the west and south. Evidently the slates were folded and overturned and then overridden by the older rocks. The stratigraphic displacement necessary to elevate the Precambric into contact with the slates must have been an extensive one. Apparently at Vly mountain the upthrust was greater, resulting in the elevation of the mountain mass above the main portion of the belt and causing the transverse break between the two. That Vly mountain is not mainly an erosional feature is indicated by its relationships. It forms an isolated block which is faulted against the slates on the west, north and east. The transverse fault on the south involved the limestones which were bought against the slates on the east of them. The gneiss and limestone form the upthrow as a result of reversed faulting, both resting against the slate. The gneiss apparently also moved with reference to the limestone. Projected southward, the fault on the east of Vly mountain falls in line with the scarp on the east of Bald hill (see plate 5).

The gneiss inliers in Matteawan, south of the Glenham belt, are also clearly faulted against the slates on the west. A long swamp borders the northern one of these on the west, while on the north it is in faulted contact with the slates.

The relationship existing between the limestone and the gneiss all along the eastern margin of the Glenham belt and the smaller masses at the south, is far from plain. Although relatively small, there is probably some stratigraphic displacement, in places at least.

The Bald hill mass shows a still greater vertical displacement. As now uncovered, the break is partly within the gneiss itself and partly along a contact with the limestone, and probably in some places with the quartzite. The slope of the gneiss is always very steep and often precipitous. A moderate slope at the base, in places, may be interpreted as that of the quartzite or the surface from which it has been removed in late geological time. This kind of slope usually changes abruptly to a sharp angle with the vertical in ascending the mountain. The abundant talus at the bases of these scarps is misleading and gives the appearance of a much gentler slope than they really possess. The complementary result of recession of the summits by weathering is also confusing.

Apparently the overthrust which elevated the Bald hill mass involved a larger area of the gneiss. It seems reasonable to explain the faulted contact of the gneiss of the Mount Honness spur and the Fishkill limestone on the northwest of it as primarily due to this thrust. Later or simultaneous tension faulting dropped the limestone east of Bald hill into its present position. A number of scarp faces at different elevations along the northwestern slope of the Honness spur in line with the strike of the gneisses, and visible even in the season of foliage, mark tension strike faulting of diminishing intensity eastward from the great normal fault on the east of Bald hill.

The eastern face of Honness is marked by a rather conspicuous normal fault scarp which diminishes and dies away to the southward (see plate 6). The throw here was not so great as on the east of Bald hill.

Along the west side of the east road from West Fishkill Hook into the mountains, is a drop fault of small displacement. It is marked first by a cliff of the quartzite, but higher up the mountain it is in the gneisses.

Plate 5

Fault scarp on the east of Bald hill

On the east of the Hook spur another fault of moderate displacement has dropped the quartzite and limestone into the East Hook.

The northwestern slope of Shenandoah mountain is very steep from the point where it cuts the southern boundary of the quadrangle nearly to Shenandoah. The quartzite has a northwest dip of approximately 50°. The gneiss in places shows precipitous ledges, though these are not very high. The angle of slope changes abruptly from quartzite to gneiss. The steep dip of the quartzite shows considerable disturbance before the break occurred.

East of Shenandoah mountain is a clearly defined normal fault scarp along which the younger rocks were dropped. Their erosion has formed Shenandoah hollow.

Along the northwestern slope of the eastern gneiss mass are very steep and precipitous scarps, sharper even than those of Bald hill. The drift-covered talus slopes at their bases are not to be confused with the quartzite. It is probable, however, that in places the quartzite was involved in the upthrow and was brought against the limestone.

These breaks are interpreted as the result, primarily, of the compression producing the Green mountain elevation. The tendency was to produce a system of flexures like those in the younger rocks at the north. The gneisses buckled relatively little but, unable to resist the great pressure, were broken and thrust up into the younger rocks. Tension faulting within the expanded arc accompanied or followed the upward thrusting.

The faulting in the gneisses is clearly subsequent to the deposition of the quartzite. The only disturbance capable of producing these effects would appear to have belonged to the close of Ordovicic time.

These faults would certainly have greatly disturbed any orderly sequence which the gneisses may have had.

SUMMARY AND CONCLUSIONS

The relatively brief treatment of the gneisses of this quadrangle given above results from the impossibility of assembling them into an orderly sequence. The thickly-wooded character of the country, the presence of faults and the difficulties introduced by ancient subaerial alteration, greatly hinder their study and make a satisfactory map practically impossible.

The origin of the gneisses is very obscure. In some respects they appear to be largely igneous in character. In many places their sedimentary origin seems almost certain. It is entirely possible that the two kinds occur together in a parallel and roughly alternate arrangement, but faulting makes it impossible to decide this point in the face of the other difficulties present. The thickness is too great to permit the interpretation of a monoclinal series.

It seems entirely justifiable to attribute the apparent igneous character to profound metamorphism. It is plain that if the gneisses represent a sedimentary series in any part, the strata must have been jammed into close folds and overturned. If folding was accompanied by the injection of igneous rocks along the axes of the anticlines, the accompanying alteration would have been very severe and both sedimentary and igneous types would have come strongly to resemble each other. There would probably be no distinguishable exomorphic and endomorphic effects to aid in separating the two.

The gneisses below the bridge in the Mount Beacon brook section show a " bedded " character more clearly than at any other place.

The general absence of crumpling and crinkling in the gneisses is noteworthy in considering the possibility of their sedimentary origin.

Interbedded limestones, if such could be found, were thought of as likely to afford the most convincing evidence of a sedimentary series in these gneisses. Dr C. P. Berkey has discovered such limestones in the Highlands farther south[1] and in the Fordham gneiss of New York city.[2] The possibility that the basic rock and bastite ledges at Hortontown, described in the following pages, might be altered calcareous and magnesian sediments of Precambric age was considered, but the field relations do not easily permit this interpretation.

Taken as a whole, the gneisses in this quadrangle present sufficient diversity to be considered, at least in part, as an altered sedimentary series.

NAME AND CORRELATION

Dr C. P. Berkey[3] has correlated the basal member of the Manhattan series with the basal gneisses of the Highlands and has

[1] Structural and Stratigraphic Features of the Basal Gneisses of the Highlands. N. Y. State Mus. Bul. 107, 1907.

[2] Science. n. s., 37:936.

[3] Structural and Stratigraphic Features of the Basal Gneisses of the Highlands. N. Y. State Mus. Bul. 107, 1907, p. 361.

Plate 6

Fault scarp on the east of Mount Honness, as seen from the West Hook district

called the whole the Fordham gneiss. This he correlates with the Grenville of Canada and the Adirondacks.

THE HORTONTOWN BASIC ERUPTIVE AND ASSOCIATED METAMORPHIC ROCKS

General relations. In the orchard by the house and near the barn on the farm of Albert Lawrence at Hortontown, are several outcrops of a massive, compact, greenish rock. One or two ledges are of moderate size, but most of the outcrops are small and inconspicuous. This rock is traceable only a short way to the north or south by actual outcrops, but in the fields and stone walls south of the orchard there are numerous boulders of this rock. The actual ledges disappear beneath the hill to the southwest of the orchard. At the summit of this hill, in a west by southwest direction from the house, and about 200 or 300 yards away, are numerous ledges of a rusty, blackish rock, which may be followed to the southwest for a short distance and then are lost. Just to the west of these outcrops, on both sides of the road and in the road itself, are numerous outcrops of quartzite with southeast dip and a strike east of north. A conspicuous ledge of this quartzite borders the west side of the road. West of this is a gully about 50 or 75 feet in width which at the west is bounded by a perpendicular cliff of the gneisses. The relationships just described are indicated on the accompanying sketch map (see figure 11).

It was not possible to determine the configuration of the mass to which the greenish rock belongs. The east-west distance between outcrops was estimated at 50 feet, but there is reason for thinking that the rock has a greater extent.

Petrography and general description. The greenish rock is very tough. It shows variations from a greenish black rock, streaked with lighter green, through a mottled variety to a lighter, greener rock with a tendency to fibrous structure.

The rock may be cut with a knife. Some varieties, when polished, give a rich, dark, glossy finish. When powdered and tested by the magnet it reveals large quantities of magnetite to which the darker hues are due. Weathered surfaces show freckles of black and greenish yellow, caused by the bleaching of the microscopic crystals among the magnetite grains. The thin section in transmitted light shows innumerable dustings and irregular grains of magnetite, while the rest of the section is yellowish white. With crossed nicols the latter appears as a network of spindles, flakes and needles of bastite. There seems to be no trace of an antecedent mineral (see figure 12).

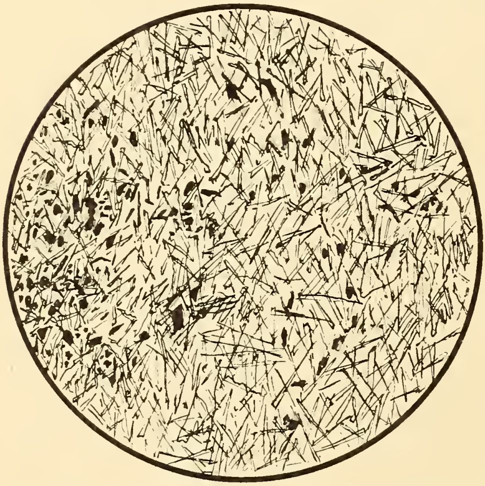

Fig. 12 Bastite rock at Hortontown. Actual size 3 mm. Showing a network of bastite needles and spindles with many grains of magnetite

The ledges of the black rock are prevailingly rusty. Excavation has been made at one place to a depth of two or three feet, apparently in a search for ore.

These ledges are inconspicuous, and, when surrounded and overgrown by grass, are readily missed, except in systematic search.

The hand specimen shows a very coarse texture. The rock is made up chiefly of massive hornblende. There are patches of finer texture in which magnetite is abundant. Small pyrite grains are frequent. In some places the hand specimen shows a relatively porous mass of rounded grains as though some mineral had been dissolved away. The rock has a high specific gravity and in almost all cases is rusty in color. The thin section shows large, irregular pleochroic brown and green hornblendes, with some pyroxene. Magnetite inclusions are numerous and this mineral also occurs abundantly along numerous cracks, sometimes in association with serpentine borders or fillings.

The ledges of the quartzite are more numerous and more extensive than those of either of the other rocks. Its apparent width is about 75 or 100 feet. It is thin-bedded and steeply inclined. It is very similar to the basal quartzite as seen at certain places and appears to belong to that formation. It may be followed distinctly for several hundred feet.

At the north and south these types give way to the characteristic gneisses of the mountains.

The exact field relations of these rocks are very obscure. No contacts could be found. Seemingly the only clue to their age and relationships is to be obtained from the structural features and the associations.

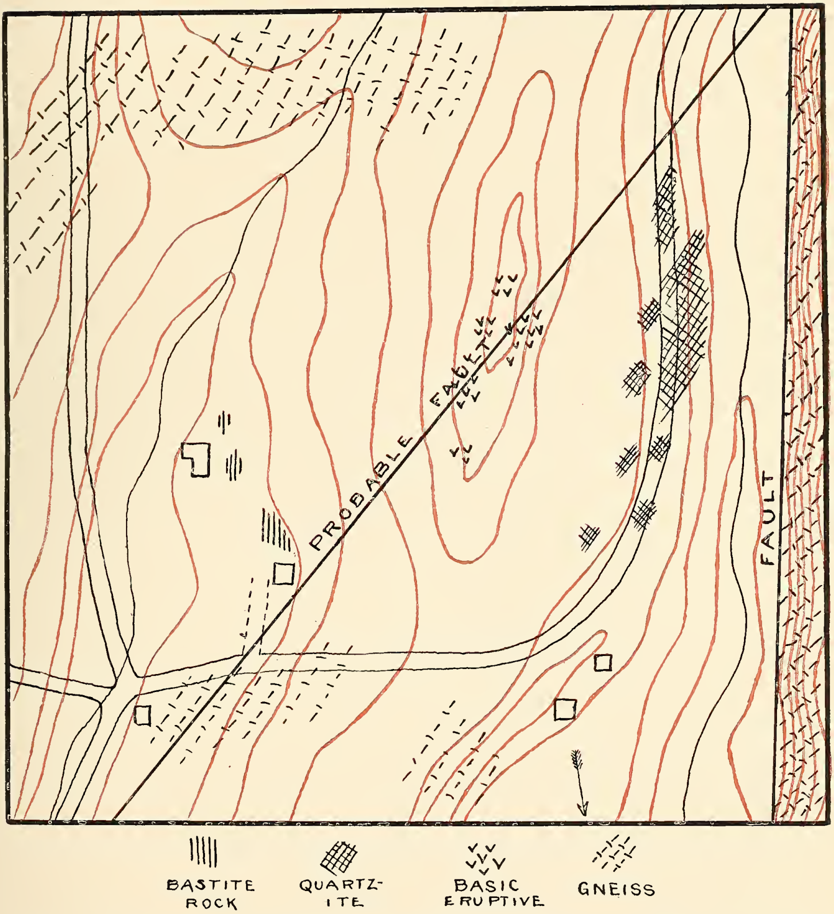

Fig. 11 Sketch map to show the general relationships at Hortontown. Scale approximately 200 feet to the inch.

Interpretation. The possibility suggested itself that some of these rocks might be members of the basal gneiss series. The quartzite, however, is almost certainly Paleozoic in age. The black hornblende rock has the characters of a basic eruptive. The green serpentine variety gives little idea of its original character, but it is apparently not an altered pyroxenic rock.

The southwestward continuation of the reversed fault along the northwestern slope of the eastern gneiss mass would apparently intersect the fault on the east of Shenandoah mountain in this neighborhood. The latter scarp is only a short distance west of the quartzite. This intersection would have been a most favorable point for an igneous intrusion. Some of the basal Paleozoics were evidently caught at this intersection and intruded by the hornblende rock. The quartzite offered little for the eruptive to act upon. The bastite rock very probably represents an impure ferruginous dolomite. From what is known of bastite, it is commonly, at least, the alteration product of orthorhombic pyroxene; but the present rock gives no indication of the former presence of any antecedent mineral. There seems to be no grave objection to the inference that the passage was direct.[1]

This is the only occurrence within the quadrangle that permits the interpretation that an eruptive has penetrated and altered the overlying Paleozoics.

THE BASAL QUARTZITE (POUGHQUAG)

Distribution and general structural features. This formation, which has frequently been mentioned in connection with the gneisses, in this quadrangle occurs only in proximity to the Precambric rocks.

In the town of Matteawan the quartzite forms a small inlier as described above, in connection with the first small inlier of gneiss south of the Glenham belt (see page 28). Outcrops were also seen just north of Howland avenue in the open field at the foot of the Mount Beacon incline. The only other outcrops which have been noted in this vicinity occur farther north along the base of Bald hill on the Maddock estate.[2] About 300 yards south of the house and well up in the woods, about 200 or 300 feet east of the private

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[1] Professor B. K. Emerson assisted the writer in the identification of the mineral bastite.

[2] The presence of the quartzite at this point was discovered by a companion, Mr W. R. Clarke.

drive, are two or three good-sized ledges. Farther up the hill on Mountain street at the point where it forks, going east, is an outcrop of the quartzite. This was first interpreted as a boulder, but the proximity of this rock in place farther down the hill suggests that it is a small ledge which has been preserved. These outcrops are the only ones which were noted in this town, after a careful search, which were referable to the quartzite as typically developed in this quadrangle.

As has been discussed above, there is strong reason for thinking that certain phases of the gneiss owe their peculiar character to the subaerial decay and partial sorting which took place during the epoch of the transgression of the sea in which the quartzite was laid down, and are therefore of the same general age.

At Vly mountain a small patch of the quartzite has been preserved just north of the road on the south side of the mountain at the summit of the hill as the road descends into the swamp, going west.

A careful search was made along the northwestern base of Bald hill from the Maddock farm to the northeastern end of the spur. The topography between the more precipitous portion of the hill and Fishkill creek often suggests the presence of the quartzite. Outcrops are few and the gentler basal portions of the slope are usually drift-covered. The foliated Bald hill gneiss outcrops in places north of the Maddock residence between it and the farmhouse at the northeast. Outcrops are absent at the base of the gneiss to the northeast of this farm, nearly to the end of the spur. The ledges of gneiss often rise precipitously from the edge of the gentler portion of the slope and the bases of the scarps are hidden by abundant talus which, in many cases, doubtless forms the gentler slopes. Near the extremity of the spur, due south from Fishkill Village, a ledge of the quartzite was discovered in the woods near the edge of the gneiss. The gneiss extends to the north of this ledge.

The Bald hill thrust carried the quartzite with it in places before the rupture occurred and in these places a characteristic quartzite slope has been preserved. Only a few scattered ledges now mark the former presence of this formation in the eastern part of the town of Matteawan. The small ledge near the extremity of the spur seemingly belongs with the upthrow block and probably rests by thrust against the limestone. It is a question whether the precipitous ledges of the gneiss northeast of the Maddock farmhouse rest against the quartzite or the limestone.

The map represents the quartzite slope, with the break to the southeast of it passing into the limestone southwest of the Maddock farmhouse. Northeast of that point it shows the gneiss against the limestone for a distance as indicating the tendency of the thrust, and then against the quartzite, with a probable break between the quartzite and the limestone.

There are no traces of the quartzite south of Fishkill Village in the valley of Clove creek, nor along the northwestern base of the Honness spur. Along the northwestern base of Mount Honness proper the gneiss is only 50 or 100 feet from the limestone, from which it rises in bold ledges. The quartzite may once have covered a portion of the northwestern slope of this spur.

East of Honness, about one-third of a mile south of Johnsville, the compact quartzite with some conglomerate outcrops for a short distance in the woods at the base of the scarp, but is soon lost beneath the kames which rest against the cliff. South of these kames on the farm of Irving Knapp, as mentioned above, a large mass of rock with northerly dip forms conspicuous ledges in the east fork of the mountain roads. It resembles both the quartzite and the gneiss and probably represents a transition from one to the other. The quartzite outcrops along the road east of Knapp's, in one or two places, but is mostly concealed by drift west of the west road from the Hook into the mountains. It was found in the bed of the brook just west of John Ireland's house and about 300 yards south of the Thomas Carey farm on the roadside just above the brook. Some conglomerate occurs at this point. Eastward from the Carey farm, on the farms of Garrett Smith and Ward Ladue, it forms large conspicuous ledges and extends to a point one-fourth of a mile south of Garrett Smith's and terminates with an abrupt talus slope in the woods. The unconformity between the quartzite and gneiss is plainly shown just south of Alonzo Smith's (see plate 4). East of the east road into the mountains, the quartzite extends a little farther south before the gneisses are reached. The southern boundary swings round northwest of the McCarthy place and then east through the woods across the Hook spur to the fault on the east of this. At this point the quartzite was dropped by a fault and is now concealed by surface deposits nearly to the quadrangle boundary. Just north of the road on the west side of the brook it appears in large ledges. Low ledges of limestone outcrop in the meadow just east of the brook.

Near the quadrangle boundary a small brook, which comes down from Shenandoah mountain, has cut through the surface deposits.

The quartzite was found exposed well up the slope in the bed of this brook dipping 50° to the northwest with a strike of n. 49° e. following closely the strike of the ridge. For a mile and a half to the northeastward this formation forms a clear topographic feature, though concealed by drift. Farther on it outcrops frequently and in large ledges along the south side of the road from the East Hook to Shenandoah. It crosses the road less than one-fourth of a mile west of that hamlet and is succeeded by the gneisses. There are numerous outcrops of the quartzite just north of Shenandoah. It is probably cut off at the east by the fault that borders the mountain on the east.

The quartzite is absent along the eastern base of Shenandoah mountain until one reaches the mass associated with the basic eruptive at Hortontown (see page 39).

Along the northwestern slope of the eastern gneiss mass the topography from the schoolhouse near Hortontown to Fowler's kaolin mine suggests the presence of this formation. The quartzite was not found and the lower portion of the slope is covered with drift which contains frequent large quartzite boulders. The kaolin rock at Fowler's mine may represent the quartzite. It seems likely that the gneiss rests against the limestone southeast of Shenandoah, and that the quartzite has since been eroded. South of the junction of the Hortontown and Mountain roads, gneiss is the outcropping rock in the valley of the brook as far as Hortontown.

Along the slope of the eastern mountain mass, northeast of the kaolin beds and the ore deposits, everything is beneath the drift for a long distance at the base of the mountain. The gentle slope which is present is probably due to talus. No outcrops of the quartzite were found. South and southeast of Charles E. Bailey's the limestone is only a short distance from the precipitous gneiss. Just north of the road at the base of the mountain scarp, east of Bailey's, a wide swamp extends northeastward. Three-fourths of a mile east of the point where this road turns southward into the mountains the quartzite was found in good-sized ledges within the edge of the woods.

The conditions along this slope resemble those described for Bald hill. There was a tendency for the quartzite to fold somewhat before the rupture occurred, and the slope of the hill marks the slope of the quartzite as seen southeast of Shenandoah. Toward the northeast the rupture occurred earlier, so that the gneiss now stands in precipitous ledges against the limestone. Farther on, east of Bailey's, the quartzite was brought against the limestone marking a diminishing tendency in the thrust to the east. As shown on the map portions of the quartzite are yet preserved near the quadrangle boundary. Where the quartzite could not be found the gneiss is represented as resting against the limestone; but in some cases, as discussed above, the quartzite may have once been present.

The wide swamp east of Bailey's marks the northeastward continuation of the great thrust fault along the limestone-quartzite contact.

Petrography and general description. This formation has great uniformity of appearance and general character throughout the area. Its principal variations may be stated very briefly. The predominating variety is a compact, granular quartz-rock of medium grain. This grades into a fine conglomerate at the base in a few places and in others at the top into finer-grained quartzitic shales. The predominating variety is either white or pinkish in color. Feldspathic varieties are rare.

Within the quadrangle there does not appear to be any appreciable difference in metamorphism in this formation from west to east. At the type locality at Poughquag there is indication of a gneissoid character. Within this quadrangle the quartzite apparently never was involved violently enough to induce this structure.

The thin-bedded varieties, often with shaly character, were noted at the northern end of the Hook spur south of the Hupfel estate, in the steep bed of the brook in the East Hook near the quadrangle boundary, north of Shenandoah and at Hortontown. Conglomeratic phases were seen southwest of Johnsville near Honness mountain, south of the Thomas Carey farm in the West Hook and north of the McCarthy place to the east of Ward Ladue's.

Strikes and dips in this formation vary greatly. In Matteawan good observations could not be made in the thick quartzite south of Anderson street nor at the foot of the Mount Beacon incline. Readings taken just south of the Maddock residence gave a strike of n. 75° e. and a dip of 54° n. w. The gneiss, only 30 feet away, dipped 50° to the southeast. Observations at the quartzite ledge at the extremity of the Bald hill spur gave a strike of n. 42° e. and a dip of 48° to the northwest. A reading taken on the east of Honness gave a strike of n. 42° e. and a dip of 35° southeast. South of the Carey farm in the West Hook the dip is 15° to the northeast. On the farms of Garrett Smith and Ward Ladue, west of the fault, the dip is to the northwest. East of the fault it is to the northeast. As the boundary swings round the western slope of the Hook spur, the dip changes from northeast to north and northwest, and at the northern end of the spur from northwest to north. On Shenandoah mountain in the East Hook, near the quadrangle boundary, the strike is n. 49° e. and the dip 50° n. w. This general strike and dip holds to Shenandoah. North of Shenandoah the dip changes to north. The quartzite disappears at the east under a mass of kames. Readings made a mile east of Bailey's gave a strike of s. 70° e. and a dip of about 18° n. e.

The quartzite thus follows the folds of the gneisses and, although eroded and disturbed by faulting, tends to fringe the spurs and hollows along the northern margin of the Highlands.

The conformable series at West Fishkill Hook. East of the normal fault that extends along the east road into the mountains, the basal quartzite is overlain by bluish-gray limestones having the same dip as the quartzite. The nearest approach to actual contact is in Ward Ladue's orchard, a few feet north of Jones's barn. The pinkish ledges of granular quartz rock are only a few feet away from the limestone and the two are seen to be in strict conformity. The limestone, which is greatly broken up into large blocks, can be followed to the south and east. In both directions it is succeeded by the quartzite. The limestone swings round the northwestern slope of the Hook spur and appears in numerous ledges in the fields southeast of W. L. Ladue's barns. Here it is conformably overlain by gray calcareous shales. At the eastern side of the pasture, south of the orchard on W. L. Ladue's farm, the shales dip to the northwest and north. A little farther west, in the center of the field, the interbedded shales and shaly limestones have buckled into a low anticline.

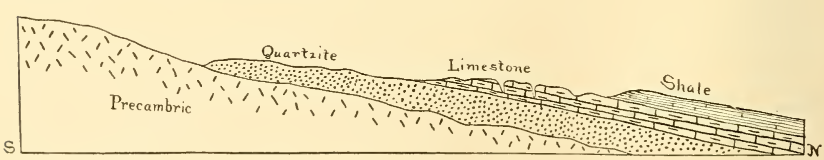

Fig. 13 Generalized section to show the conformable series of the Lower Cambric in the West Hook district. Distance approximately one-third of a mile

Fossils from the quartzite and overlying limestone. With the exception of a few worm borings found in the quartzite along the west road from the West Hook into the mountains in the summer of 1906 (see figure 14), fossils had not been discovered in this formation up to the summer of 1909.

In August of that year the writer discovered in the yard of Ward Ladue at the West Hook a fossiliferous slab of compact quartzite, about three feet square, and plainly derived from a bed about five inches thick. Both surfaces were covered with fossils, chiefly brachiopods and the cephalic borders and spines of trilobites. Some of the latter were from one and one-half to two inches long.

Fig. 14 Worm borings in Lower Cambric quartzite

This slab was from a fine-grained, gray quartzite bed and was very compact and resistant. The fresh surface showed numerous rusty markings.

This discovery led to persistent search for the fossiliferous rock in place.

Directly south from Ward Ladue's house a gorge in the quartzite apparently marks the beginning of the normal fault displacement that extends southward just to the west of the public road. The western wall of this gorge is composed of thickly bedded compact quartzite. The eastern wall shows thinner rusty layers interbedded with the compact rock. The fact that only a hundred feet or so to the eastward the quartzite is overlain by the limestone, together with the evidence of faulting, were taken to indicate that the rocks in the eastern wall are younger than those on the western or upthrow side. With this assumption as a basis, and in the belief that the rusty layers interbedded in the superficial portion of the quartzite should yield fossils, if such were present, the eastern wall was given a very careful examination. No fossils could be found between Ladue's and the point where the gorge intersects the road. Although the dip of the quartzite is very gentle along here, the thickness crossed is considerable.

The gorge was then traced southward from the road. A rich assemblage of fossils was discovered in the eastern wall about 250 yards southeast of Herman Adam's house. The ledge occurs just beneath an old stone wall that separates the gully from an old orchard. The fossil traces were first discovered in the compact rock similar to that seen in the slab in Ladue's yard, and showing the same rusty markings on the fresh surface. This rock overlies some thinner, rusty, decomposed layers in which fragments of trilobites and brachiopods are very abundant. The trilobite fragments are smaller than those displayed on the slab described above, but in other respects are quite similar. They were identified as fragments of Olenellus, probably thompsoni. The brachiopods bear a strong resemblance to Obolella. Two specimens of the rusty quartzite crowded with fossils are shown in figure 15.

Fig. 15 Fossiliferous Lower Cambric quartzite

In the summer of 1908 the opercula of Hyolithellus micans were discovered in the limestone overlying the compact quartzite in Ladue's orchard at an estimated distance of 20 feet above the latter. After a careful search another operculum was found at a slightly higher level in the first ledge east of the lower barn on Jones's farm.

Age and correlation. These fossils prove the quartzite to be of Lower Cambric age. The similar relations which it has to the underlying gneiss indicate that it is the equivalent of the basal quartzite at Poughquag. The latter was described and named by Prof. J. D. Dana[1] as the Poughquag quartzite.

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[1] Amer. Jour. Sci., Ser. 3, 1872, 3:250–56.

Summary and conclusions. The relationships among the quartzite, limestone and calcareous shale described above are exhibited nowhere else in this quadrangle.

The field relations of the gneisses and the quartzite indicate that the older rocks have been thrust up into the younger series and that in general their present relative position must be regarded as very different from that which obtained when the Cambric sea overlapped the older land. It is plain that the quartzite was involved in the thrust movement and, although never violently folded, was yet greatly disturbed by folding in certain places. In many instances the quartzite was moved bodily with the gneisses, so that where it is now present, or was apparently present up to a comparatively recent epoch, it is not contiguous with the limestones of its own epoch, but with later ones on which it has been thrust.

A not unreasonable restoration of the Precambric floor, which is thus assumed to have been fractured and elevated, would allow a considerable extension of the thick quartzite formation southward from its present northern position. The actual evidence for such a former extent consists in the faulted mass at Hortontown, which, since the thrust movement was northwestward, could hardly have had an original position farther northwest, but which might readily have come from the southeast, and in occasional ledges observed in the woods during a reconnoissance south from West Fishkill Hook across the quadrangle boundary. The character of the slope of the quartzite where least disturbed, as in West Fishkill Hook, its thickness and the rather steep southern termination at certain places, indicate a former southward extension.

The varying strike and dip of this formation is best interpreted as the result of disturbance subsequent to its deposition, rather than to original initial slope.

In attempting to explain the present valley position of the younger rocks along the northern border of the Highlands, instead of assuming that they were deposited in valleys, we are offered the alternative explanation of down-faulting, and subsequent partial or entire erosion in which the ice sheet may have played an important part.

The Precambric masses may have stood as islands in the early Paleozoic sea, but the present relationships do not require such an interpretation.

The disturbance of the quartzite has given it such inclination that it might be regarded as of different geological age at different altitudes. Of this there is no evidence.

THE WAPPINGER (BARNEGATE) LIMESTONE

This formation appears within the quadrangle in two main belts with some smaller faulted masses lying between them. The westernmost main belt is the Barnegate limestone of Mather,[1] but now commonly referred to as the Wappinger creek or New Hamburg belt. It is followed by Wappinger creek from the latter's source near Pine Plains to the Hudson river, and its eastern contact with the overlying "Hudson River" formation crosses the river at New Hamburg. The eastern belt is known as the Fishkill limestone, as it lies chiefly in the town of old Fishkill.

THE WAPPINGER CREEK BELT

This belt enters the quadrangle from the north at Pleasant Valley and continues in a southeast by south course to New Hamburg. It reappears west of the Hudson and continues in the same direction beyond the western boundary. East of the Hudson it is broken up into a central strip, with a large rectangular strip on the west of this along its southern half and separated from it by a narrow band of the slates, and several smaller masses lying to the east of the central strip along its middle portion.

THE WESTERN STRIP

Boundaries. This strip is clearly faulted against the slates at the north. The fault line runs in a southeast-northwest direction across the Poughkeepsie driving park. The western contact is marked at many places by swamps or scarps which indicate that the western margin is also a faulted one.[2] The presence of a fault along here receives confirmation from the apparent age of the limestone in contact with, or in proximity to, the slates. The western boundary begins just southeast of the junction of Hooker avenue and the road that runs southward from it on the west of the driving park and passes across the northwestern part of the Ruppert farm and just west of the old Hinckley house, and then may be traced by swampy ground or a low scarp to the schoolhouse at the corner of the Spackenkill and Poughkeepsie roads; thence under drift to the first road leading to the river. The limestone outcrops on the north side of this road in low-lying ledges and in more conspicuous ones south of it in proximity to the slates. From here the contact is

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[1] Geology of the First District, 1843, p. 410.

[2] This fault was described by Professor W. B. Dwight. See Amer. Jour. Sci. Feb. 1886, 31:125–37, with map.

indistinctly followed to the river, where the limestone terminates in a bluff. The northern portion of its eastern boundary is concealed by drift, but farther south to the east of the road that runs southward on the east of the driving park the limestone forms a conspicuous feature for several hundred yards along the eastern edge of R. J. Kimlin's farm. Southwest from here it apparently follows Casper creek to the Hudson river. The slates which come in between it and the central strip form conspicuous ledges both north and south of the Spackenkill road and were noted southwest of the Poughkeepsie-Wappinger Falls road, on the east side of the road to New Hamburg, and also near the Hudson river. The lower reaches of Casper creek, west of the Poughkeepsie road, are choked with kame deposits.

Terranes present. The Potsdam and Trenton horizons have been recognized in the strata composing this western strip of limestone.

The Potsdam. Fossils belonging to this horizon have been discovered in a few places. The first were reported by Professor W. B. Dwight[1] from the northern portion of the strip. Just south of the Poughkeepsie driving park, and to the west of the new private road which runs south from the park to the Ruppert farmhouse, are a number of low-lying ledges. They have yielded: "Lingulepis pinniformis, L. minima, L. acuminata, Obolella (Lingulella) prima, Obolella . . . resembling 'nana,' Platyceras, Ptychoparia (Conocephalites) n. sp. Dicellocephalus, Ptychaspis, Stromatocerium, encrinal columns." A few months later Professor Dwight reported other Potsdam fossils from a locality about a mile southeast by south on the Spackenkill road, about one-half mile east of the Ruppert farmhouse, at the point where the private road to the Varick farm leaves the main road. In addition to Lingulepis pinniformis and allied species found at the first locality, he identified Ptychoparia saratogensis Walcott, and P. calcifera Walcott.[2] These fossils may be seen in the museum of the Vassar Brothers' Institute at Poughkeepsie. Another ledge yielding L. pinniformis was found by Professor Dwight near the eastern margin of the belt about one-half mile southeast of the first locality described.[3] This ledge is just east

[1] Amer. Jour. Sci., Feb. 1886, 31:125–37. See also Trans. Vassar Bros. Inst., 4:130–41.

[2] Trans. Vassar Bros. Inst., v. 4, pt. 2, p. 206–14.

[3] Amer. Jour. Sci., July, 1887, 34:28–32.

of the little house north of Mr R. J. Kimlin's barn. The ledge carrying Solenopora compacta found by Professor Dwight is only a short distance to the southeast.

In the summer of 1908 a new Potsdam locality was discovered by the writer. The beds yielding fossils were found in the quarry on the Ruppert farm about 200 yards north of the Spackenkill road. The rock was being removed for lime and blasting operations greatly facilitated the search for fossils. These are scattered and usually fragmentary. They are embedded in compact, resistant limestone which made the search difficult. A half dozen good specimens of Lingulepis pinniformis were found, besides numerous fragments; also a head of Ptychoparia sp. A photograph of the quarry is shown in plate 7. Fossils seemed most abundant in the middle layers. Figure 16 shows two of the best preserved specimens of L. pinniformis.

Fig. 16 Two specimens of Lingulepis pinniformis from the arenaceous Upper Cambric limestone beds at Ruppert's quarry

The rock in the floor of this quarry showed many peculiar markings of concentric rings from three-fourths to one inch in diameter. These were sectioned and examined by Professor John M. Clarke. A part of a letter from Dr Clarke referring to these structures is given below.

"I have had the specimen you sent to me cut and polished in the hope of bringing out some structure from the concentric masses therein. The result is not very satisfactory, except as indicating what seems to be an inorganic origin, though I would not be willing to say that the masses were not spongoid like Streptochaetus. The successive laminae might indicate such a structure, but the intimate composition of the skeleton has been so altered by granulation as to seem to leave possibility of organic structure pretty hazy; yet I am inclined to believe that the rock carries organic remains, as

Plate 7

Showing the almost horizontal Upper Cambric beds in the quarry at Ruppert's farm southeast of Poughkeepsie. These beds dip slightly to the west. The middle layers have yielded *Lingula pinniformis* and *Ptychoparia* sp.

indicated by apparent fragments of shells seen on polished surfaces and in section. I return these specimens to you for your examination. I notice that one side of the rock specimen exposes something that suggests a head of Conocephalus or other primitive trilobite."

Figure 17 is a photomicrograph of a section of this rock and shows what appears to be a fragment of a tiny shell. The microscope failed to bring out any structure in the concentric masses.

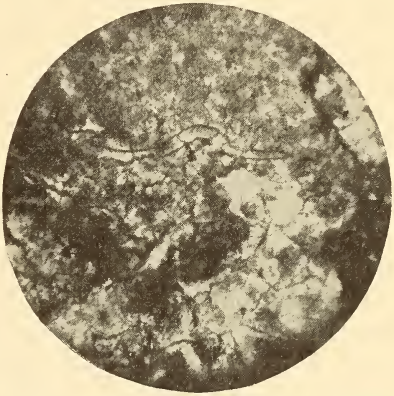

Fig. 17 Showing a thin section of the limestone in the floor of Ruppert's quarry

In addition to the suggestive marking referred to by Doctor Clarke as possibly representing a trilobite cephalon, the writer noted another strongly suggesting a Hyolithes.

The rock layers in the floor of the quarry are about ten or twelve feet below the layers yielding L. pinniformis and the whole are conformable.

The Trenton. This horizon, as mentioned above, was reported by Professor Dwight from the eastern margin of the belt on the farm of R. J. Kimlin and was recognized by the presence of Solenopora compacta. No other localities have been described.

Petrographic characters and further description. The Potsdam rock in the locality first reported by Professor Dwight was described as varying from a tough compact limestone through fissile, shaly argillaceous types and arenaceous and oolitic limestones, into quartzitic varieties which were sometimes brecciated. All were calcareous. These may be verified for the most part. The calcareous quartzite is often friable from the loss of the carbonate and rusty from iron discoloration. It frequently carries shell-like depressions or molds. Along the western margin of this strip large quantities of sand are dug and shipped away for molding purposes. In appearance, it strongly suggests the rusty quartzitic phase of the Potsdam of this western strip. As favorable a place as any for observing this sand is on the farm of Mr Toel on the Camelot road north of Casper creek.

A section beginning at the eastern margin of the belt, just southeast of R. J. Kimlin's farm, and running west along the Spackenkill road to the Poughkeepsie road, and then continued to the river along the road to the molding sand dock a mile and a half north of Camelot,[1] and thence along or just east of the track to Camelot station gives all the principal varieties of rock that have been met with north of Stoneco quarry.

Beginning at the east, south of Kimlin's farm, at the top of the hill on the Spackenkill road, the rock in the ledges is of a light steel-blue color and of medium grain (letter A in the section, fig. 18).

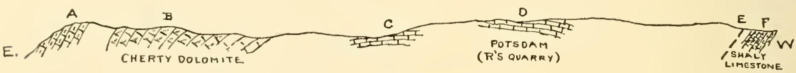

Fig. 18 Section along the Spackenkill road

It often carries on fresh surfaces markings of calcite, shaped like the segments of various curves, and blackened depressions and pits which have no particular or definite form. Just north of the junction of the two roads at this point on the east side of the road that passes Kimlin's house a brecciated conglomerate was noted resembling the Trenton as seen elsewhere in the quadrangle and carrying masses that resembled *Solenopora compacta*.

The next cut west on the Spackenkill road shows many chertlike masses and scroll effects of silicious material that have weathered out. North of here in the fields of Mr Mulkemus and in the neighboring woods the ledges carrying this variety of rock are very numerous and may be traced some distance east and west (lettered B, fig. 18).

This rock gives place, near and at the junction with the Varick road, to dull gray ledges of arenaceous limestone which has a coarse sandpaperlike appearance on weathered surfaces. One-fourth mile beyond this, rock outcrops on the north side of the road and lies quite flat (lettered C, fig. 18). The rock at Ruppert's quarry, one-fourth mile farther west (lettered D, fig. 18), in general character is almost identical with that of the two previous outcrops. The rock in the quarry varies in color from black to gray. The beds average thicker at the base and grow thinner toward the top. There are a few shaly layers. The strike of the quarry rock is about n. 75° e. and the dip about 10° northwest.

At the corner of the Spackenkill and Poughkeepsie roads impure limestone outcrops on the east side of the latter road with

[1] Camelot station is at the point marked Stoneco on the map. The name Stoneco is usually applied to the Clinton Point Stone Company's quarry, a mile below Camelot station.

a strike of n. 23° e. and a dip of 70° s. e. This may belong with the slate formation and may therefore be on the downthrow side (lettered F, fig. 18).

Ledges of rock similar to that in Ruppert's quarry occur to the southeast along the western margin of the belt, to the north and south of the first road leading to the river, and west of the road leading from this toward Camelot station. East of Camelot station, about 100 feet up the hill, on the south side of the New Hamburg road, ledges of rock identical with that in Ruppert's quarry strike approximately east and west and dip about 12° to the south.

The first road leading to the river, south of the Spackenkill road, leaves the Poughkeepsie road (old Albany turnpike) one-fourth mile south of the schoolhouse. The river road gives off two branches, the shorter, lower one going to the dock of the Whitehead Sand Company and the other to Camelot station.

On the east side of the lower road, just north of the red house, coarse conglomerate, familiar in Trenton localities within this quadrangle, outcrops in one or two large ledges. This rock, in a brecciated condition, was also noted farther south along the upper road where this runs parallel with the railway track, about one-fourth mile north of Camelot station.

Along the middle portion of this western strip the topography generally indicates a very gently sloping almost flat substratum of rock, and the extraordinary width of the belt is plainly due to the nearly horizontal position of the underlying strata for long distances.

The varieties of rock described by Professor Dwight would seem to be accounted for mainly as outcrops across the dip of several beds showing variations of texture and composition, and partly to the different effects of weathering on these, as well as to possible frictional brecciation.

The portion of the section which may be seen at Stoneco in the quarry of the Clinton Point Stone Company is between one-fourth and one-third of the breadth of the strip from its eastern margin and displays a thick mass of dolomitic limestone dipping gently to the west (see plate 8). For the most part it is thick-bedded. There are some thinner layers near the top and in the middle. Some beds carry numerous chertlike masses and in this particular, as well as in

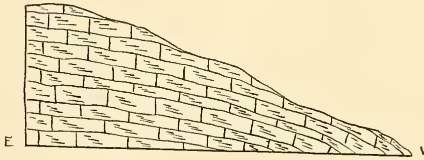

Fig. 19 Section at Stoneco quarry

general character, the rock strongly resembles the variety described above along the Spackenkill road on the farm of Mr Mulkemus near the eastern margin of the belt. No fossils were found in the beds of this quarry and hence no definite idea of its age could be obtained.

Just east of Camelot station, as described above, arenaceous limestone identical with that in Ruppert's quarry, dips to the south at an angle of 12°. This suggests a southward pitch and a superior position for the strata in the Stoneco quarry, a mile to the south of Camelot.

The stratigraphic position and estimated thickness of the Stoneco beds agree with those of the cherty rocks along the Spackenkill road to the northeast. Presumably these strata once entirely covered the Upper Cambric (Potsdam) along the central and western portions of the strip and have been preserved at the south on account of the pitch of the series.

Structural features. It is not possible to tell with absolute certainty what the exact relationships are among the different strata composing the series of this western strip. Presumably the Upper Cambric beds are followed conformably by those which apparently have a superior stratigraphic position. But in these latter strata it is necessary to recognize a probable interval of erosion as is indicated by relationships which can be determined with more exactness within the central strip and which is shown by the presence of a conglomeratic layer, even in this western belt. As will be discussed farther on this conglomerate, though possessing peculiar features, marks a change in fauna as well as in the lithic character of the rock and must be taken as marking a definite hiatus.

The present almost horizontal position of the Upper Cambric and overlying beds theoretically admits of two explanations. It either represents a close overturned, recumbent fold, or else a reversed fault accompanied by westward thrusting, which was preceded by only relatively little folding.

These rocks show no indications of extensive slickensiding, of compression of layers, or of flow structures such as would be expected in violently folded strata. There is evidence of some brecciation and slipping in the rock along the eastern margin, but this is not severe. There is extensive fracturing which is, however, readily explained by the hypothesis of reversed faulting and thrusting.

The field relations point to an upward movement of older strata into overlying younger ones similar to that already described for

Plate 8

A portion of the southeast wall at the quarry of the Clinton Point Stone Company, Stoneco, showing the thickly bedded limestones dipping to the west

the gneisses. Along the western margin of the strip the compression brought the Upper Cambric beds against the slates, which were first folded and overturned and then overridden. At the quarry at Stoneco and below Marlboro station across the river the westward dipping younger strata show a diminution in the upward thrust toward the southwest which may be associated with an earlier release that elevated the Glenham belt.

As already indicated, the conglomerate appears in places along the western margin of the strip. It is best interpreted as belonging with the downthrow block and is to be associated with the slate rather than with the limestone. It is likely that there was a strong horizontal component in the thrust that carried the older beds over the slates to the west of this strip.

The conglomerate along the eastern margin would appear to occupy a normal position, but the fact that it is brecciated is noteworthy. The presence of ledges yielding Lingulepis pinniformis, as described above (see page 49), along the eastern margin in the near neighborhood of the Trenton, seems best explained as an instance of faulting. The Potsdam beds seem clearly to have been overlain by younger strata, as is now the case at Stoneco quarry. It does not seem possible from the relationships exhibited elsewhere that the overlying strata were eroded so as to expose the Potsdam before the deposition of the Trenton.

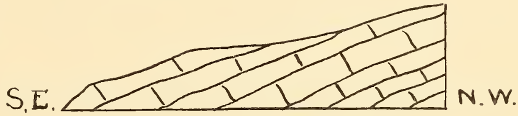

Fig. 20 Section at Danskammer

Apparently the limestone on the west of the Hudson is essentially the continuation of this western strip, but presumably the beds are younger even than those of the quarry at Stoneco. Some of them resemble the beds of the central strip, as shown at the New Hamburg tunnel. On the west of the Hudson, near the river's edge at Danskammer, the limestone dips to the southeast at an angle of 10°. Along the western margin, as shown just below Marlboro station, the dip is to the northwest. The limestones rest by overthrust on the slates at the west.

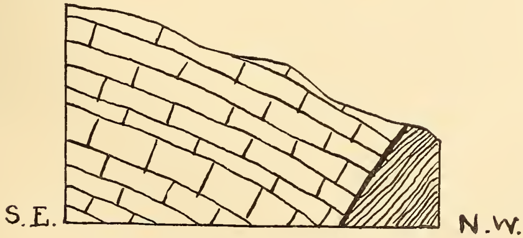

Fig. 21 Section below Marlboro station

Metamorphism and alteration. Brecciation has been noted along both margins of the strip. Fracturing has been extensive, producing many small cracks that have been healed by calcite. The broken surfaces of the rock along the eastern margin of the strip show by the smooth, distorted blackened depressions that there has been some movement in the rock. The alteration is least where the beds are flattest. The principal changes then are due to granulation which usually has been sufficient to conceal or destroy organic remains.

Summary. Presumably the Upper Cambric beds are followed in this strip by the Beekmantown (Calciferous), as is the case in the central strip; but fossils belonging to this horizon have not yet been discovered. This terrane may be represented by all or part of the dolomitic strata shown in the Stoneco quarry and their apparent equivalents to the north.[1]

Locally about Saratoga a very fossiliferous limestone lens appears in the basal portion of the dolomite formation.[2]

The trilobites discovered by Professor Dwight on the Spackenkill road, as mentioned on page 49, were like those discovered by Mr Walcott at Saratoga.[3]

No fossils have been reported from the limestone on the western bank of the Hudson within this quadrangle. In 1879 R. P. Whitfield[4] reported Maclurea magna from these limestones at Newburgh and in 1880 W. B. Dwight[5] found an assemblage of Trenton fossils in that city.

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[1] The description of the cherty, dolomitic limestone at the Stoneco quarry and overlying the Potsdam beds along the Spackenkill road was written in October 1909. At the meeting of the Geological Society at Cambridge, Mass., the following December, Professors Ulrich and Cushing described a dolomite in the Mohawk valley which "is found to consist of two distinct formations, the lower a dolomite formation of Ozarkic age, the upper a limestone of Lower Beekmantown age with a distinct unconformity between the two." The Beekmantown was described as thinning to the west, so that west of Little Falls the Lowville rests on the Ozarkic. The unconformity may be followed into the Champlain valley, reappears in the St Lawrence region "and is believed to mark the line of division between the two formations everywhere in northern New York."

[2] Preliminary list of papers. G. S. A., 22d winter meeting at Boston-Cambridge, December 1909.

[3] See Thirty-second Ann. Rept. N. Y. State Mus.; also U. S. G. S. Bul. 30, p. 21, and Science, 1884, 3:136-37.

[4] Amer. Jour. Sci., Ser. 3, 18:227.

[5] Amer. Jour. Sci., Ser. 3, 19:50-54.

THE CENTRAL STRIP

Boundaries. This strip enters the quadrangle from the north at Pleasant Valley. Its eastern margin forms the western bank of Wappinger creek north of the covered bridge at Pleasant Valley and southward follows the creek closely as far as Rochdale. At this place the limestone is in contact with the slate at the dam and on the island just below it. South of Rochdale the limestone follows the creek for one-half mile and then bears slightly to the west. It apparently ends just north of the terrace one-fourth of a mile east of Tompkins's house (see plate 17) on the Pleasant Valley road. This terrace fringes an old meander of the creek and extends around to the south side where the limestone appears again just south of the road that skirts its edge. East of the portion of this road running north and south, just west of Frank De Garmo's house, are numerous outcrops of the slates, but these disappear at the terrace slope and no outcrops appear in the deep westward embayment formed by the old meander.

This embayment is regarded as lying in a zone of transverse faulting. It seems probable that the slates were dropped down in here. At any rate, either on this account or because of faulting, a weakness was produced which the base-leveling forces caught and finally left as a gap in the ridge of limestone. It seems probable from the dimensions of certain faulted limestone blocks a short distance to the eastward that they belong in or near this gap. The slate has been dropped between the faulted masses and the dismembered main strip.

South of the break in the central strip its eastern margin follows the road until the latter turns eastward and then extends as a conspicuous wooded scarp in a north and south line to a point about one-third of a mile south of Frank De Garmo's house. At this point the limestone sends a sharp angular spur eastward for about 200 yards, as shown on the map. The strike of the slates just west of De Garmo's house, projected southward, would bring them sharply against the limestone in the included angle of this spur, showing a transverse fault between the slates and the spur and indicating that the eastern marginal scarp south of De Garmo's is a faulted one.

Limestone outcrops at the apex of this spur, whence it may be traced by continuous outcrop along the margin of the slate to and across the railroad track and highway west of Manchester Bridge. South of here the eastern margin follows the eastern base of an immense drumlin and south of this distinctly to the Poughkeepsie-

New Hackensack road; then across this and for a short distance to the south. The margin is then apparently broken by a spur in a manner similar to that just described, although this time the break appears to be along an extensive fault line. The slates which outcrop south of the Poughkeepsie-New Hackensack road and west of the cross road that leads from it to the Spackenkill road, lie in the included angle of this spur.

The contact is then easily followed southward by the steep marginal scarp in the limestone, from the point where the cross road just mentioned makes its turn, to and across the Spackenkill road, and east of the old Boardman farm. The gully which, as shown on the map, cuts across this central strip west of the northern termination of the narrow faulted strip lying on the east, may represent a fault.

South of the Spackenkill road slates outcrop in numerous places between the main strip and the narrow faulted mass just east and south through the swamp to the southern end of the small strip, leaving no doubt but that, at the surface, the two limestone masses are separated by a narrow band of the slates. The eastern contact is then very readily followed through the fields to Channingville and then less distinctly under the drift between the creek and the New Hamburg road to the bank of Wappinger creek near its junction with the Hudson.

The western margin of the central strip could be determined with much more exactness in certain places than in others. At the north the surface deposits conceal it for the most part, but swamps and other topographical features and occasional outcrops enable one to follow it approximately, and in a few places distinctly, until it crosses the Pleasant Valley road just west of Rochdale. The limestone then forms a distinct scarp east of the road to the break just southeast of Tompkins's house. South of this the margin is distinct to the railroad, but across this it is soon lost under the drift composing the large drumlin at this point. The limestone reappears on the south side of this hill and again a little farther south as a scarp which crosses the Poughkeepsie-New Hackensack road. South of this road the margin is readily followed, often with the limestone and slate in close proximity, to the Poughkeepsie-Wappinger Falls road which, going south, ascends the western scarp of the limestone. South along the New Hamburg road the contact is clearly for a distance on the east side of the road as the slate was noted in the latter. But along here the kame deposits effectually conceal the exact relationships between the limestone and slate. At the northern end of the New Hamburg tunnel the limestone rests by overthrust upon the slate (see plate 9) and occasionally the limestone outcrops along the slope to the northeast for a short distance.

Terranes present. The Potsdam, Beekmantown (Calciferous-Rochdale group) and Trenton horizons have been identified along this central strip within the quadrangle.

The Potsdam. This horizon was first noted in this strip just a little north of the quadrangle boundary half way between Pleasant Valley and Salt Point.[1] At Pleasant Valley Lingulepis pinniformis was reported along or near the western margin of the strip to the northwest of the village in rather characteristic argillaceous limestone, and also from some hills to the north of the village between the old Poughkeepsie and Eastern Railroad bed and Wappinger creek.[2] At the latter place the beds carrying L. pinniformis also had small brachiopods, apparently Orthis and Triplecia, as well as minute gastropods, fragments of trilobites and Ophileta compacta. These beds were mixed with Calciferous and Trenton strata carrying other fossils characteristic of these limestones in this region. The Potsdam was identified near Rochdale, just west of the Poughkeepsie-Pleasant Valley road. The beds exposed in the quarry just northwest of Alson De Garmo's house, from which stone was removed for the State road, are possibly of Upper Cambric age. A search for fossils in this quarry was unrewarded. In a note to his paper on the discovery of Potsdam fossils in Poughkeepsie, south of the driving park, as described for the western strip, Professor Dwight[3] mentioned the discovery of a fragment of brachiopod shell which he believed to be that of Lingulepis pinniformis in a rock very similar to that at the locality south of the driving park. He described this new locality as about one-half of a mile south of the Boardman mansion on the Spackenkill road, but it is uncertain from his description at just what point the fossil was found.

The Beekmantown (Calciferous-Rochdale group). In January 1880, Professor Dwight[4] reported the discovery of a rich assemblage of fossils of Pretrenton age at Rochdale, a small factory hamlet four miles northeast of Poughkeepsie.

[1] W. B. Dwight. Amer. Jour. Sci., July, 1881, 34:27–32.

[2] (W. B. Dwight) J. M. Clarke. Guide to the Fossiliferous Rocks of New York State. N. Y. State Mus. Handbook 15, p. 9–10.

[3] Amer. Jour. Sci., Feb. 1886, 31:136.

[4] Amer. Jour. Sci., January, 1880, 19:50 et seq.

The following named fossils were enumerated as the most important:

"Ophileta complanata (possibly Ophileta compacta), O. levata, O. sordida (Maclurea sordida), Orthoceras primigenium." Other univalves were noted but not identified. A network of "fucoidal fronds" might be Bythotrephis antiquata. The fossils of the neighboring Trenton at the east were absent from this rock and it was believed to lie beneath the Trenton, both strata having an eastward dip. It was called the Calciferous.[1]

In October 1880, Dwight[2] found at the Rochdale locality another remarkable assemblage: "great numbers of Orthocerata and other fossils, many of which are not reported as occurring in New York State." In lithology this rock was identical with that previously assigned to the Calciferous. Orthocerata were abundant and discoidal gastropods very plentiful. In addition to its own peculiar fossils, it contained the "fucoids" and other types of the adjacent Calciferous. Dwight hesitated to announce the exact stratigraphical position of this new fossil assemblage. The wealth of cephalopods separated it very sharply from any other known terrane in the United States below the Black River-Trenton, to which it was inferior. In its numerous orthoceratite cephalopods it resembled the Quebec group of Canada.

In 1882 Diwght[3] reported tracing the Calciferous in this strip to a point five miles below Poughkeepsie. In addition to the above-named "Calciferous" fossils he announced in this paper: A large Holopea and smaller ones not identified, many Pleurotomaria resembling Canadian forms, a minute Ophileta n. sp., a Murchisonia resembling gracilis of the Trenton, one or two orthides, many undeterminable fragments of Bathyurus, Chaetetes lycoperdon var. ramosa, not hitherto reported below the Trenton, 25 to 30 species of Orthocerata, all apparently new in the United States, two species of Lituites and a Cyrtoceras. In 1884[4] a number of these fossils were described with figures; trilobite fragments were provisionally assigned to the genus Bathyurus (B.

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[1] The ledges at the summit of the hill north of Alson DeGarmo's house on the Pleasant Valley road belong, in part at least, to Dwight's Calciferous locality.

[2] Amer. Jour. Sci., Ser. 3, 21:78.

[3] Proc. Amer. Assoc. Adv. Sci. (Montreal meeting), v. 31. Abstract Aug. 1882, p. 3–6.

[4] Amer. Jour. Sci., Ser. 3, April, 1884, 27:249–59.

taurifrons and B. crotalifrons). New cephalopod species were described as Cyrtoceras vassarina, C. ? dactyloides, C. microscopicum, Orthoceras apissiseptum; O. henrietta, Oncoceras vassiforme.

In 1900 Dwight[1] designated the main Calciferous strata as the Cyrtoceras vassarina beds and called attention to the great persistence for a distance of nearly thirty miles in the Wappinger limestone, of a layer which contains a fauna quite different from that of the main beds. It lacked cephalopods entirely. There were no important fossils in common in the two beds except two or three always present in the Calciferous. In some respects it resembled the Fort Cassin of Vermont, but differed in the extreme scarcity of cephalopods. The presence of Lingulepis pinniformis suggested a low horizon in the Calciferous. What Dwight has called a low horizon in the Calciferous may be Upper Cambric disconformably overlain by Beekmantown.

The Trenton. Fossils belonging to this horizon were the first to be discovered in the Dutchess county limestone and were first reported from the area within this quadrangle.

Mather referred only in a footnote to their having been found in a quarry south of Pleasant Valley by Professor Briggs. His assignment of the age of this formation was based on fossils found in the beds of limestone within the slate formation a mile or so north of Barnegate.

In 1879 Professor Dwight[2] found the following Trenton fossils at Rochdale: Leptaena (Plectambonites) sericea, Orthis tricenaria, Receptaculites sp. A week after the discovery Dwight and Dana visited this locality. The following fossils were found: L. (P) sericea, Escharapora recta, Ptilodictya acuta, the caudal shield of a trilobite probably Asaphus vetustus, Orthis tricenaria, O. pectinella, O. testudinaria, an Endoceras, an Orthoceras, specimens of Chaetetes, and encrinal columns.[3] On this same excursion the quarry south of Pleasant Valley, mentioned by Mather, was visited. A fossil assemblage very like that at Rochdale was at once discovered. Subsequent examination of this collection showed Strophomena alternata fragments. The Chaetetes was named by Dwight C. tenuissima.

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[1] Bul. Geol. Soc. Amer., v. 12, 1900, abstract.

[2] Amer. Jour. Sci., May, 1879, 17:389.

[3] Amer. Jour. Sci., May, 1879, 17:390. See also p. 381.

In 1880 Professor Dwight[1] added to the above from the Rochdale locality: a number of cyathophylloid corals, among them Petraia corniculum, a head of Echinoencrinites anatiformis, and the caudal shield of a trilobite identified as Illaenus crassicauda. The C. tenuissima was identified as in part at least, Stromatopora compacta Billings (Chaetetes compacta Dawson). This fossil is now recognized as Solenopora compacta.

The Trenton also occurs at Pleasant Valley in the railroad cut just east of the Central New England station on the old Poughkeepsie and Eastern road. The Trenton beds here have yielded Tetradium cellulosum and great numbers of entomostraca and fragments of small trilobites.[2] The characteristic Trenton conglomerate carrying Solenopora compacta occurs at the northeast end of the cut. The Trenton apparently has an extension eastward in the village. The conglomerate carrying fossils was noted by the writer at the hose house.

It is quite probable that other Trenton localities in later years were noted by Professor Dwight which were never published.

Petrography and further description. Beds from this strip, which have been referred to the Potsdam, vary from argillaceous to arenaceous limestones with occasional shaly layers. It is not possible to say much about the extent of the Potsdam along this strip to the south. It may occur at many places for which, however, there is at present no paleontologic evidence. The structural features suggest that it is probably confined to the northern and central portions of the strip and that the beds at the south are probably younger The shaly limestones in the quarry west of the tunnel at New Hamburg have been thought to be of Potsdam age on stratigraphic grounds.

The Beekmantown (Calciferous) of this strip is best studied at its type locality at Rochdale. It is often, if not characteristically, arenaceous and varies in color from a bluish gray to a gray with lighter chamois-colored layers which weather very white. The two are interstratified, though the writer's observations indicate that the bluish beds are usually near the eastern margin and therefore in the upper layers. The bluish beds carry grayish wavy markings and are very tough and splintery, breaking with conchoidal fracture.

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1 Amer. Jour. Sci., v. 19, January 1880.

2 (W B. Dwight) J. M. Clarke. Guide to the Fossiliferous Rocks of New York State. N. Y. State Museum Handbook 15.

The lower portion of the Calciferous shows many thick, grayish layers in places.

Apparently the Beekmantown has a wide distribution in this strip. It forms the main mass of the high hill northwest of the Trenton in the cut at Pleasant Valley and may be traced rather satisfactorily as a lithic unit to Rochdale, where it is seen to have a great thickness, estimated at from 1000 to 1200 feet. Dwight claimed to have traced it definitely to a point five miles below Poughkeepsie (see above). The beds resting on the slates at the New Hamburg tunnel are probably of Beekmantown age.

At Rochdale the Beekmantown in places passes through a heavy conglomerate into the Trenton which rests upon it. Just a little way south of a ledge of this conglomerate on the property of Henry Titus, along the road, are fine exposures of the bluish-gray beds. These give place at the west to the gray and dove-colored beds which compose most of the hill between Rochdale and the Pleasant Valley turnpike.

The bluish-gray beds were noted farther south near the eastern margin just north of the break in this strip. Taking the apparent thickness at Rochdale as a guide, the beds intervening between these blue beds and the scarp just east of Tompkins's house are probably all Beekmantown. South of here the lithology does not convey very much, though indicating on the whole the southward continuation of the lower portion of the Beekmantown as shown at Rochdale.

Within this strip farther south, about one-fourth mile north of the Spackenkill road, along an old wood road, or cow path, are probable beds of the Beekmantown within a few rods of coarse Trenton conglomerate apparently carrying Solenopora compacta. The road from the orchard on the north side of the Spackenkill road, opposite the old Boardman farm, leads to these outcrops. This locality is seemingly not so far south as Professor Dwight claimed to have traced the Beekmantown; but the writer has not been able to add anything definite to the age of this belt to the south of this point.

The Trenton, within this strip, is usually a dark blue rather crystalline rock of quite different appearance from the Beekmantown. Its lower portion is conglomeratic and carries colonies of the coral S. compacta which, without careful examination, might be taken for pebbles. This coral, or a conglomerate appearance, is often the only means for identifying this member of the limestone formation. The Trenton is also somewhat finely conglomeratic at times. The conglomerate was noted at Pleasant

Valley, at Rochdale and north of the Spackenkill road. The Trenton also is probably present in places not yet discovered along the eastern margin of this strip. At Rochdale the dark blue Trenton beds have a thickness apparently between 60 and 100 feet and form a conspicuous stratum.

Strikes and dips within this strip show much uniformity. In the Poughkeepsie and Eastern Railroad cut at Pleasant Valley the Trenton beds show a strike about n. 37° e. and a southeast dip. In the quarry on the Pleasant Valley road to the west of Rochdale the supposedly Potsdam beds strike n. 42° e. and dip 60° to the southeast; at Rochdale in the road near the mill site, the strike is n. 40° e. and the dip 55° southeast; at the conglomerate ledge on the Titus place approximately n. 43° e. and 58° s.e.; at the eastern margin east of Tompkins's n. 28° e. and 35° southeast; north of the Spackenkill road in the woods near the old barn n. 53° e. and 42° s.e.; at the New Hamburg tunnel about n. 60° e. and 30° s.e.

Structural features. The presence of an erosion interval between the Trenton beds and the Beekmantown is conclusively shown by the relationships at Rochdale. The Beekmantown is separated from the Trenton by a heavy conglomeratic layer, and the fauna and lithologic character of the two strata are markedly different. The general uniformity of dip shows a " deceptive unconformity " or " disconformity."[1] From the apparent thickness of the Beekmantown at Rochdale, it would seem that this formation was not extensively eroded here.

The limestones of this central strip rest against the slates on the west by overthrust. This is best shown at the north end of the New Hamburg tunnel (see plate 9). The occurrences of the Potsdam along this western margin is also evidence of it. Frequent slips along and across the strike within the limestone are probably present.

The slates along the eastern margin of the strip may be at places in conformable relationship with the limestone. In other cases such is almost certainly not the case.

Metamorphism and alteration. The strata composing this strip are all visibly altered. Fossils have usually been greatly obscured. The Beekmantown shows the metamorphism most. Fossils in it are recognized or identified usually with difficulty although they sometimes weather out with distinctness. The Trenton beds are usually somewhat crystalline, but fossils are preserved in them in better condition than in the Beekmantown.

[1] Professor A. W. Grabau. Science, n. s., 22:534.

Plate 9

Limestones overthrust on the slates at the northern end of the New Hamburg tunnel

Summary and conclusion. The absence of the Trenton conglomerate at places along the eastern margin of the central strip might be interpreted as the result of faulting and, in any event, is probably due in part, at least, to faulting.

The presence of Tetradium cellulosum in the Poughkeepsie and Eastern Railroad cut at Pleasant Valley is noteworthy. Professor Clarke[1] has indicated that elsewhere this fossil is characteristic of the Lowville. The Trenton conglomerate at this locality is apparently a few feet above the beds carrying this fossil. This would seem to indicate that the Lowville might have been deposited here. Doctor Ruedemann[2] has discussed the Trenton, as descrbed by Dwight, as probably not lower than Midtrenton in age.

The examination of this strip leaves one in great doubt as to how to represent its structure. It is certainly very different from Professor Dana's early representation as a simple fold.[3] It is best interpreted as belonging to the same thrust that pushed the western strip on the slates, but as the map shows the limestone broke both along and across the strike and at the south was pushed farther west, apparently feeling the influence of the Highlands mass.

MISCELLANEOUS FAULTED BLOCKS OF THE WAPPINGER CREEK BELT

Several smaller limestone masses, each of which can be reasonably shown to be a detached and separate block, forming an inlier in the slates, are scattered to the east of the central strip along its middle portion. The mantle of the surface deposits at times greatly obscures their exact relationships to the slates, but as a rule the field relations leave scarcely any doubt of their inlying character. In most, if not all cases, these relations point to faulting, both along and across the strike between the limestone masses and the slates which surround them.

These blocks will be described separately and will be designated by numbers from north to south. The occurrence of these faulted blocks of limestone to the east of the central strip seems to be directly due to the thrust which carried the limestone of this belt over the slates. They have been left, stranded as it were, behind the main mass.

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[1] Guide to the Fossiliferous Rocks of New York State. N. Y. State Mus. Handbook 15, p. 9.

[2] Hudson River Beds near Albany and their Taxonomic Equivalents. N. Y. State Mus. Bul. 42, 1901, p. 501.

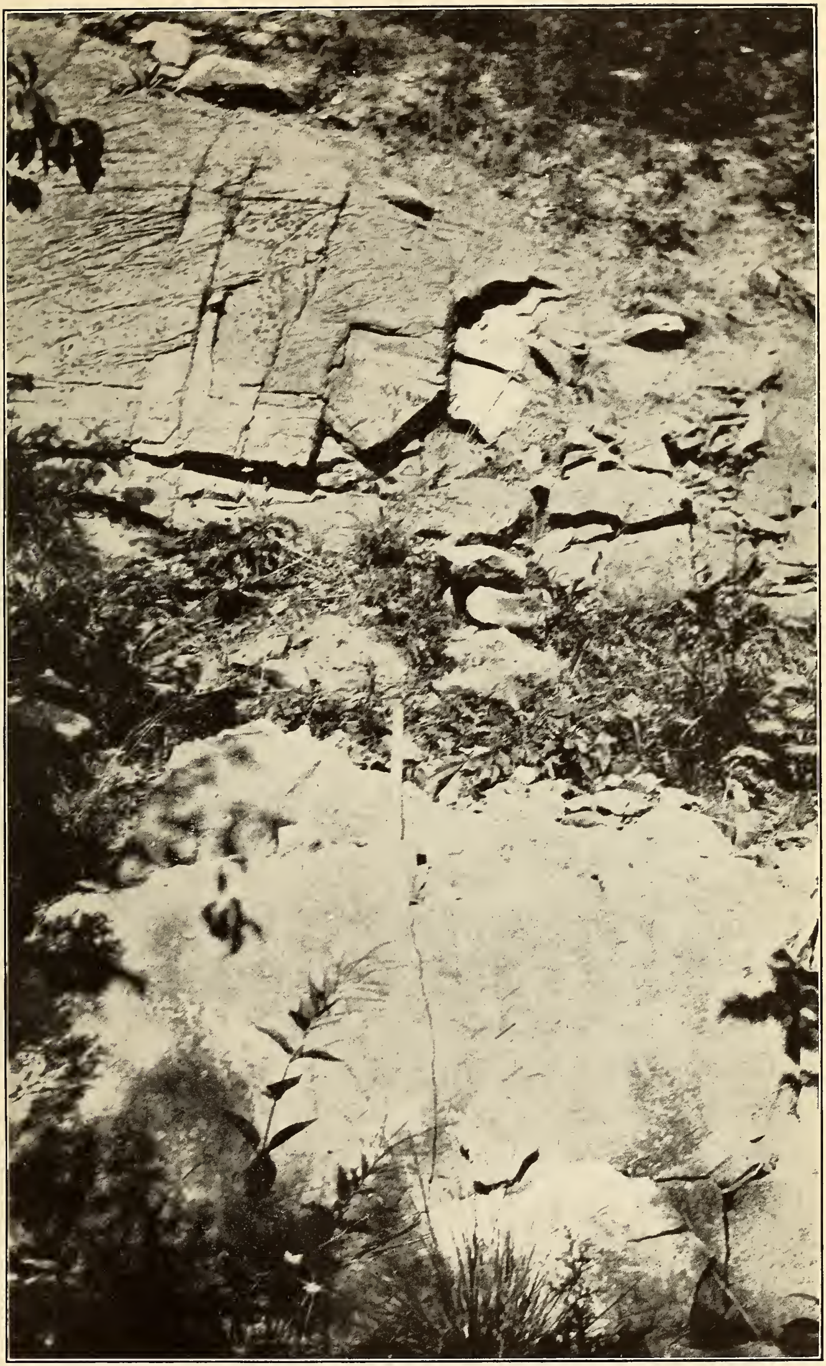
[3] Amer. Jour. Sci., May, 1879. 17:382.

Faulted block number 1. This block of limestone, which is the most northerly of these masses, lies about a mile north of Manchester Bridge on the farms of A. W. Sleight and George Byer. Its apparent northern boundary is along a northwest-southeast line that crosses the Sleight farm just north of the barn and intersects the roads to Pleasant Valley and to Overlook. About 75 yards south of the Overlook road, where this makes its first turn in ascending the hill, the visible northeastern boundary of the limestone is marked by a ledge. Its eastern boundary extends south from here for about one-fourth of a mile. At the southeast the limestone is represented by impure shaly limestone. At a point just north of the wall between the Byer farm and Hart's orchard, the slate outcrops and continues to outcrop to the south for a mile or more. The slates are in close proximity to the limestone in many places along the eastern border. Just south of the sheep pen they form a scarp between which and the limestone the farm road descends. The road is, however, apparently on the limestone. The limestone outcrops just south of the farm road at the base of the hill and continues as a steep scarp just within the woods northward from this point for several hundred yards and then turns west and crosses the road and ends in a large ledge 50 feet west of the road. North from here it is finally lost under drift, but is readily followed along the road toward Sleight's house. There are no outcrops of any kind between Byer's house and barns, which stand on a knoll of limestone, and the steep scarp 200 yards east of the road. Ledges of limestone probably determined the terrace slope just west of Sleight's house. Drift conceals outcrops north of Sleight's barns. Quartzitic rock of the slate formation outcrops between the Pleasant Valley and Overlook roads 100 feet north of the latter. Between here and the outcrop of limestone marking the northeast corner of the block there are no outcrops. Presumably the limestone, in part at least, underlies the flat terrace level just east of Byer's house.

On the eastern margin of this block, partly on the property of A. W. Sleight and partly on that of George Byer, is an old quarry, which many years ago furnished stone for the abutments of the bridge at Manchester. The fact that this is a rich fossil locality appears up to this time to have escaped attention.

There are two varieties of rock in the quarry. The one which was quarried chiefly and which makes up most of the quarry is a dark blue rock which varies in texture from a fine calcareous con-

Plate 10



A portion of the wall in A. W. Sleight's quarry. In the foreground Trenton conglomerate with *Solenopora compacta* resting on probable "Calciferous" which is exposed in the upper half of the picture. The two are disconformable, but have the same dip to the southeast

glomerate, shown at the south end and in the central part of the quarry, to a dense fine-grained mud rock at the northern part. The bedding surfaces are distinct, and good-sized blocks, frequently a foot or more in thickness, have been removed. The rock has been weakened by blasting. It still breaks with difficulty into thin irregular pieces that are often crowded with fossils and their fragments. The removal of the mud rock at the south end of the quarry has exposed the basal conglomeratic portion which contains abundant crinoid stems, colonies of Solenopora compacta and some brachiopods. The quarry faces east. The beds of limestone strike n. 40° e. and dip 42° s.e. At the top of the quarry, under the bank and at the summit of the ridge the rock changes to a chamois or gray color but retains the same strike and dip.

About seven or eight feet in thickness have been preserved of the finer-textured blue mud rock at the north end of the quarry. Fossils are distributed through it, but could be removed in numbers only from the surface layers. The rock has yielded:

Orthis pectinella	31
Plectambonites sericeus	18
Dalmanella testudinaria	13
Strophomena alternata	1
Orthis lynx	3
Streptelasma sp. (resembling parvula)	2
Chaetetes lycoperdon	3
Ceraurus pleurexanthemus (probably)	3
Platynotus trentonensis (probably)	1
Calymmene senaria	6
Phacops sp. (probably)	1
Illaenus crassicauda (probably)	1
Ostracod (undetermined)	1

At the western base of the ridge, somewhat to the southwest of this quarry, and now completely hidden by thick underbrush within the edge of the woods, is another and older quarry from which it appears the rock was removed and burned for lime a good many years ago. Solenopora compacta was noted here.

The width of the dark blue limestone stratum on the east is probably less than a score of feet. A small diagonal fault crosses the limestone just west of the road that ascends to the sheep pens.

The blue rock of the quarry is the same as that at Pleasant Valley and Rochdale. The chamois-colored or gray rock is assumed to be the Beekmantown (as qualified above).

The presence of the Trenton along the western scarp, as marked by S. compacta, accompanied as it is by a scarp, suggests that it probably is faulted in here.

Faulted block number 2. Whether this block is distinct from number 1 might be a matter of interpretation. The house and barns of George Byer are built on the summit of the western scarp of this block which, west of the house, descends abruptly to the level of the present flood plain of the creek. The northern margin ends 100 yards north of the barn. The most eastern outcrop at the north is separated from the ledge, marking the visible western margin of block number 1 by a shallow gully. The two may unite below the surface. At the south the limestone is lost under the terrace, but it is assumed to continue south for a distance. The slates do not outcrop between its western scarp and Wappinger creek, but as the slates extend well up in this space in the bed of Wappinger creek and west of it they almost certainly underlie the interval where outcrops are concealed. The block is regarded as a dismembered part of the central strip. The slates have been dropped down between the latter and these two blocks at the east.

Faulted block number 3. The evidence for the presence of the limestone at this point consists of two small detached ledges apparently in place, and a scarplike topography. The low hill shown on the map at this place was approached through the fields south of Manchester Bridge station. The northern slope of the hill is made up of drift, but along the wooded western slope a careful examination disclosed a small ledge of conglomeratic rock with a strike of n. 5° w. and a dip of 32° e. The base of the slope is marked by a swamp. A few hundred feet to the southeast is another ledgelike mass of the limestone with nearly the same strike. North near the railroad and east and west outside the cover of the drift and in the fields at the south are low-lying ledges of slate.

Faulted block number 4. The visible northern termination of this block is on the farm of Mr Rothenburg at Titusville. The limestone forms a conspicuous ledge just southeast of the barn. Its eastern margin may be followed southward as a low scarp across the road where the limestone abruptly disappears under the lowland along Wappinger creek. In places along the eastern margin, and well shown in two ledges just southeast of Rothenburg's house, the apparent dip is about 55° w. and the strike about n. 44° e. and the rock appears somewhat thin-bedded. The western margin is indistinct. The limestone outcrops just under the road bank, where the road turns east, and rests against the slates in the bed of the brook.

On the north side of the road near the turn is an old quarry. No fossils were found, but the quarry rock resembles the dark blue mud rock of the Trenton.

Faulted block number 5. Between this block and number 4 is an interval of lowland forming the present flood plain of Wappinger creek. This interval is probably underlain by the slate which was dropped down in here and which, in connection with faulting, produced a line of weakness which the base-leveling forces early reduced and which has been perpetuated by the present stream. Outcrops are concealed in the flood plain interval except near the southwest corner of block number 4. At this point there is a large patch of slate that has been planed down and which disappears under the alluvium at the southeast.

The rather steep slope on the southwest side of this interval is taken as representing the northern margin of block number 5. The eastern and western margins are approximately those shown on the map, while the southern margin appears to be along the great fault line at this point. Surface deposits conceal the northern margin, but outcrops are occasional to the north of the Poughkeepsie-New Hackensack road, and almost continuous along it from east to west. The western margin is easily followed along the crossroad to the Spackenkill road until the limestone is cut off by the fault. No fossils were found in this patch of limestone and the lithology did not help in making any provisional correlation with other localities.

Faulted block number 6. This small strip lies south of the Spackenkill road and is a little over a mile long and less than one-fourth of a mile wide. It is separated from the main central strip by a narrow band of the slates which form conspicuous ledges for a few hundred yards south of the Spackenkill road and are traceable along the edge of the swamp through the woods to the southern termination. At the south the limestone disappears abruptly beneath the slates just north of the old barn and probably is faulted here. At the north it also gives place to the slates north of the Spackenkill road and is certainly faulted here. The limestone of this strip forms a conspicuous ridge throughout its length. No fossils were found although a careful search was made, particularly near the southern extremity.

Faulted block number 7. This block lies farthest east of all. The boundaries are best indicated by the map. The entire strip has a northeast-southwest bearing which closely follows the general strike of the limestone. It is about one and one-fourth miles long and one-fourth of a mile wide. At the north it disappears beneath the low ground along the railroad and gives way at the north to slates, although some distance intervenes between outcrops. The northern margin is plainly a faulted one and lies along the very prominent but narrow valley that forms the route of the Central New England Railroad track almost the entire distance from Hopewell Junction to Manchester Bridge. That this represents a line of faulting is reasonably certain. As a topographic feature it may be followed across country for miles. It is often swampy, frequently for long distances, and this feature was probably still more prominent before the railroad bed was put in. It does not have the appearance of having been a prominent line of drainage, but rather a more extensive illustration of the topographic effect of base-leveling forces operating along a continuous line of weakness such as a great fault would produce. There are other conspicuous illustrations of the same kind, both within the slates and limestones of this quadrangle.

The southern margin is obscured by a great mass of drift, but the limestone is almost certainly cut by a fault on the southwest.

A mile and a half north of New Hackensack a crossroad connects the New Hackensack road with another running for some distance parallel with the railroad track. The northwestern margin may be followed from this road northeastward to the railroad track, outcrops appearing between the latter and the road just south of it. Along this margin the limestone shows a low scarp for some distance. The eastern margin is also easily followed as a scarp from the crossroad where the limestone appears in contact with the black, splintery slates northeastward to the railroad. Outcrops occur along the public road at the north. Everything is concealed south of the crossroad at the south.

The limestone of this block is of a very dark bluish-gray color. It often shows veinlets and nests of calcite. Fresh surfaces show darker and more crystalline bunches in a rock of dark gray color. The rock is more crystalline than other members of the Wappinger creek belt. In lithology, it often has a strong resemblance to varieties met with in the Fishkill limestone, notably southeast of Hopewell. No fossils were found. The average strike is about n. 60° e. and the dip 40° s.e. The block forms a distinct topographic feature.

THE FISHKILL LIMESTONE

The belt of which this limestone is a part may be traced with some interruptions from Millerton in the northeastern corner of Dutchess county nearly to the Hudson river. The portion within

Plate 11

A view from "Bonney hill" south of Hopewell Junction, looking northward. Near the center of the picture is the village of Hopewell Junction. North of the village is the triangular valley in the faulted Fishkill limestone (see map)

this quadrangle occurs as a great fault-bounded block north of the Fishkill mountains. Northeastward it may be followed up the Clove valley, east of which it passes under the mass of schist composing Chestnut ridge and reappears in the Dover-Pawling valley.

The overlying slate formation has been removed from this faulted limestone mass within this quadrangle, which makes it convenient to discuss the mass as a unit.

Boundaries. The northern boundary enters the quadrangle from the town of Beekman and extends southwestward along the old roadbed of the Clove branch of the Newburgh, Dutchess and Connecticut Railroad to a point about one mile east of old Hopewell, where it intersects a northwest-southeast fault and turns with a sharp angle to the northwest. The actual contact of limestone and slate usually can not be seen, but the field relations and obvious fault features approximately determine the course of the boundary. Somewhere south of Arthursburg, the actual point being concealed, the boundary again turns abruptly, this time to the southwest, as shown on the map, and follows the valley of the Whortlekill to a point just west of Hopewell Junction, and then turns to the northwest to follow the fault previously referred to, along the raliroad. Three-fourths of a mile west of here a ledge of shaly limestone marks the northwest limit of the limestone along this fault line. The slates extend down into the included angles of these fault lines, as shown on the map. Southwest from the ledge of shaly limestone just mentioned the boundary is easily followed across the fields, often with a clear scarp or other distinct topographic feature, and with slate and limestone frequently in close proximity, to the fault that bounds Vly mountain on the east; then north along this fault, with the slates again in the included angle, to Vly mountain, which is bounded by the limestone on the south. Southwest of Vly mountain the limestone bounds the Glenham belt to the carpet mill at Glenham. South of here it is faulted against the slates for half a mile, then rests against the gneiss of the northernmost inlier in the town of Matteawan, then on the quartzite patch just south of this, and again on the gneiss.

Its southern margin has been described sufficiently in connection with the gneisses and the quartzite.

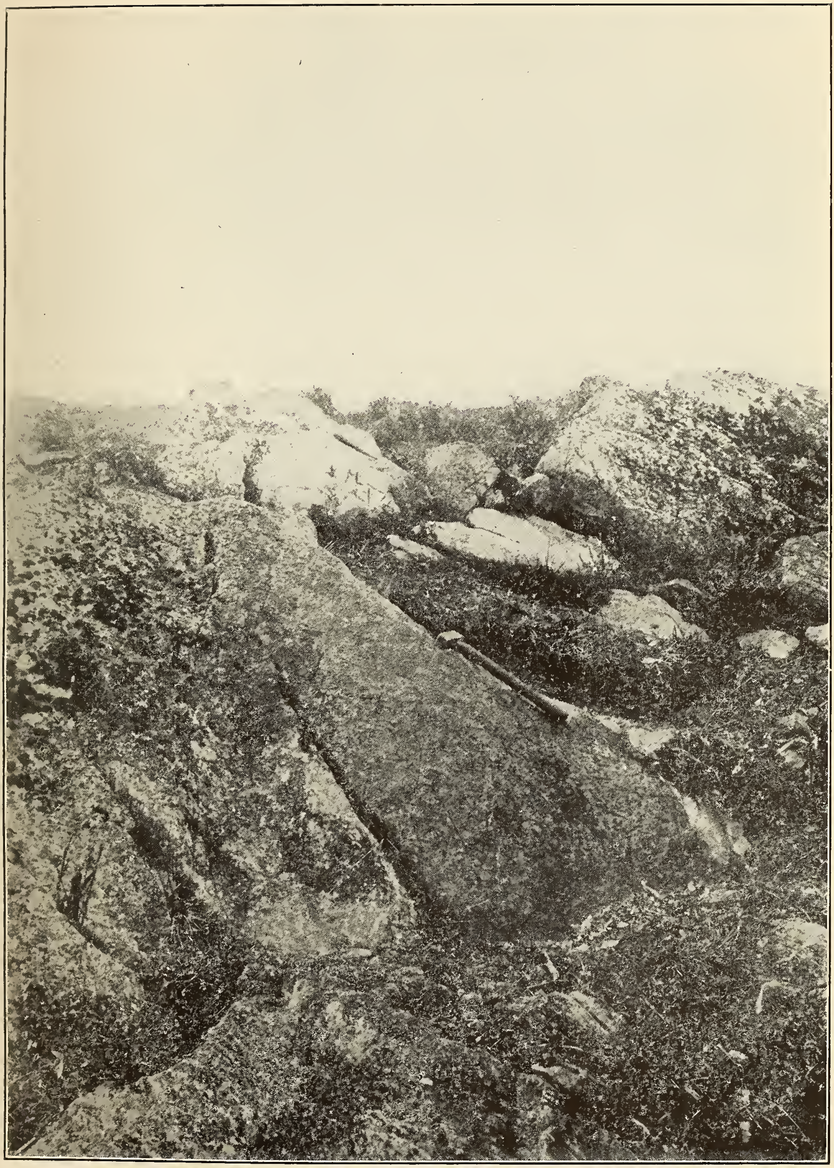
Terranes present. The fossil localities so far discovered in this limestone are limited in number and in distribution. The Lower Cambric (Georgian), Beekmantown and Trenton have been definitely identified. In the systematic and extensive examination of outcrops in cuts and weathered surfaces, suggestive markings have been noted and collected at several places. Increasing metamorphism to the eastward has destroyed or otherwise effaced traces of organic remains, besides making very difficult any provisional correlation on the basis of lithological resemblance. Folding, faulting and erosion have added great confusion.

The Lower Cambric (Georgian). Strata belonging to this horizon have been described under the heading, " The conformable series of West Fishkill Hook (see page 44). The reasons for their preservation here are not quite clear, but evidently the conditions are peculiar. As previously discussed, it seems probable that the Lower Cambric limestone is, as a rule, not in association with the quartzite of that epoch which more probably rests against younger strata at most places. The patches of limestone resting upon the quartzite at Vly mountain and in Matteawan may be of the same age. Some peculiar, very thinly-bedded metamorphosed strata, which were noted standing on end in the swampy areas east of Mount Honness, may represent the shaly member of the Lower Cambric series and these Lower Cambric rocks may have an extension to the north from here in certain rock types that will be described beyond.

The Beekmantown. Fossils belonging to this horizon were found along the western margin of the Fishkill limestone. They were first noted north of the road from Fishkill Village to Glenham on the farm of Albert Haight, in the second field west of Haight's house, about 300 or 400 yards from the public road. The rock carrying the fossils is of a light gray or steel-gray color and is interbedded with other rock which weathers to a soiled gray. The weathered surface of the former shows many spiral coils. The fresh surface reveals a much altered rock. No traces of the whorls, so plainly visible on the weathered rock, can be seen on the freshly-broken surface; but the latter is often dotted or splotched with numerous orange or pollen-yellow markings.

In this field there are two conspicuous ledges of the fossiliferous stratum besides many outcrops of other ledges, for the most part soil-covered. In the northwest corner of the next field to the north on Haight's farm is another ledge of the light gray rock covered with the coiled markings. This stratum was traced by scattered outcrops carrying the coils along and within the edge of the woods and thick brush for a mile to the northeast, to within about half a mile of the road from Fishkill Village to Glenham, and then was lost. Beyond this road it has not been noted, unless it may be

Plate 12



Fossiliferous ledges on the farm of Albert Haight, between Fishkill Village and Glenham. The surface marked by the hammer is covered with the whorls of Ophileta compacta, some of which are visible in the plate

represented by a somewhat banded bluish rock without visible fossils which was found on the very edge of the limestone about four miles to the northeast at Swartoutville, a hamlet two and one-half miles north of Brinckerhoff. On the Haight farm the fossiliferous limestone is well exposed in the fields, but in the brush it is followed with great difficulty. This rock, or that with which it is interbedded, is overlain by a calcareous conglomerate in certain places.

The fossiliferous limestone is very dense and compact. It is quite impossible to remove the coils from the smooth surface. A hard blow with the sledge simply chips the rock into small pieces with conchoidal fracture. The chisel makes no impression.

The coils are most distinct when at right angles, or nearly so, to the axis of the whorls. They then show as fine spiral lines, resembling a fine loosely-coiled watch spring, which have weathered out very sharply into bas-reliefs. When in the plane of the axis, or at a small angle with it, the lines are thick and patchy. The fine coils vary in diameter from one and one-half inches to three-fourths

Fig. 22 Whorls of a discoidal gastropod identified as Ophileta compacta Salter, from the ledge shown in plate 12

of an inch. The medium-sized are most abundant. They bear the closest resemblance to the discoidal gastropod Ophileta compacta Salter, as described for the Calciferous of the Quebec group[1] (see plate 12).

[1] Canadian Organic Remains, 1859. Decade 1, p. 16, plate 3.

The smaller coils resemble the Maclurea sordida and Ophileta levata of the Calciferous of New York.[1] One form, which very closely resembles the Ophileta complanata as figured by Hall,[2] was noted.

The fossiliferous rock at Haight's farm lies just east of the Glenham gneiss belt with outcrops of the latter not more than 150 or 200 feet away. The strike of the limestone varies from n. 15° w. to n.–s. and the dip from 35° to 40° e. The strike is such as to carry the limestone diagonally across the gneiss belt. The distance separating the gneiss is too short to allow a very great thickness of older beds to come between the two. South of the fossiliferous ledges in the quarry used by the State road contractors on the farm of Mr Wilsey, are thick-bedded arenaceous limestones with a strike of n. 35° e. and a dip of 51° s.e. These are probably older beds.

East of the ledges of Beekmantown outcropping along the Glenham belt, this horizon has not been definitely identified. In the town of Old Hopewell, just east of Fishkill creek, is a prominent hill which has some beds strongly suggesting the blue beds interstratified with the gray ones in the main strip of the Wappinger creek belt at Rochdale and two or three miles south of that hamlet. The two rocks look very like each other and the resemblance is strengthened by the presence of the peculiar seaweed-like markings which have been described. The rock at Hopewell is more metamorphosed. Along the track of the Highland division of the New York, New Haven & Hartford Railroad, in the cut three-fourths of a mile east of the railroad bridge crossing the creek east of Hopewell Junction, these blue layers form the upper portion of a gentle, northward-pitching anticlinal fold (see plate 13). A distinct fault is seen just east of here crossing the track and, when traced northward, this is seen to be in line with the recess shown on the map just south of the point where the creek turns northward in making its detour around the hill. East of this northward bend the creek has cut a gorge in the limestone, having been deflected southward by a great mass of glacial deposits that flanks the limestone knoll north of Gregory's mill. On the weathered surface of this knoll a fossil, which looked like a cephalopod, was found.

This rock resembles the blue layer just described. It often shows a banded character which recalls the banded marbles or crystalline limestones seen in the quarry two miles southwest of Millerton.

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[1] Palaeontology of New York. 1:10–11, plate 3.

[2] *loc. cit.*, p. 11, plate 3.

Presumably the beds with which the bluish beds are interstratified belong with them and the Beekmantown may be fairly well represented. Elsewhere it has not proved possible to make any correlation even of a provisional character with this horizon.

The Trenton. The presence of this horizon within the Fishkill limestone was first indicated on the basis of fossils by Professor J. D. Dana.[1] He described the white fine-grained and gray limestones north and east of Shenandoah and announced the discovery in the gray rock "one-third of a mile north of Shenandoah Corners" of "large shells of a Strophomena like S. alternata, distinct in form though disguised by pressure and slight alteration, indicating for the beds a Trenton age." He also noted suggestive forms and markings between Hopewell and Fishkill,[2] but nothing of distinctive value was obtained.

This horizon, as known from the Wappinger belt, was definitely identified by the writer along the western margin of this limestone in close association with the beds carrying Ophileta compacta. In the second field northwest of the barn on the farm of Albert Haight, on the road from Fishkill Village to Glenham, a ledge of coarse conglomerate lies just south of the ledge showing the O. compacta. A few yards east of the latter ledge a finer conglomerate carrying Solenopora compacta was discovered. The latter is almost covered with soil and this rock is exposed in only a few places. The conglomerate was also followed along the edge of the wood in a series of low-lying knolls for some distance. About half a mile northeast of these ledges, about 350 yards northeast of the Southard house, and the same distance north of the public road, near the edge of the woods, at the point where an old wood road leaves the woods, the light grayish-colored rock passes into a thin layer of fine conglomerate of the same color and then abruptly into a dark blue fine-grained conglomerate. The ledge showing this transition is in place, but is very narrow and lies nearly flat, dipping at a very slight angle to the southeast. A hundred feet northeast of this ledge, beyond a stone wall, the coarse conglomerate outcrops. What appeared to be brecciated conglomerate was noted in one or two ledges farther north.

There is thus a narrow, but well defined, strip of the Trenton conglomerate along the western margin of this limestone. Its former eastward extension is wholly problematical.

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[1] Amer. Jour. Sci. Ser. 3. Dec. 1880. 20:452.
[2] Amer. Jour. Sci. Ser. 3. May, 1879. 17:383.

At Swartoutville, a little hamlet about half way between Brinckerhoff and Hopewell Junction, on the farm of Irving Hitchcock, a calcareous conglomerate, with the pebbles squeezed into bands, outcrops in places between the bluish-gray limestone, referred to above as possibly representing the Beekmantown, and the calcareous shales with interbedded limestone layers, the latter lying on the west along the margin of the limestone. In other places the shales with their interbedded limestones grade downward into a fine conglomerate with what looked like S. compacta and other fossils.

During the spring of 1909 a number of new cuts were made in the limestones along the road from Johnsville to Stormville in the process of constructing the State road. In one of these, about two miles east of Johnsville, a fairly distinct impression was found. This may be a fossil. The general form is apparently preserved, but the details are obliterated. Other blackened and much more distorted impressions were noted. These impressions, together with other markings, such as bunches of calcite crystals, mark the rock as probably fossiliferous.

Some peculiar lithic variations within the Fishkill limestone. Northeast of Johnsville, on the farms of Messrs Gildersleeve and Taylor, are frequent outcrops of a coarse silicious limestone, which was not noted elsewhere in this limestone belt. It somewhat resembles the basal quartzite at times. It is always calcareous, effervescing readily with cold dilute acid, but leaving a prominent residue of quartz. It is interbedded with other limestones, which in their lithological characters recall the chamois-colored beds in the Beekmantown of the Wappinger creek belt. The silicious rock just referred to outcrops along the road south of Bonney hill north of Taylor's house, while Bonney hill seems to be largely made up of the medium-bedded chamois-colored rock, except at the west along the lower portion of the scarp slope, where it gives place to a gray limestone. No fossils were discovered in these limestones. It is noteworthy that they lie close to the northward continuation of the strike of the rocks in the West Fishkill Hook district.

A diligent search was made within this limestone east of the western margin for a conglomeratic layer, but none was found. What appear to be coarse brecciated zones are of frequent occurrence, particularly west of the Honness spur. These were noted just southeast of Milton C. Hustis's house at Brinckerhoff, between Mount Honness and Fishkill creek, where the rock is mashed, and in the Newburgh, Dutchess & Connecticut Railroad cuts between Fishkill Village and Brinckerhoff, and less noticeably but plainly elsewhere to the north toward Hopewell Junction and east toward Stormville. The discussion of the structural features will bring out the fact that there must have been a strong tendency toward crushing and mashing along the limbs of minor folds within this formation.

In the woods west of Wood's greenhouses at Fishkill Village are numerous outcrops of a very fine-grained metamorphosed rock which suggests an altered silicious ooze. It was noted in several places within short distances of each other and not far from ledges carrying Ophileta compacta. It appears to be a rather abrupt variation of the rock with which it is associated, and probably is to be regarded as a variation of the Beekmantown.

Certain varieties are plainly the products of metamorphism and will be referred to again under that heading.

In most cases, the lithology of the Fishkill limestones does not convey anything definite of which one may make use for provisional correlation. In the new cuts along the road from Brinckerhoff to Stormville even the fresh surfaces convey very little. In some of the ledges near Gayhead [1] the fresh surface carries numerous rusty patches, possibly siderite, which recall some surfaces seen in the quarry at Stoneco.

The magnesian character of some of these limestones is well known. There is some reason for thinking that they were accumulated in somewhat restricted bodies of water. Possibly they are partly the products of precipitation from saturated solutions.

If during the time these deposits were accumulating there were several basins more or less completely cut off from each other, it is easy to understand that there would have been some diversity in the condition of sedimentation in this region. In some places there would have been normal marine conditions with characteristic animal forms, while in others, perhaps, there would have been an accumulation of sediments peculiar to basins more or less completely cut off from the sea with an absence of animal forms. An influx of the sea in these restricted basins would carry with it a change in sediments and a marine fauna and a fossiliferous lens might thus be produced within a barren dolomite.

The absence of the conglomerate and overlying formations over most of the Fishkill limestone indicates that it is composed chiefly of older strata, probably ranging discontinuously from Lower Cambric to Beekmantown. As the folds in the limestones are

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[1] East Fishkill is invariably referred to as "Gayhead," in this region. The name seems to have originated from the head adornments of the ladies who flocked to this place for dance festivals in early years.

moderate swells the older masses have not been exposed, except where faulted. Much of the surface rock may be of Beekmantown or Upper Cambric age, the latter belonging to the upper dolomitic layers of the sediments of that epoch.

Structural features. The hiatus that is present between the Beekmantown and the Trenton within the Wappinger creek belt has its counterpart along the western margin of this limestone; but the failure to find any conglomerate farther east, such as usually represents the base of the Trenton, not only in the Wappinger creek belt and along the western margin, but also in the slates at the north, leaves much uncertainty as to the relative stratigraphic position of much of this Fishkill limestone. The presence of certain faults adds to the perplexity; while the general faulted position of the Fishkill limestone as a whole and the absence of the slates within it rather leaves the impression that it is made up chiefly of limestones older than the Trenton conglomerate, except where younger beds have been faulted in.

In spite of faults and thrusts the general folded arrangement of the Fishkill limestones can in some instances be made out with a fair degree of exactness.

In the hamlet of Wolcottville the limestone is in contact with the gneiss. In the town of Matteawan it first rests against the slates, which are almost certainly younger, and then on the gneiss, then on the quartzite and finally on the gneiss again. The quartzite contact may be normal. The gneiss contact may also be normal in places, but in such cases the gneiss is presumably the equivalent of the basal quartzite and represents an altered condition of the gneiss.

The fault on the west of the Glenham belt represents an early thrust which was succeeded and outstripped by the Bald hill thrust. The western break also bounds the Matteawan inliers at the west. Faults bound the Glenham belt on the south and the northern inlier of Matteawan on the north and between these the slates have apparently been dropped.

Numerous breaks may occur in Matteawan so that the limestone resting on the quartzite in that town may not be of the same age as that which rests against the slates. The limestone is traceable to the north across Fishkill creek and through Glenham and beyond. But as a rule not much can be made out about the structure.

At Wilsey's quarry on the Fishkill-Glenham road the arenaceous limestone strikes n. 35° e. and dips about 51° s.e. In the field just north the fossiliferous Beekmantown and interbedded limestones have a strike varying from n. 15° w. to n. s. and a dip of 35° e. One-half mile to the northeast the dip is gently away from the gneiss and the strike cuts across it at a small angle. This general relation holds to the Chelsea road.

The topography southeast of Fishkill Village is very flat. There are few outcrops north of the Fishkill-Glenham road, between it and the woods, until the farm of Albert Haight is reached and none to the south of it until Glenham is reached. Low ledges of limestone appear north of Fishkill Village. Between the Chelsea and Wappinger Falls roads and north of that road and the Cold Spring turnpike they are abundant.

Just north of the village on the west side of the road, to the south of the cemetery, the strike is n. 55° e. and the dip 35° s.e. (lettered B in section figure 23). Farther north on the roadside near the gneiss the strike is n. 15° e. and the dip 49° n.w. (lettered A). At the railroad crossing on the Cold Spring road the strike is n. 80° e. and the dip 46° n.w. (lettered C). Southeast of Fishkill creek and northeast of the Cold Spring road, from a point a short distance from the road as far as Milton Hustis's farm, the strike varies from 25° to 40° east of north and the dip is toward the mountain and according to readings taken varies from about 50° to 62° s. e. (lettered D). Along the road from Fishkill Village to Brinckerhoff, about one-half mile from Main street in Fishkill Village, the strike and dip are about the same as at the railroad crossing. Along the northwestern margin of the limestone to the northeast of the Wappinger Falls road the strike and dip are not easily followed. Along a section in a northwest-southeast direction from the Glenham belt through Fishkill Village to the northwestern base of the Honness spur, as shown on the map and the accompanying

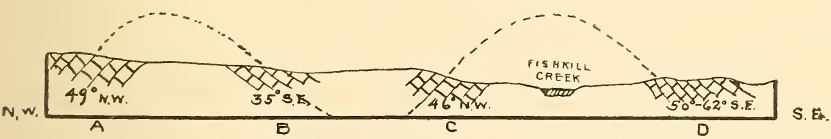


Fig. 23 Section across the Fishkill limestone along a northwest-southeast line through Fishkill Villagef rom the G'enham gneiss to the Mount Honness spur, to show the character of the folds Distance 2 miles

section (fif. 23), the limestone is in a series of northwest-southwest folds which have suffered great erosion and, at places, much disturbance. The latter is shown along the highway and in the railroad cuts southwest of Brinckerhoff, where the strike is only at a small angle to the east of north and at one place n. 50° w. with easterly dip. Northeast of Brinckerhoff the strike and dip return to the former general direction. In the railroad cut just north of the Johnsville road they are n. 30° e. and about 45° s.e., and one mile south of Hopewell Junction n. 44° e. and 45° s.e.

The western slope of Bonney hill has the appearance of a fault scarp and shows numerous outcrops of limestones dipping to the east. Along the road leading south from Bonney hill, at the north to the east of the road and at the south to the west of it is another scarp with easterly dips. South of Bonney hill a northeast-southwest break apparently intersects this fault and the limestones north of Johnsville lie in the angle between them.

The section (fig. 24) along the railroad cut east of Hopewell Junction shows some structural detail. Heavy erosion has obscured the larger features and has brought out the minor ones. Beginning at the west, the section is first through beds dipping gently eastward,

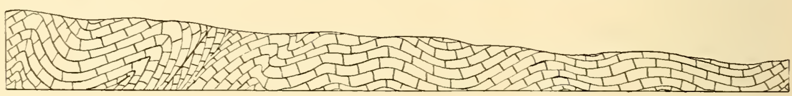


Fig. 24 Generalized section of the south wall of the railroad cut east of Hopewell Junction

and apparently bordered on the west by the northward continuation of the fault that follows the road southeast of Bonney hill. East of this it is through a symmetrical northward pitching anticlinal shown in plate 13, and complemental synclinal, then in a smaller anticline and syncline, and then through an irregular fold with its eastern limb pushed up. This is followed by a closely compressed syncline which is succeeded by a closely-folded overturned anticline (see plates 14 and 15) ; then two small folds which are cut off at the east by the fault shown on the map.

East from here along the railroad the sections are fragmentary. In the second cut east of the overhead bridge on the road from Gayhead to Gregory's mill, the limestones show an arrangement like that of figure 25. Just west of Stormville station the beds are isoclinal, dipping to the east, and show a considerable aggregate thickness.

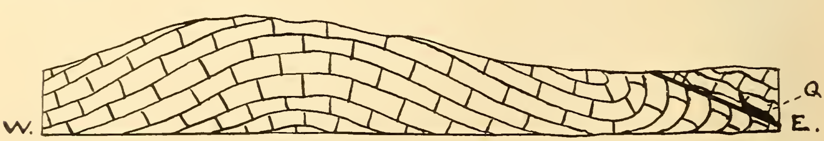


Fig. 25 Section just east of the overhead bridge on the railroad between Hopewell Junction and Stormville. *Q*, nest of quartz

The tendency to arrangement in somewhat gentle folds is shown by numerous observations. In some places the dip is east and at

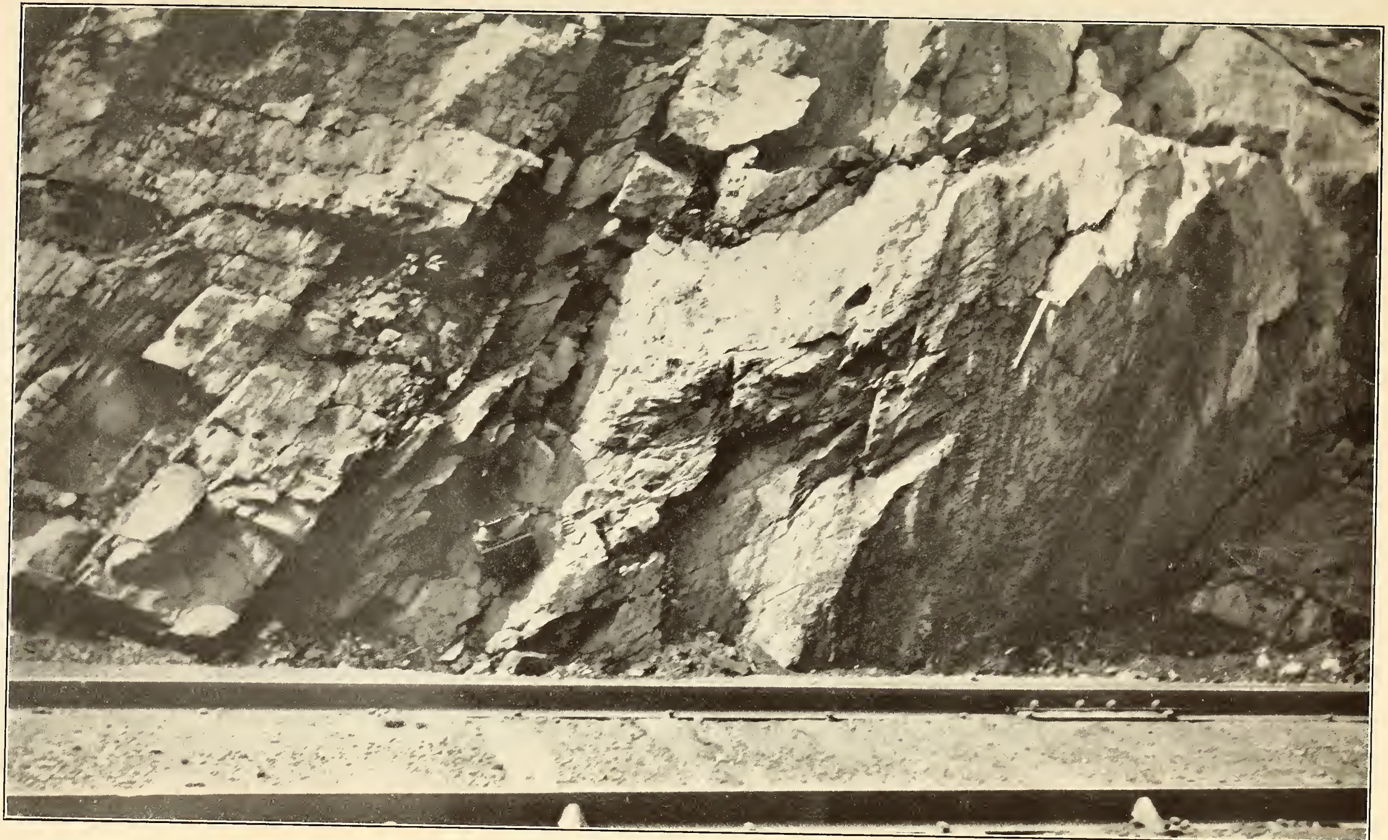
Plate 13

Anticlinal fold in the limestones at the western end of the railroad cut east of Hopewell Junction. The axis pitches gently to the north

Plate 14

Compressed and overturned syncline in the railroad cut, one mile east of Hopewell Junction. Note the compression along the axial plane and the thrust along the overturned limb. The axial plane dips eastward

Plate 15



A view in the railroad cut about one mile east of Hopewell Junction, showing an overthrust on the left and a compressed syncline on the right marked by the hammer. The dip is eastward

others west. The strike remains practically unchanged for some distance in many instances for beds with the same general dip. The limestone differs from the slate at the north with its isoclinal arrangement over wide intervals.

The tendency to overthrust, shown in the section along the railroad, probably prevails over the entire area. Strike faults are most apparent. The regularity of the strike for long distances seems to indicate that horizontal offsetting has not been important. Two large breaks along the strike are shown on the map. They are shown in the field by long stretches of swampy lowland that may be followed for several miles across country. They seem to be the northward projection of faults in the Highlands. The presence of these large breaks and minor ones complicates the question of the age of the limestone. The displacement must have been a large one at places as, for example, along the fault line that bounds Shenandoah mountain on the east. Possibly beds of very different age lie in close proximity.

Metamorphism and alteration. Were it possible to trace continuously from west to east the beds now known to be present along the western margin of this limestone, more could be definitely determined about gradation in metamorphism to the eastward. Examination of the belt has shown that the rock usually displays greater crystallinity as one goes eastward. Banded limestones not very different from some seen in the Dover valley were noted near Gregory's mill. There is much evidence of crushing. Bunches and veinlets of calcite and quartz nests and stringers are abundant. These indicate hydrothermal activities. Organic remains have doubtless been obliterated by these as well as by crushng, shearing and pressure.

Summary. The Fishkill limestone, in its relations to the slates, stands essentially as a huge faulted block. Though less plainly shown, the same is true of its relations to the Highlands mass. This arrangement has produced a northwestward gradation by faulted blocks from older to young masses. These considerations afford further reason for believing that the Highlands owe their present elevation to the mountain-making processes that gave birth to the Green mountain system and that the younger rocks once had an extension much to the south of their present southern limit, thus giving an altogether different notion of the early relation of the Paleozoic sea to the Precambric land from that which the present topography might be assumed to show.

The northward projecting spurs of the Highlands indicate a tendency to fold with the younger series, but owing to their crystalline condition and high coefficient of elasticity the gneisses broke and were thrust up into the younger rocks, in some places carrying the latter with them, and in others overriding them. The West Hook series was apparently first thrust up and then dropped back and has thus been preserved.

The arrangement in echelon of transverse faults along the northwestern margin of this limestone belt seems to show the influence of the gneissic substratum on which it rests.

The northward pitch of the younger rocks, which is observable in places, may be as readily explained as the result of greater vertical movement at the south as of original inclination.

The Mount Honness spur is plainly faulted on the north and shows numerous transverse gaps (see plate 2).

The abnormal position of the Lower Cambric caused much confusion in early years and led to its assignment to the Potsdam on the basis of its apparent stratigraphic position.

The occurrence of numerous faults in the quadrangle suggests that the apparent absence of a Middle Cambric might thus be explained.

The evidence now in, although in great need of being supplemented, shows that the limestones of the Fishkill belt are, in part, the eastward representatives of those of the Wappinger creek belt.

THE "HUDSON RIVER" SLATE GROUP

The term "Hudson River" is used in this paper for the slates of the quadrangle because of the extensive section displayed in these rocks along the Hudson river and because the name is both widely known and locally followed by those who refer to the members of the slate formation. It is used only as the equivalent of other names employed in this paper and entirely without reference to the value of the term "Hudson River Group."

Distribution and general relations. Members of this formation underlie the major part of the quadrangle. At the present time there are no representatives of it within the Fishkill mountains or the Fishkill limestone of this quadrangle. Northwest of these rock masses the Hudson River rocks are the prevailing ones. The limestones of the Wappinger creek belt are faulted in with the slates. Northwest of this belt the slates entirely conceal the limestones. North of the Fishkill limestone block are several small patches of limestone within the slates which will be described with this formation.

Terranes present. Mather described the members of this formation under the headings, "Hudson River Group," "Utica Slate" and "Trenton Limestone Group."[1] He wrote of fossils being found in the "slates and slaty altered limestones that would not be recognized as limestones without close examination." The locality was about one and one-half miles north of Barnegate[2] and the fossils were recognized as belonging to the Trenton limestone.

In 1878 T. Nelson Dale[3] discovered fossils in the slates near Vassar College and "on the Stormville road between Casper creek and the first limestone ridge." Mr Henry Booth, of Poughkeepsie, and students at the college found other fossils at the ledge near the observatory at Vassar. The writer has also found fossils there.

In company with Mr Booth, Mr Dale discovered other fossils on the west of the Hudson opposite Poughkeepsie. This locality is on the eastern slope of "Illinois mountain" southwest of Highland.[4]

The fossils discovered by Dale were identified by Hall as: Orthis (Dalmanella) testudinaria, Orthis pectinella, Leptaena (Plectambonites) sericea, Strophomena alternata, Bythotrephis subnodosa, Bellerophon bilobatus and crinoid stems. Specimens of the first five named are in the Vassar Institute Museum at Poughkeepsie and are labeled "Highland, N. Y." O. (D.) testudinaria and L. (P.) sericea were found on both sides of the river. Dale thought these fossils verified Mather's use of the term "Hudson River Group." Certainly these strata belonged to some member of the Trenton period.

The first three types mentioned have also been reported from Marlboro-on-the-Hudson about nine miles north of Newburgh. They have also been found in the slates at the northern end of the New Hamburg tunnel.[5] The writer has found fossils here, including O. pectinella, in the shales under the bank, back of the boathouse.

[1] Geology of the First District. Part IV, p. 369, 390, 397.

[2] *loc. cit.* p. 401.

[3] Amer. Jour. Sci. Ser. 3. 17:56–59.

[4] Directions for reaching this locality were furnished by Mr Henry Booth. Take Modena road from Highland south one mile to cemetery, then wood road through cemetery to mountain. Fossiliferous ledges occur 150–200 yards up the mountainside.

[5] J. M. Clarke. Guide to the Fossiliferous Rocks of New York State. Handbook 15, p. 6.

Crinoid stems have also been found at Marlboro. L. (P.) sericea and O. (D.) testudinaria were found on both sides of the Hudson as rather abundant and characteristic.

The only other fossil locality in the slates which was found by the writer, and which appears to be new, is at Swartoutville. At the western edge of the large field across the road from the house of Irving Hitchcock is a ridge composed of fissile, gray sandy shales with interbedded, dense blue impure limestones.

The shales stand almost vertical, dipping slightly to the west and strike diagonally across the ridge, so that in going from south to north along the ridge one passes over probably older beds. The interbedded limestones are of dark blue color and carry numerous traces of organic remains. The fissile shales have yielded Plectambonites sericeus, and fragments of indeterminable fossils.

Relations are very obscure, but one or two small outcrops of limestone conglomerate were noted between these strata and the bluish-gray limestone a short distance to the east. In their structural relationships the fossiliferous shales probably belong with the limestones and are probably near the base of the slate formation. The slates at the west are younger. The amount of displacement between them is wholly problematical.

In 1883, during the construction of the railroad along the west bank of the Hudson, Messrs H. Booth and C. Lown of Poughkeepsie discovered graptolites in the newly-made cuts at two localities, one two miles south of Highland and the other about one mile north, near the place where the icehouses now stand. These graptolites were identified by Whitfield as follows [the correct names have been added in brackets]: Diplograptus pristis Hall; Climactograptus bicornis Hall; Dichograptus [Dicranograptus] furcatus Hall; D. [Dicellograptus] divaricatus Hall (?); Monograptus [Nemagraptus] gracilis Hall; M. [Didymograptus] sagittarius Hall; Diplograptus marcedus Hall. [Cryptograptus tricornis]. He considered them as of Utica age. A graptolite identified as Graptolithus [Amphigraptus] divergens was also reported from the slates one and one-half miles north of Poughkeepsie on the east bank of the Hudson river. This specimen is in the Vassar Institute Museum at Poughkeepsie.

Some of the slates within the quadrangle are shown by these discoveries to be younger in age than the so-called Trenton conglomerate of the area. Some may be contemporaneous and probably are; others are possibly much younger. The relations farther north, in Washington county, have shown that the Lower Cambric slates have been brought to the surface by faulting, but within this area it has not proved possible to determine this. On the whole, it does not seem probable.

The general problem of the slates is postponed until several features have been stated in detail.

Red slates. Red slates with green bands of varying thickness may be traced at intervals diagonally across the quadrangle, along the prevailing strike, from Matteawan to the northeastern corner of the area. Their regularity of recurrence indicates that an important stratum is involved in the folding. The main stratum of these red slates as shown in several places has a fairly uniform thickness. Thinner red bands have rarely been noted in the more common grayish-black members of this formation.

In the town of Matteawan red slates with green bands form thick masses along the banks and bed of Fishkill creek as far as the carpet mills at Wolcottville, and north of here at Glenham along the road from Matteawan to Fishkill Village, just west of the Glenham gneiss belt, ledges of these rocks are abundant. The red slates are locally called the "paint rock." Farther north along the strike they were noted north and south of the road from Fishkill Village to Chelsea and along the road from Swartoutville to Hughsonville. A thick band occurs along the New York Central Railroad track one-fifth of a mile south of Paye's clay pits and a similar band just north of the station at Chelsea. They were not noted farther north along the river section. The slates at Chelsea continue northeast along the strike and appear one mile north of New Hackensack along Wappinger creek, and again near Manchester Bridge and at Overlook; also frequently along the roads from Pleasant Valley to Moores Mill. At the north they appear oftener, chiefly because of the more frequent and larger outcrops of the slates and the thinner covering of surface material.

There are reasons for thinking that the slates form a synclinal fold west of Matteawan and possibly the red slates at Matteawan and south of Paye's pits respectively represent the east and west limbs, while those at Chelsea may represent the western limb of the succeeding anticline.

Associations of the red slates. Along both the north and south roads from Pleasant Valley to Moores Mill the red slates occur just to the west of small conglomeratic limestone patches that have plainly been brought up by faulting. There is no way of determining the amount of displacement, but it is reasonably clear that the red slates lie above the limestone and are younger and probably are not far from the base of the slate formation.

Along the New York Central tracks near Fishkill Landing station are heavy-bedded members of the slate formation, such as make up most of it northwest of the Wappinger creek limestone belt. Assuming that the slates west of the Glenham gneiss belt have synclinal structure, these heavy members can not be far from the axis of the fold and lie several hundred feet above the red slates in stratigraphic position. The reason for the gneiss being in contact with, or in proximity to, the red slates along the Glenham belt, while the limestone conglomerate has that position at the north, is clearly due to greater vertical movement of the older rocks at the south and west.

The red slates have not been noted within this quadrangle northwest of the Wappinger creek belt. According to the writer's observations, the companion members of the red slates southwest of that belt, although sometimes showing heavy beds and even fine conglomerates like those seen at the northwest, are prevailingly more fissile and splintery mud rocks of blackish-gray color. These also occur along the northwestern margin of the Wappinger belt, but farther northwest give way to beds of coarser sediments.

Quartzite near Rochdale. Along the road from Manchester Bridge to Pleasant Valley, east of Wappinger creek, between the farm of A. W. Sleight and that of George E. Smith at Rochdale, are prominent ledges of compact quartzite which rather strongly resembles some varieties of the basal quartzite. These ledges are portions of a continuous strip which can be traced from a ledge on the farm of A. W. Sleight just north of the Overlook road northward, roughly parallel with the Pleasant Valley road, to George E. Smith's house. Just south of here it crosses the road and ends at the bank of the creek west of the house. East of the road it ends just beyond the barn south of the brook shown on the map, which apparently occupies a fault between the quartzite and the slates to the north of it. This quartzite is bounded entirely by the slates, except where it disappears in the creek. Here it is only a short distance from the Trenton limestone at Rochdale. Along the eastern contact with the slates, about one-half mile south of Smith's house, the quartzite shows a strike of n. 20° e. and a dip of about 60° e. A mile and a half to the southeast, on the farm of Eugene Storm at Overlook, is a large block of compact whitish quartzite identical in character with that just described. This is cut off by a fault at the south against the slates. It can be traced only a short distance northward and disappears beneath the drift. This mass apparently belongs with the strip first described.

This quartzite is probably an interbedded member of the slate formation. Its exact equivalent has not been noted elsewhere within the quadrangle.

MISCELLANEOUS FAULTED LIMESTONES WITHIN THE HUDSON RIVER FORMATION

Arthursburg. Three small patches of limestone are faulted in with the slates at Arthursburg. One of these is near the Central New England Railroad station. The impure shaly limestone is exposed in the railroad cut and forms a conspicuous knoll, which is situated partly on the railroad property and partly on the estate of Obed Hewitt. It is bounded on all sides by the slates and is hardly more than one-fourth of an acre in extent. It occurs along the northward projection of the line of faulting that farther south forms the western boundary of the angular portion of the Fishkill limestone north of Hopewell Junction. Its present position is due to this fault and marks its northward continuation. A careful search showed that the limestone does not occur in the neighborhood to the west of this fault.

A few hundred yards to the northeast of the station, on the road ascending the hill toward Beekman, conglomeratic limestone, with pebbles squeezed and elongated, outcrops along the road just north of the old schoolhouse.

One-fourth of a mile north of this outcrop on the farm of G. L. Wiley, just southeast of the private cemetery, the limestone is exposed on a knoll just north of the brook. Some bluish-gray beds, like those seen at Rochdale, are present. The conglomeratic facies is absent. The beds strike n. 10° w. and dip 55° e. The knoll is entirely surrounded by the slates. The topography suggests a fault more or less parallel with the brook at this place. The fault just referred to as projected north from the Fishkill limestone dies away to the northward.

An unmistakable fault passes southeastward from Arthursburg and intersects the strike fault that follows the line of the old Clove branch railroad bed.

The shaly beds near the station are probably younger than the conglomerate, while the latter is probably younger than the mass near the cemetery from which the conglomerate may have been eroded. These small masses are all separated from each other by the slates and no others could be found. They are clearly small faulted inliers of the older rocks lying near or at the intersection of two faults, one of which exactly parallels a similar break bounding the Fishkill limestone just south, while the other is the northward continuation of a fault between that limestone and the slate.

The fault features which mark the Highlands and the Fishkill limestone thus continue northward within the slate formation.

Moores Mill. On the farm of Mr Skidmore, about one mile west of Moores Mill station, is a larger mass of limestone resting against the slates. It extends up the hill on the northwest side of the road and for a short distance through the woods, but on the west, north and east gives way to slates. On the southeast it passes beneath the flood plain of Sprout creek. The entire patch does not exceed an acre or so in extent. In the orchard west of Skidmore's house the slate and limestone are mixed together. The limestone is of a gray color and somewhat crystalline and seamy, but has no distinctive character. No satisfactory readings could be obtained.

East of the creek, one-half mile from Skidmore's house, on the farm of Mr Houghtalin, is a small, precipitous ledge of limestone in place, apparently dipping to the east at a high angle. This ledge is in the angle formed by the two roads northeast of Houghtalin's house. The topography just south of the ledge is that of a scarp, which continues for one-third of a mile southwest. The scarp slope for this distance is uniformly abrupt, but outcrops are concealed south of Houghtalin's. The topography suggests a transverse break at the south along the line shown on the map. South of this break, along the base of the slope, outcrops are concealed by surface material for some distance, but farther on the slates outcrop in low-lying ledges and in some places lie close to the base of the slope.

The discovery of these two limestone patches aroused the suspicion that the valley of Sprout creek might be in the limestone, but careful search failed to show the limestone in any other outcrops with one doubtful exception. Along the bank of the creek, one mile northeast of Skidmore's farm, a mass of limestone about fifteen feet square was found between the road and the brook. At the base it is made up of coarse limestone conglomerate, which is followed by arenaceous limestone. This is succeeded by a finer-grained conglomerate. The apparent strike is n. 25° w. and the dip 34° n.e. This was regarded as a boulder. It strongly resembles similar beds found in place to the northwest. It hardly seems probable that this small ledge would have been preserved in its present position.

It is reasonably apparent that these two limestone patches have been brought to their present position by overthrust faulting, involving a horizontal displacement of at least one-half a mile. At Skidmore's the limestone has been eroded so as to expose the slates on which it has been thrust. The small ledge at Houghtalin's is only part of a scarp which is for the most part concealed.

The valley southwest of these two limestone patches is plainly in the slate. There is strong suggestion that it is along a line of strike faulting that extends from the Highlands northward beyond the limits of the quadrangle. The view which shows this best is that obtained from the western slope of the ridge southwest of Moores Mill. The conspicuous scarp on the west of the high hill west of Lagrangeville, which is seen so distinctly from Freedom Plains, lies along this line of faulting, while the northeastward continuation of the latter is marked by a hollow plainly visible at the elevation of the viewpoint just mentioned.

East of Pleasant Valley. Three limestone masses are faulted in with the slates east of Pleasant Valley. The largest of these is farthest east of the three and is shown on the map along the north road from Moores Mill to Pleasant Valley. A small ledge of the limestone outcrops among the slates one-fourth of a mile south of the fork in the roads near Ivy's house. This is separated from the main portion of the mass along the road by slates. East of Ivy's house, occupying practically all of the small triangle formed by the roads as shown on the map, and north of here for several hundred yards, are ledges of conglomeratic limestone interbedded with silicious limestones (silicicalcarenytes[1]) and limy shales. The dip is eastward. Low ledges of limestone outcrop on both sides of the road east of Ivy's. On the east side of the road the conglomeratic

[1] A name proposed by Professor A. W. Grabau for silicious limestones with sandy texture.

member forms a scarp for some distance. The pebbles of the conglomerate are squeezed out into a stringerlike appearance along the strike.

At the east this limestone patch gives way to the slates. At the south limestone and slate are somewhat mixed. At the west the patch evidently rests by overthrust on the slate formation. At the north relations are very obscure. It probably dies away along a strike fault.

Distinct fossil traces were not noted here. The silicious limestone often shows many rusty grains. The red slates outcrop less than one-fourth of a mile to the west.

Farther west, along this north road, about one and a half miles east of Pleasant Valley, as shown on the map, squeezed limestone conglomerate and interbedded silicious limestones form a knoll north of the brook and outcrop along the crossroad leading north. The limestone dies away at the north and is entirely surrounded by the slates. This block is along the line of thrust that brought up the third patch to the south of here along the south road to Moores Mill.

About two miles southeast of Pleasant Valley is another patch of limestone conglomerate with associated silicious limestone. The latter here is often weathered and shows a distinct clastic rock with fine quartz grains predominating. The weathered surface is pitted and the rock friable from loss of the lime constituent. This rock could be equally well designated as a calcareous quartzite. It is very similar to the rock overlying, or interbedded with, the conglomerate near Ivy's house farther east, but perhaps is a little more silicious. It carries the same rusty grains. The writer was interested to compare this rock with specimens collected from the Sprout brook limestone near Peekskill and was surprised to note the strong resemblance in texture, mineralogy and markings.

This patch lies back from the road, about 500 or 600 yards east of J. Fleet's house. It forms a distinct scarp which continues south in the slates along the road after the latter makes its southward turn just east of Fleet's house. A thick band of the red slates comes in between this scarp and Fleet's house and is crossed diagonally by the road. The conglomerate rests by overthrust on the slates at the west. This feature is shown at "Fox Hole," a local name for the precipitous scarp shown in plate 16 and figure 26.

Plate 16

Overthrust of the conglomerate on the slates east of J. Fleet's farm, southeast of Pleasant Valley

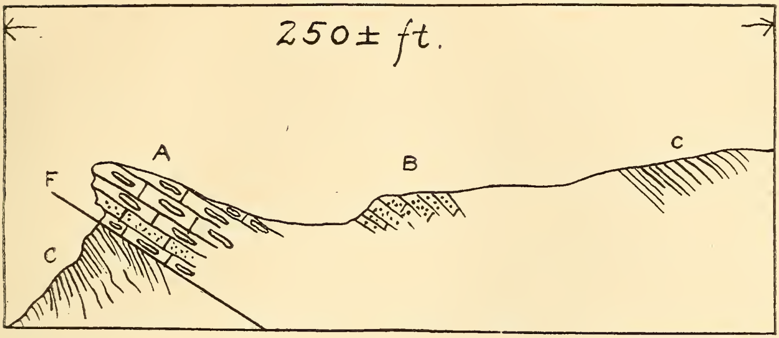


Fig. 26 Overthrust east of John Fleet's. *A*, limestone conglomerate; *B*, silicious limestone; *C*, slate; *F*, fault

When seen from above the conglomerate is coarse, but when examined along the edges of the eastwardly dipping beds the pebbles are seen to be squeezed out into stringers, so that the apparent coarseness can not represent the original condition. The dip is about 20° e. and the strike about n. 10° e. The calcareous quartzite was not seen in actual contact with the conglomerate, but is undoubtedly conformable. At the east the former is followed by the slates. Solenopora compacta, showing the characteristic very fine lines, was noted in the conglomerate. The quartzitic rock outcrops at intervals to the south for one-fourth to one-third of a mile, but gradually dies away. At the north the series ends more abruptly.

The conglomerate at the last mentioned locality of those which have just been described is undoubtedly the equivalent of that which at Pleasant Valley and Rochdale overlies the eroded Beekmantown, and there can be little doubt but that the conglomerate at the other localities is also the same. There is shown again the general tendency for the older rocks to be faulted up among the younger ones.

Summary of features shown by the conglomerate and associated rocks. At Pleasant Valley and at Rochdale the conglomerate and overlying or interbedded blue limestone resting on the eroded Beekmantown are prominently developed. At Rochdale the series is from 70 to 100 feet in thickness and at Pleasant Valley it is apparently about the same. At Sleight's quarry near Manchester Bridge the conglomerate and blue limestone is from 20 to 30 feet in thickness, but certain faulting here makes it unsafe to regard this change as marking a thinning of the limestone. Farther south along the Wappinger creek belt one can get no idea of the extent to which this basal series is represented. Along the western margin of the Fishkill limestone, as shown east of the Glenham belt, the conglomerate has plainly been eroded so extensively that no idea of its original thickness can be gained. At Swartoutville the conglomerate is apparently thin and passes quickly into a series of interbedded bluish limestones and gray limy shales. The impure shaly limestones along the railroad track west of Hopewell Junction, at the apex of the limestone angle and those near Arthursburg station, are probably near the base of the slate formation. At Arthursburg the conglomerate is present at a distance of a few hundred yards from the shaly limestones at the station. In the localities east of Pleasant Valley, which have been described, the conglomerate is interbedded with and followed by calcareous quartzite, the blue fossiliferous mud rock not being present.

At the east within this quadrangle the rocks associated with the conglomerate, though varying in texture from shaly rocks to quartzitic ones, tend to be more silicious than those farther west. Folding and faulting have doubtless brought the two into their present rather close proximity.

Other varieties within the slates. This formation shows many varieties of more or less altered clastic rocks, ranging from muds to fairly coarse conglomerates. While folding and faulting have produced the greatest confusion, it seems possible to make out the general sequence. The writer's observations favor the idea that the calcareous conglomerate and overlying quartzitic limestone represent an eastwardly overlapping sea. These were quickly followed in some cases by limy mud rocks and in others by argillaceous ones. These were both succeeded by a clastic series of both argillaceous and calcareous nature with one and sometimes the other element in excess and occasionally with so much lime as to form an impure lime rock. The varieties varied in texture and followed each other irregularly. Impure argillaceous muds predominate, and are interbedded with limy muds and grits of varying thickness, but often attaining several feet. Grits often reaching conglomeratic texture are frequent. In these, the larger particles range from the size of a pin head through that of a pea to that of a walnut and larger.

On the whole, the finer-textured members are more characteristic of the basal portions of the series and the coarser and gritty layers of a higher horizon. Such a series as has just been described is folded in between the red slates of Matteawan and those south of the clay pits at Paye's brickyard, and the members are exposed at

Plate 17

West side of Hudson river showing location of Marlboro and "Illinois" mountains

many points between or along the strike to the north and south, and along the New York Central Railroad track. The coarser, gritty members, or conglomerates, were noted about midway between the strikes of the two bands of red slates.

The red slates suggest that they were formed under conditions of regular exposure to the atmospheric influences, perhaps on extensive tidal flats or river deltas. It is probable that these rocks were formed on a gently subsiding sea floor which occasionally allowed for partial nonmarine conditions of sedimentation. The relative horizon of the red slates is indeterminate, but is probably not far from the base of this formation. This is indicated by the geographical associations with the conglomerate and their absence northwest of the Wappinger creek limestone.

North of Camelot, along the railroad track, almost to Poughkeepsie, crushing has affected all members much the same, producing coarsely splintered slates. The great confusion exhibited by the slates about Poughkeepsie and on the west of the river north and south of Highland seems to have been due very largely to the effect of heavy beds interbedded with thinner ones.

Along the western bank of the Hudson from Marlboro to a point two miles or so north of Highland, the rocks are quite similar to those along the east bank. Westward from the Hudson the rocks grow prevailingly coarser. The section along the Central New England track between Highland and Lloyd shows thick masses of quartzitic rocks interstratified with coarse grits and conglomerates. The latter form relatively thin beds, perhaps from six to eight feet in thickness, often with pebbles from two to four inches in their longest diameters, embedded in a matrix of finer conglomerate; while in the grits are scattered pebbles ranging from the size of a walnut to that of a man's head. These coarser types prevail along the track west of Highland station and are particularly well shown just east and west of the overhead trolley bridge on the New Paltz road and at the foot of the mountain along the road just south. These rocks appear to be the northward continuation of the rocks of "Illinois mountain." That some of the strata were deposited under marine conditions is indicated by the fossils that have been discovered on the eastern slope of "Illinois mountain" and on Marlboro mountain farther south. While this is true, there appears to have been a gradual coarsening of sediments westward which suggests changed conditions in the source of supply, lying to the eastward, as though terrigenous sediments gradually encroached westward and contended with marine deposits. This idea would seem to fall in line with what we know of the record of closing Ordovicic time in eastern North America.

Some of the members of the slate formation on the west of the Wappinger limestone belt may be much younger than those on the east of it. They may be thought of as having been preserved partly on account of their occupying, in general, a downthrow position with reference to a tendency to thrust and reversed faulting to the eastward, as well as on account of being west of the axis of maximum folding.

About two miles north of Poughkeepsie are strata of black, somewhat carbonaceous slates in which graptolites have been found. They indicate changed conditions of sedimentation from those which chiefly prevailed during the accumulation of these rocks. These black slates have been thought to be of Utica age.

Structural features. Where the stratification dip has been determined on what is plainly the limb of a fold, it is chiefly eastward. Judging from the conditions shown in the Fishkill limestone, the structure is that of minor folds within a system of larger ones with a tendency to overturning. The presence of strong cleavage usually obscures everything in surface outcrops.

The dimensions of the larger folds seem to be smaller at the north and northeast than at the southwest, and the folds seem to be more open at the north. The slate ridge just east of Freedom Plains, which ends abruptly at the south at a point due east from that hamlet, has synclinal structure of a rather open character. At various points along the southern portion of its eastern slope it shows the slates dipping to the west into the hill. To the north, along the south road from Moores Mill to Pleasant Valley, the red slates come up on the western limb of this syncline and about three-fourths of a mile farther northwest they appear again apparently on the western limb of the succeeding anticline.

There was a tendency to form irregular folds. This is shown on a small scale in plate 18, in which we have a small overturned and compressed syncline on the right of the picture, followed by an irregular anticline, which becomes compressed and pushed up at the west, and then another compressed syncline not distinct in the photograph but similar to the first. In this instance, it is seen that the production of anticline and syncline in the middle part of the ledge has been incomplete. With similar tendencies prevailing in the larger folds, it is easy to see how, along the western portion of the irregular anticline, there would have been a tendency to overthrust. Crumpling is not uncommon. The wrinkles vary from

Plate 18

Folds in the slates on Ivy's farm, three miles east of Pleasant Valley

minute size to the dimensions shown in plate 19. These features are more common at the east.

Cleavage is so prominent in surface outcrops that the stratification dip is usually obscured. The prevailing eastward dip indicates a common eastward inclination for the cleavage. The presumption is that stratification and cleavage often coincide or approximate each other very closely. Where the cleavage is not dominant to the exclusion of the stratification, this fact is often observed.

Jointing is well displayed in Matteawan along the Newburgh, Dutchess and Connecticut track. A prominent set of joints shown here has a general strike of n. 20° e. and a dip of 80° w.

Some of the faults within the slates have been alluded to in describing the limestone patches within this formation.

Extending in a northwest direction approximately parallel with the road from Brush to Arthursburg, as shown on the map, is a clear transverse fault. This break is best seen from the southeast near the old railroad bed. This break intersects a line of strike faulting at Arthursburg, and probably ends at that point. The strike fault just mentioned dies away to the northward. Continued south, it bounds the limestone triangle north of Hopewell Junction on the west.

The high hill northwest of Lagrangeville is bounded by a fault scarp on the west. This scarp is a conspicuous cliff east of the road from Lagrangeville to Freedom Plains. The high hill northwest of Billings is bounded on the south by an east–west fault whose scarp is very conspicuous.

The other lines of fracture shown on the map have already been referred to.

A long line of swampy lowland, beginning two miles north of Freedom Plains and running northward toward Pleasant Valley, appears to mark a line of crustal weakness similar to that which extends from Hopewell Junction to Manchester Bridge.

The fault which bounds the western strip of the Wappinger creek limestone on the north may extend across the Hudson and bound "Illinois mountain" on the north.

Metamorphism and alteration. The members of the slate formation show an appreciable increase in metamorphism toward the east within the quadrangle, passing into slaty phyllites and graywackes. These rocks do not develop into perfect schists like those occurring a few miles to the eastward, but pellets of decomposed ferruginous particles, suggesting former garnets, were noted in the phyllites east of Arthursburg. Veins, veinlets and nests of quartz are most abundant in the northeastern part of the area. Sandstones have been changed into quartzites.

Summary. There is no evidence at hand that any slates of the quadrangle are older than the limestone conglomerate that has been discussed, either as overlying the Beekmantown or as isolated inliers within the slates. The slate formation was ushered in by this basal conglcmeratic layer. The area of deposition of the latter may have been much more extensive than is indicated by its present faulted outcrops. The period of its formation was of short duration.

The most that can be said of the slate series is that it began in some horizon of the Trenton and perhaps ranges upward an indefinite distance into the Cincinnatian. Probably a large portion is of Trenton age.

The Utica may be present, although the graptolite beds that have been so called more probably represent an early invasion of the Utica fauna in Trenton time in what is known as the Normanskill subepoch. Some of the slates may be contemporaneous with the Utica as developed elsewhere to the north, and possibly even younger; or they may all be of Trenton age.

PREGLACIAL HISTORY OF THE DRAINAGE

Old valleys of the Tertiary cycle. During the erosion cycle inaugurated by the Postcretacic uplift, the Hudson river then, as now, must have been the dominant factor in the drainage of this and adjacent areas. A broad valley region was formed and the tributaries of the master river steadily pushed their valleys eastward. The early Tertiary valley of the Hudson itself is now represented by old rock terraces preserved at different points back from the river's edge. Near Poughkeepsie they have an elevation of about 200 feet.

The rock valleys of the present tributary streams are in most cases out of proportion to the present size of those streams. During the time the Hudson river occupied the valley now marked by the terraces that have just been alluded to, its tributaries widened their own valleys a good deal and acquired their present open character. These branches formed a drainage system of the second order within the broad valley region of the main river and a somewhat advanced stage of mature topography was attained. During this time the various lines of crustal weakness became marked off into their present prominence, without necessarily becoming prominent lines of drainage; simply responding in a logical way, on

Plate 19

Crumpled slates east of Freedom Plains

account of reduced resistance, to the base-leveling forces of the time.

Late Tertiary uplift. Late in the Tertiary cycle, probably during the latter part of Pliocene time, it seems probable that an elevation occurred which rejuvenated the whole river system. The Hudson began the construction of its present gorge and its tributaries began to deepen their valleys within their former confines. It has been suggested that the temporary shifting of the St Lawrence drainage through the valley of the Mohawk gave the main stream a tremendous advantage. It was able to sink its channel at a very rapid rate. The larger tributaries were able to deepen their gorges near their mouths and for some distance back from the Hudson before the glacier invaded the land.

Buried river channels. Borings have been made at different points across the Hudson river and its tributaries in connection with the location of the aqueduct of the great metropolitan reservoir in the Catskill mountains. These have yielded important data regarding the preglacial channels of these streams. Professor Kemp has summarized and discussed these data in an interesting paper.[1]

Borings across the Hudson have been made at Pegg's Point, at a point one-half of a mile north of that place, at New Hamburg and at Danskammer within this quadrangle, and at Storm King just south of Newburgh.

The most northerly line of borings is known as the "Tuff crossing." From this, only wash borings were secured. The river here is only 2200 feet wide.

At Pegg's Point the river narrows still more. A diamond drill was sunk 720 feet from the west shore and reached the slate at 223 feet below sea level. Another sunk 440 feet from the east bank reached the limestone at 92 feet. The distance separating these two borings is 1040 feet. Professor Kemp believes that a deep and relatively narrow gorge lies between. Several lines of wash borings at this place gave depths to supposed bed rock varying from 139.5 feet to 256 feet in what would perhaps be thought of as the deepest part of the river.

At New Hamburg the river is 2300 feet wide. Drill borings on each bank found the slate beneath the limestone. At the point of boring on the east bank it was reached at 220 feet; on the west at 351 feet. Only wash borings were made in the river bottom. These ranged from 130 feet to 263.5 feet below tide.

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[1] Buried Channels beneath the Hudson and its Tributaries. Amer. Jour. Sci. Ser. 4. 26:301–23.

At Danskammer the stream is about 3500 feet wide. The results of wash borings gave a range in depths from 133.2 feet to 268.5 feet to supposed rock bottom, but the evident irregularity and variability would seem to indicate a bed of loose material at these depths at this crossing.

At the Storm King crossing the drill brought up from a depth of 617.4 feet a core of granite just like that on the east bank of the river, which it had penetrated to a distance of 8.8 feet. The drill was thought to have reached rock bottom at this point at a depth of 608.6 feet not far from 750 feet from the east bank.

Casper creek was tested near its mouth by wash borings. The lowest point thus reached was 67 feet below tide.

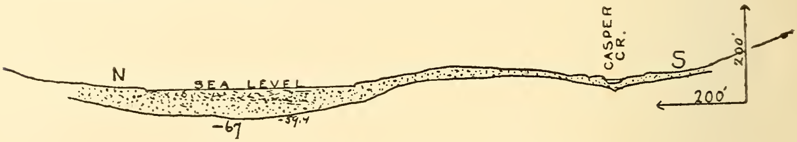

Fig. 28 The Casper creek crossing. (After Kemp)

In Wappinger creek one wash boring below the falls reached a depth of 50 feet below tide. Of three core borings, the maximum was 39 feet.

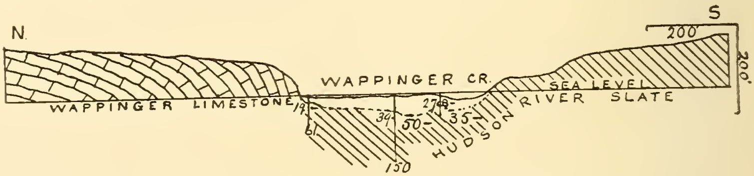

Fig. 29 The Wappinger creek crossing. (After Kemp)

A proposed line of the aqueduct crossed Fishkill creek near the village of Fishkill. Everything is beneath the drift at this point. Of two core holes, the deeper reached the limestone at 40 feet below tide. After penetrating 8 feet of limestone, the drill encountered fine yellow sand in which it continued for 60 feet, when the hole was abandoned. This crossing is about five miles back from the Hudson.

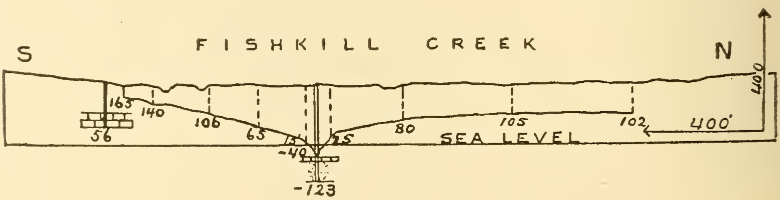

Fig. 30 The Fishkill creek crossing. (After Kemp)

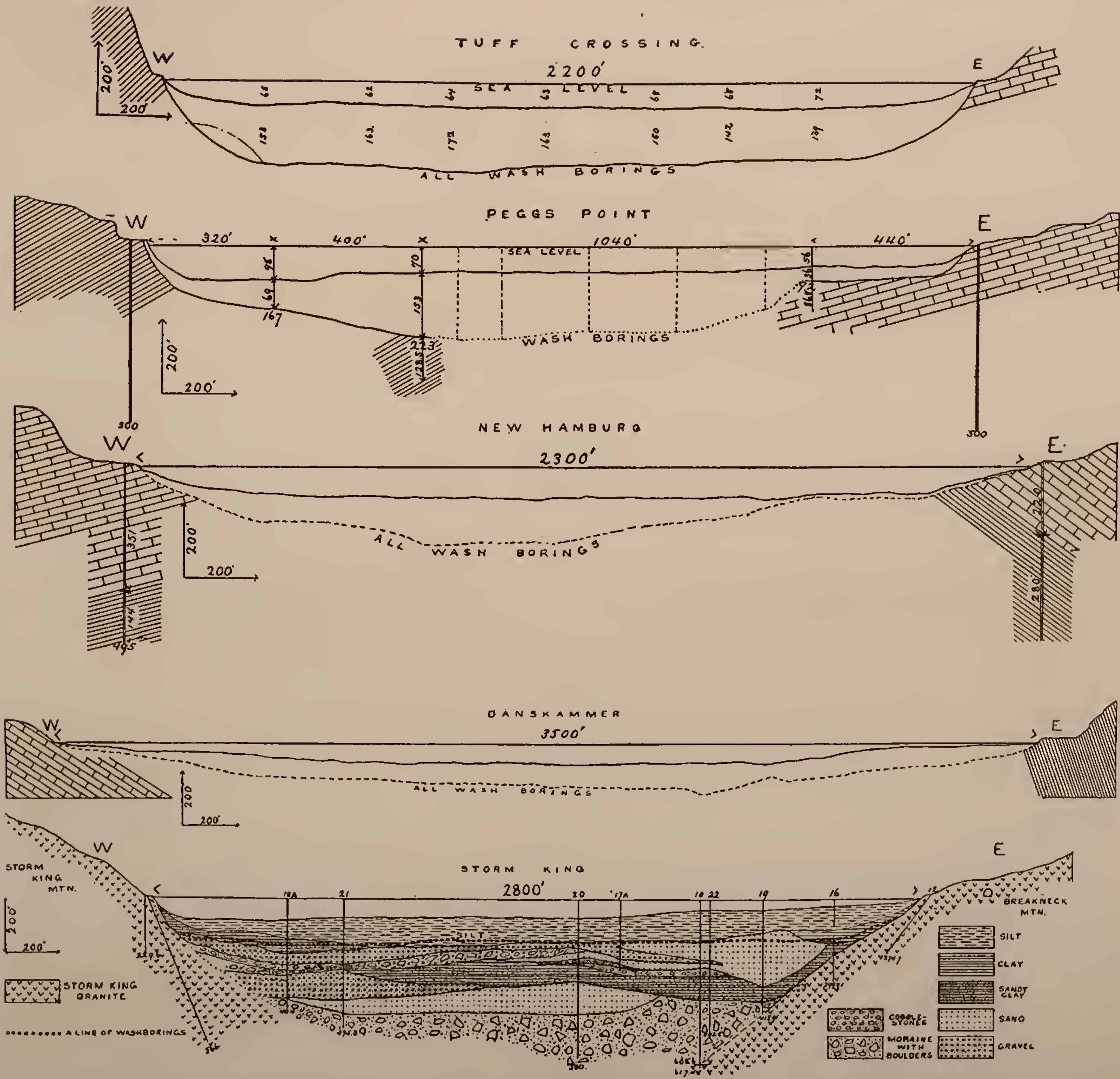

Fig. 27 Sections showing borings across the Hudson river at Tuff crossing, Peggs Point, New Hamburg, Danskammer and Storm King (after Kemp)

The above-given numerals and description were taken from Professor Kemp's paper. The general conclusions to be drawn from these facts to which Professor Kemp has called attention, are that the Hudson river occupied a deep gorge at the close of the Tertiary period and that its tributaries emptied into it from hanging valleys. Unless a deep gorge exists at the Pegg's Point crossing, as discussed above, a rather large gradient between this point and Storm King would have to be assumed.

The borings south of Fishkill Village suggest that this creek deepened its gorge some distance back from the Hudson during late Tertiary time. The other tributaries probably did the same to an extent commensurate with their size and erosive power. All the tributaries, however, occupied hanging valleys with reference to the bed of the main stream.

The boring records also show that much glacial stuff now lies in these buried channels.

GLACIAL GEOLOGY

Erosion. The elevation of the land at the close of the Tertiary is believed by many to have ushered in the glacial epoch. The passage of the ice sheet over this region is marked by grooves and striae and characteristic deposits of surface material. The ice sheet may have assisted in gouging out the channel of the Hudson.

The following is a summary of observations by the writer on the direction of glacial striae and grooves in different parts of the quadrangle. West of the Hudson about two miles northwest of Highland, along the road to Lloyd, a deep glacial groove was noted with bearing true s. 15° w. One and a half miles west of Milton another fine groove gave a reading of true s. 9° w. Fine *roches moutonnees* occur to the west of "Illinois mountain" south of Lloyd.

East of the Hudson in the eastern part of the city of Poughkeepsie, near the driving park, striae were noted with bearing true s. about 14° w. and farther east, just west of the central strip of the Wappinger belt along the Hackensack road, a reading of true s. 1° w. was taken. Near the Central New England Railroad at Poughkeepsie the striae had a bearing of true s. about 26° w.; north of Poughkeepsie near quadrangle boundary, east of Fallkill creek, true s. 11° w.; one mile north of New Hackensack, n. 21° w.; near the Hudson, north of Fishkill Landing, true s. 33° w.

Some of the strike fault scarps, as, for instance, those of Bald hill, Mount Honness and Shenandoah mountain of the Highland spurs, and the fault east of Freedom Plains, appear to show the effects of glacial plucking.

The Highland crests were buried by the glacier. Some places along the northern slopes show polishing effects (see plate 6). The excavation of the valleys between the northern spurs of the Highlands was probably materially assisted by the ice.

Deposits during the advance. Drumlins, or drumlinoid masses of till, are rather numerous in the quadrangle and often are conspicuous features of the topography. They seem to be deposits of the advancing ice sheet which molded them by pressure into their usual elongated domelike shapes. These masses greatly obscure the structural relationships over much of the area. They are the most conspicuous features of the ground moraine. The larger part of the veneer of till, which is very plentiful, probably dates from the advance of the glacier. About 200 feet of boulders and sand, which rest on the bottom of the Hudson gorge, probably are a part of the ground moraine.

RETREAT OF THE ICE SHEET

It is generally held that accompanying and following the retreat of the Wisconsin ice sheet from this region there was a slow subsidence of the land. At this time a large body of water filled the old valley of the Hudson within this area. It would appear that the subsidence went on gradually and that during the earlier stages much sand, gravel and sandy clay was deposited on the earlier boulder material that covered the bed of the gorge to a depth of 200 feet, and then a thin layer of boulders representing a probable flood of floating ice, and then typical river deposits.[1] Finally, it would appear that the subsidence may have brought in estuarine conditions, at which time the Hudson river clays were laid down. These considerations assume an open gorge and postulate the probable deposition of the clays entirely across it, their present condition having been brought about by later dissection. It is proper to state that there are exceptions to this idea. Professor Woodworth, from a study of the entire Hudson and Champlain valleys, holds the opinion or belief that, during the deposition of these clays, the Hudson gorge was filled with a long tongue of ice against which were standing bodies of water at a higher level than water could have assumed in the open gorge. He cites many observations to

[1] See J. F. Kemp. Buried Channels beneath the Hudson and its Tributaries. Amer. Jour. Sci. Ser. 4. 1908. 26:322.

show that the clays, and overlying sands and gravels are best explained as depositions under such conditions.[1] Woodworth's hypothesis does not call for so great a subsidence of the land as the other, and logically explains the present bisected character of the clays as their original condition. The proximity of the ice during the deposition of the so-called Champlain deposits is shown in several ways. It seems quite reasonable, however, to explain the upward more or less perfect passage from coarse to finer detritus in the Hudson gorge as due to gradual deepening, and a passage from fluviatile to estuarine conditions which would furnish the conditions for the accumulation of the finer material.

Terraces. The finer material in question takes the form of stratified deposits of clay, capped with sand and gravel, which occur in the form of terraces at various places along the Hudson gorge. A number of these are in this quadrangle.

Such a terrace begins somewhat over a mile north of Fishkill Landing and extends for a mile north of that point, varying in width from about one-fifth to three-fourths of a mile. It is about 100 feet high at the outer edge and a few feet higher at the inner edge. It is followed on the north by a lower terrace varying from 30 to 40 feet in height, with varying depths of clay and covered with coarse gravel. On the west bank of the Hudson at Roseton and at Danskammer gravel-covered terraces also occur. These are somewhat higher than the north terrace on the east bank. Terrace deposits also occur at Marlboro.

At New Hamburg the deposits are a good deal coarser and have a terrace delta form. The coarse sands and gravels of this terrace and their general relations, as well as the Roseton and Danskammer terraces, are thought by Woodworth to "compel the belief" that they were deposited against the ice. In the case of the Roseton terrace, he states that there are signs of inthrusting of drift from ice movement (*loc. cit.* p. 119) and further that the terrace can not be attributed to a river pouring into an estuary after the disappearance of the ice.

The diminishing altitude of the terraces northward has been interpreted as favoring the idea of their formation against the ice in glacial lakes. The coarser material overlying the clays has been attributed to the retreat of the ice front beyond the mouths of tributary stream valleys, allowing an influx of coarser sediments.

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[1] Ancient Water Levels of the Champlain and Hudson Valleys. N. Y. State Mus. Bul. 84, 1905, p. 66–265.

By others, the lower level at the north has been attributed to erosion accompanying elevation, and the coarser sediments to the same cause.

C. E. Peet[1] has made the observation that, if the valley between the low terrace just south and north of Carthage Landing and the slightly higher one on the west of the river at Roseton and Danskammer were filled with ice, the latter was stagnant, and may have stood on the lower terrace at the east. He also admits the possibility that the terraces may have been continuous and that the lower one on the east is the product of the erosion of higher deposits.

Later, in discussing the history of the "Hudson water body and the successive positions of the ice as it retreated through the Hudson valley, Peet[2] states that the ice front appears to have assumed two distinct phases in different parts of the valley. In some parts, notably the narrower ones, it is believed that the ice protruded down the valley and that accumulations took place at the edge of this ice-tongue, or between it and the valley wall. The deposits at Carthage Landing and New Hamburg might represent such conditions, but the valley ice was probably not an active contributor, although at the latter place waters from the valley ice may have been active in the early stages of the plateau building. In the broader parts of the valley the deposits were probably deposited in an embayment of the ice front.

Peet cites many facts to show that the Hudson water body may have been a lake made by a barrier at the south, or a succession of lakes made by a succession of barriers or by a migrating barrier, and, on the whole, leans toward the lake hypothesis as against a salt water body. The reader is referred to the original paper (see *loc. cit.* p. 640–56).

It is probable that a series of glacial lacustrine basins at the south would have allowed both for open water and the many characteristic glacial phenomena in connection with the deposition of this material.

On the submergence hypothesis an elevation of between 100 and 150 feet was necessary for the bisection of the delta at New Hamburg, and at this time the deposits in the gorge of the Hudson may have been dissected, although to a greater extent in the case of the main river. The moot point seems to be the extent to which the gorge was submerged by the sea.

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[1] Journal of Geology. 12:445.
[2] *loc. cit.*, p. 618–21.

Plate 20

A portion of the high-level terrace of Wappinger creek near Tompkins's farm, east of the road from Poughkeepsie to Pleasant Valley

Well-preserved sand and gravel erosion terraces occur at frequent intervals along Wappinger creek. These are best shown in the open portion of the valley of this stream in the neighborhood of Manchester Bridge and between that hamlet and Rochdale. The road from Manchester Bridge to Rochdale for a mile north of the former place closely follows the edge of a fine terrace that drops with uniform slope from the 160 foot level to the present flood plain of the creek. The cemetery at Manchester Bridge is built on a projecting tongue of this fine terrace which is broken by the limestone knoll on which Mr George Byer's house stands. North of here it may be followed for a short distance.

South of Rochdale, to the east of the Pleasant Valley road, on the west side of the creek, the present flood plain makes a large embayment to the west, north of Frank De Garmo's house. This embayment is fringed by a fine terrace, a portion of which is shown in plate 20. Other terrace remnants may be followed southward along the creek.

These dissected deposits clearly belong to an epoch when the creek valley was flooded and the creek was able to aggrade its valley floor to the level of these terraces, at least. It was probably during this time that the delta deposits were making at the mouth of the creek, whatever the conditions there may have been. These features would appear to have been intimately connected with the retreat of the ice sheet which, as it melted, would have furnished both the floods and the material. This material is in the form of sand and gravel. A good deal of finer detritus must have been carried out into the Hudson gorge.

To allow for this accumulation of sand and gravel in the old valley of the creek, either there must have been a body of standing water in the Hudson gorge nearly 200 feet higher than now, or the land must have been much lower than now.

Fishkill creek and its tributaries were also able to aggrade their valley floors. Gravel deposits belonging to a former higher level form imperfect terraces at different points. In some places, the gravels look like outwash plains during a short halting of the ice, as in the vicinity of Hopewell Junction. The Newburgh, Dutchess & Connecticut Railroad apparently cuts a series of terrace remnants from Hopewell to Brinckerhoff. Fishkill Village is located on a terrace at the 200 foot level which extends southwest to Glenham. Small, but perfect, terrace levels along brooks tributary to Fishkill creek, belonging to a stage in the subsidence of the water corresponding to the rock barrier over which the main stream flowed at Glenham, are preserved near Johnsville.

Kame deposits. These are prominently developed in places along the northern margin of the Fishkill mountains. A conspicuous group occurs along the Cold Spring road south of Fishkill Village, near the quadrangle boundary.

Kame moraine deposits are prominently developed south of Johnsville along the eastern base of Mount Honness, and still farther south along the western road from West Fishkill Hook into the mountains.

The brook flowing north from the mountains, through the hollow of East Fishkill Hook, cuts through similar masses.

Kames are noticeable features along the road from East Fishkill Hook to Shenandoah. Northeast and east of that hamlet they are pronounced topographic forms guarding the approach to Shenandoah hollow (see plate 21).

Kames also occur along Casper creek between the Hudson river and the Poughkeepsie road (see plate 22), and near Camelot.

POSTGLACIAL EROSION

After the retreat of the glacier either the land, which probably was at a higher level than now, remained stationary, while the water level in the gorge subsided, or it was elevated. The tributary streams, now greatly reduced in volume, meandered over their old floor plains and began the vertical and lateral dissection recorded in part by the terraces described or alluded to above. Wappinger creek, in seeking an outlet to the Hudson, was confined near its mouth between narrower rock walls and began the bisection of its old delta of the flood period. It readily found its old preglacial channel, which it tumbles into at Wappinger Falls. The precipice at this place forms a local base-level to which the stream is slowly reducing its bed at various places along its course at the north.

Fishkill creek is off its old preglacial channel for some distance in Glenham, and between that hamlet and Matteawan. When the stream was superposed on its former flood plain it was obliged to make a wide detour at Glenham round the huge drumlin on which the cemetery of Matteawan stands. It eventually found bed rock and finally the contact between the limestone and the gneiss of the Glenham belt, and has made the gorge shown in plate 23. At the northeast end of the carpet mill the creek crosses a fault between

Plate 21

Kames northeast of Shenandoah at the northern opening of Shenandoah hollow. Shenandoah mountain may be seen in the background on the right of the picture

Plate 22

Kames along Casper creek west of the road from Wappinger Falls to Poughkeepsie

Plate 23

Postglacial gorge of Fishkill creek below the railroad bridge at Glenham. Gneiss forms the right wall and limestone the left

the limestone and the slate and from this point on cascades over the slates until its own delta is reached. It is probably along or very near its preglacial channel from Wolcott avenue southward. The preglacial channel north of here is probably to the southeast of the present course of the stream.

It may be that during this time of erosion the Hudson cut its present gorge and that the gravel-covered, laminated clays are erosion terraces instead of benches laid down against the ice.

THE PRESENT DEPRESSION

Following the bisection of the Wappinger creek delta, the valley of the Hudson suffered the depression that produced the present estuary and the later channel of Wappinger creek was submerged (see plate 24). Fishkill creek filled up its gorge to tide level and produced its present delta.

OTHER DRAINAGE FEATURES AND ADJUSTMENTS

Near Gregory's mill at Old Hopewell, Fishkill creek was deflected by the drift and imposed on the limestone through which it has cut a gorge.

The rock valley of Casper creek, at points north of the Hopewell branch of the Central New England Railroad, suggests a once more powerful stream which may have drained a larger area to the north of this quadrangle along the valley of the brook that rises in the swamp east of Van Wagner, and now flows north to join a southward flowing stream of considerable size, and which reaches Wappinger creek by making an abrupt turn to the east-northeast.

The course of the Fallkill near Poughkeepsie suggests that this stream has utilized certain fault features. Fishkill creek, along its course within the quadrangle, makes a number of bends to the northeast that are in line with the fault features of the Fishkill limestone.

LAND FORMS

These are apparently of two fundamental types: those produced by a sort of block faulting and those produced by folding, accompanied by faulting. Each is distinct, but is modified by the other. Both apparently date from the time of the Green mountain revolution.

At the close of Cretacic time this region was a peneplain. A reelevation introduced the history of the present topographic aspect of the quadrangle and subsequent erosion presents the striking discordance between the present topography and relations and those of Precambric and early Paleozoic time.

The Precambric gneissic floor appears to have behaved in a measure as though it had no load. It was twisted and broken into blocks like a piece of glass and thrust up into the overlying formations, the force of the shove diminishing to the northwest. The plateau type of the Highlands is primarily the result of upward thrust as a mass and secondarily the effect of the resistant quality of the Precambric rocks when subjected to erosion. The present topographic level of the Fishkill limestone would appear to indicate a normal position for the limestone now. Primarily, however, it is a faulted up thrust block; erosion has exposed the older stratigraphic series which were thrust up into the overlying slates.

The northern valleys of the Highlands represent down-faulted masses of the younger rocks which later erosion cycles discovered and removed.

As superstructures on these basal features are forms connected with folding and breaks along the strike and dip.

Influence of the petrographic character of the rock. The low average level of the Hudson valley is attributable to the ease with which the slates are broken up and removed. The relatively low topographic level of the Fishkill limestone, corresponding with its lower stratigraphic position, is deceptive. In this case, the removal of the slates and the erosion of the limestone obscures the structural position brought about by faulting.

The present altitude of the high ridge forming "Illinois mountain" is due in part to the resistant character of its grits.

The resistant quality of the metamorphosed rocks in the eastern part of the quadrangle has been a factor in producing their present relief.

ECONOMIC GEOLOGY

The agricultural industry. The agricultural interests are chiefly those of fruit growing and dairy farming. The former is conducted on an intensive plan on the hilly land west of the Hudson where well-drained hills of tilted slates, covered with a veneer of till and coarse gravel, afford highly suitable soil conditions for growing fruit of excellent quality. Large consignments of peaches, apples, pears and small fruit are sent to New York city and New England markets and some growers find a highly profitable business for fancy fruit in the markets of England. Grapes are also a successful and important crop.

Plate 24

Drowned gorge of the Hudson as seen two miles south of New Hamburg, looking north

Fruit growing is also practised east of the Hudson. Nearly every large farm has its apple orchard, some of which are of large size. Peaches are also successfully grown and apparently are growing in popularity as an investment. Some fine fruit is grown in small orchards along the northern slopes of the Fishkill mountains. The Hudson river affords favorable temperature conditions for the budding season and insures good crops. The ravages of the coddling moth and other injurious insects are, however, sometimes extensive.

The importance of the climatic influence of the Hudson river as a successful factor in fruit growing is clearly recognized. Fruit is not so successfully grown out of reach of this influence, even on soils of the same character and with similar drainage.

Dairying is perhaps the largest farming industry and the one most widely practised. The area enjoys unusual facilities for transportation of farm products.

Soils. The glacial ice, as shown above, moved in a course generally roughly parallel with the longer axes of the rock ridges. This fact seems to have had an influence on the character of the soil along these ridges. It is noticeable that the upland soils have a definite relation to the underlying rock.

Lower levels, which mark the flood epoch of the waning ice sheet, have sandy and gravelly soils, with clayey subsoils, and are often of terrace form or in kamelike masses. In addition to these are the drumlinoid masses of somewhat more compacted character, often attaining or approximating boulder till. Finally, there are the alluviums of the river bottoms.

The limestone areas are considered the finest grass lands, but all the upland soils yield good grass crops. The gravelly river bottoms are usually good corn soils. The more sandy terrace soils are suitable for garden truck or early fruit. The slaty hill sides usually give good apple-growing soils when not too clayey.

The finest farms are in the limestone areas, but the slaty uplands of moderate elevation are highly valued for both of the principal farming pursuits of the present day.

Clays. All the important clays of this area are of sedimentary character and belong to Pleistocene time.

A number of important brick industries are located within the quadrangle. The laminated clays that have been briefly described as forming the terraces along the Hudson, between Fishkill Landing and New Hamburg, and on the west bank at Roseton and Danskammer, are worked on extensive scales (see plates 25 and 26).

These beds form only a part, but are perhaps as important as any, of the valued clays of the Hudson valley.

These deposits are very similar in appearance. The lower portions are usually bluish and the upper yellowish in color. The laminated character is best shown in the upper layers. Thin laminae of sand occasionally appear, in some places forming such proportion of the masses as to require no admixtures of that material in the process of brick manufacture. The coarser sandy material overlying the clay, when screened, furnishes sufficient quantities of sand when that is required, which is usually the case on account of the purity of the clay.

The chemical composition of the clay at Roseton is given from the following analysis:[1]

SiO_2	55.00
Al_2O_3, Fe_2O_3	34.54
CaO	5.33
MgO	3.43
K_2O, Na_2O	0.48
Combined H_2O, Moisture	1.22
	100.00

Both the blue and yellow clays are calcareous and effervesce with acid. They have been used as marls on account of their lime content. The yellow color is due to oxidation. The clays are used entirely for brick.

Clay deposits also occur at Arlington, a mile east of Poughkeepsie, and are used for brick. The clay which is fairly abundant along the banks of Casper creek in the neighborhood of Arlington is covered with some sod, but is easily exposed by stripping this off. Yellow clay is underlain by blue clay.

It seems possible that the deposits at Arlington were accumulated in lacustrine waters, perhaps impounded by stagnant ice at the mouth of Casper creek. The kames (see plate 21) that now lie near the mouth of the creek may have been left by the melting of such a mass of ice.

Limestone quarries. Quarries have been opened at places in the limestone strips of the Wappinger creek belt. The largest of these is Stoneco quarry, operated by the Clinton Point Stone Com-

[1] Ries, N. Y. State Mus. Bul. 35, 1906, p. 381.

Plate 25

Laminated clays in the pits at J. Paye's brickyard, north of Fishkill Landing. The photograph also shows joint structure in the clays

Plate 26

Showing the laminated clays and overlying gravel in the pits at Roseton

pany. The rock is somewhat silicious and dolomitic, as the following analysis[1] shows:

Lime	29.07
Magnesia	16.29
Carbonic acid	40.76
Alumina	2.33
Ferric oxid	.47
Silica	10.17

Another quarry has been opened on the west bank of the Hudson in the southwestern extension of the western strip of the Wappinger creek belt, about three-quarters of a mile south of Marlboro station. This is commonly known as Kerr's quarry. A considerable enterprise was apparently projected and was in active operation up to the season of 1909. During that season work was suspended.

The limestone near New Hamburg was burned for lime in earlier years. Its silica and magnesia content would necessitate lean returns.

At Ruppert's quarry near Poughkeepsie the Potsdam is burned for lime for private use.

The Fishkill limestones were used for lime in earlier days, and also as a flux in the operation of the Hopewell furnace a generation ago.

Limonite deposits. Limonite, or brown hematite, beds belonging to a fairly well-defined belt of these deposits occur two miles south of Fishkill Village and near Shenandoah. A small quantity of ore was taken from the former in 1885. The Shenandoah mine was abandoned in 1879 on account of the small quantity of ore.

The question of the origin of these deposits was discussed by Professor Dana.[1] According to his view, during the transition from the limestone-making epoch to that of terrigenous sediments, iron-bearing waters were washed into restricted basins and in the course of time the calcareous and magnesian material became changed to ferriferous rock. In some cases pure iron carbonate was probably formed. The general magnesian character of the limestone was taken as good evidence of the confined character of the basins receiving the additions of iron-bearing solutions.

Kaolin. A residual deposit of kaolinite derived from the disintegration of a feldspathic rock occurs near Shenandoah, and

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[1] N. Y. State Mus. 51st Rep't 2:434; also N. Y. State Mus. Bul. 44, p. 779.

[2] Amer. Jour. Sci., Ser. 3. 1884. 28:398–400.

is known as Fowler's kaolin mine. The material at present is taken out on a small scale and sold principally for stove cement.

Molding sands. Molding sand is dug in large quantities a short distance back from the Hudson, near the mouth of Casper creek and two miles north of that place, and is hauled to docks at these places for shipment.

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 152

GEOLOGY OF THE HONEOYE-WAYLAND QUADRANGLES

BY

D. DANA LUTHER

New York State Education Department
Science Division, December 2, 1910

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

SIR: I have the honor to transmit to you herewith and to recommend for publication as a bulletin of the State Museum a manuscript report and map covering the geology of the Honeoye and Wayland quadrangles of the geological map of the State, which have been prepared by Mr D. Dana Luther, of this staff.

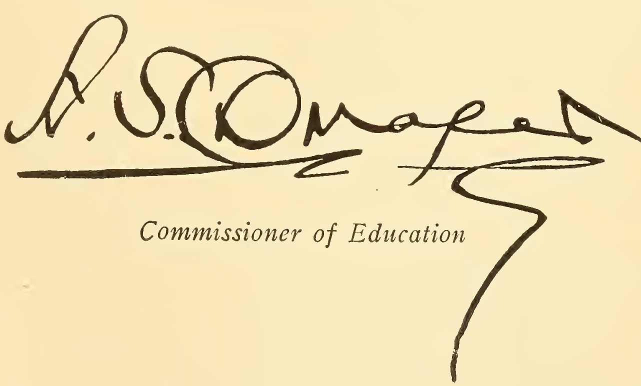
Very respectfully

JOHN M. CLARKE

Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 2d day of December 1910



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GEOLOGY OF THE HONEOYE-WAYLAND QUADRANGLES

By D. DANA LUTHER

The Honeoye-Wayland quadrangles are included between the lines of latitude 42° 30′ and 43° north, and of longitude 77° 30′ and 77° 45′ west and contain one-eighth of a degree, or about 441 square miles of territory.

The rocks of these quadrangles have an estimated aggregate thickness of about 2660 feet, of which 1510 feet are surface rocks because of the difference in altitude between the lowest outcrop, which is on Honeoye creek near Sibleyville at 590 feet A. T., and the highest, at the top of Sand hill near the south line of the Wayland quadrangle at 2100 feet A. T. Eleven hundred and fifty feet of strata are brought to the surface by their elevation toward the north at an average rate of about 33 feet per mile.

These rocks embrace the following geological subdivisions or formations, twenty-four in number, which are represented by distinctive colors on the accompanying map.

Devonic	Senecan	Chemung shale and sandstone
		Wiscoy shale
		Nunda sandstone
		Gardeau flags and shale
		Grimes sandstone
		Hatch shale and flags
		Rhinestreet black shale
		Cashaqua shale
		Middlesex black shale
		West River shale
		Genundewa limestone
		Genesee black shale
		Pyrite layer. Tully horizon
	Erian	Moscow shale
		Tichenor limestone
		Ludlowville shale
		Skaneateles shale
		Cardiff shale
		Stafford limestone
		Marcellus black shale
	Ulsterian	Onondaga limestone
	Oriskanian	Oriskany sandstone
Ontaric or Siluric	Cayugan	Bertie waterlime
		Camillus shale

FORMATIONS IN ASCENDING ORDER

ONTARIC OR SILURIC

CAMILLUS SHALE

The drift hills on the northern border of the Honeoye quadrangle rest upon thin magnesian limestones and soft gypseous shales belonging to this formation, which receives its name from the town of Camillus, Onondaga county, where the first discovery of gypsum in the United States was made in the year 1792, and where the beds of this formation are abundantly exposed.

The Camillus strata are entirely covered on these quadrangles, but are exposed at Victor on the Canandaigua quadrangle and at Wheatland and Garbuttsville on the Brockport quadrangle.

BERTIE (AND COBLESKILL?) WATERLIME

The Camillus shales are succeeded by 85 to 100 feet of waterlimes varying in character from hard, flaggy layers to beds of soft dolomite in which lines of deposition are very obscure. At the top of this formation, in the vicinity of Honeoye Falls, there are exposed 35 feet of waterlime, of which 3 feet 6 inches at the top are in uneven layers 2 to 6 inches thick and break easily into small rough blocks. It is quite probable that this stratum, which somewhat resembles the " bullhead " of Erie county, should be correlated as Cobleskill waterlime, but no fossils are found in it.

Next below these are 20 feet of hard waterlimes showing faint lines of bedding. Some parts have no regular fracture. In this vicinity, this bed has been quarried quite largely for building purposes.

The underlying ten feet of rock are flaggy and at one or two horizons quite shaly. The lower beds are generally softer, and in some parts shaly, but there are thin hard layers separated by thin partings of black bituminous matter and heavier strata of softer waterlimes that have no regular fracture. The contact with the Camillus shales is not exposed on this quadrangle.

The waterlimes are exposed along the Hemlock outlet in the village of Honeoye Falls below the milldam east of the high school building, and along the stream to below the Lehigh Valley Railroad bridge. There are quarries in the upper beds east and west of the south end of this bridge, where the contact with the Oriskany horizon also appears. There are good exposures of forty feet of the upper beds along Spring creek two miles west of Honeoye Falls, and in the large old quarry one-fourth of a mile south of the New York Central Railroad bridge over this stream.

There is a small exposure of waterlime near an old limekiln one and one-half miles west of Spring creek with the Onondaga limestone five feet higher, and small outcrops of this rock occur in the bed of Stony brook at Five Corners.

In the central part of the State and in Erie county the waterlime beds contain fossils of several species, but the strata exposed on this quadrangle are almost barren. Leperditia alta (Conrad) and Whitfieldella laevis (Whitfield) are the only forms observed.

In the salt shaft near Livonia on the Honeoye quadrangle the following fossils were found in these beds:

Spirifer vanuxemi *Hall*
Stropheodonta varistriata (*Conrad*)
Liopteria rugosa *Hall*
Leperditia alta (*Conrad*) and a small Favosites

DEVONIC

ORISKANY SANDSTONE

This formation is represented here by eight inches of gray calcareous sandstone containing no fossils. It is exposed in the rock wall along Hemlock outlet at the dam east of the high school at 634 A. T. in Honeoye Falls and also at the south end of the Lehigh Valley Railroad bridge one-half mile northwest of the village. In the Livonia salt shaft there were at this horizon five feet of coarse, green and gray conglomerate containing eight species of brachiopods, suggestive of a commingling of the faunas of the Oriskany sandstone and Schoharie grit of the eastern part of the State. They are

Pentamerella *cf.* arata (*Conrad*)
Atrypa reticularis (*Linné*)
Orthis *cf.* propinqua (*Hall*)
Hipparionyx proximus *Vanuxem*
Stropheodonta *sp.*
Pentagonia unisulcata (*Conrad*)
Spirifer *cf.* arenosus *Conrad*

ONONDAGA LIMESTONE

The Onondaga limestone is composed of layers or tiers of blue gray limestone, separated by partings of dark shale or black bituminous matter.

Dark chert or impure flint in nodules or nodular layers is unevenly distributed throughout nearly the entire formation, but is in larger proportion in the lower part, except for an uneven stratum two to five feet thick at the base, which is largely composed of corals and from which chert is absent.

The cherty lower beds supply the material for the crushed stone used in roadmaking and for ballast, while the basal stratum and the layers clear from chert found in the upper part of the formation furnish an inexhaustible supply of valuable building stone and quicklime.

The entire section of this formation is exposed along Honeoye creek from the Monroe milldam in Honeoye Falls to the north side of the bend half a mile south of North Bloomfield, except for a small hiatus in the middle of the formation between the two villages. The lower beds may be seen along the bed of Spring creek and the upper tiers in the quarry of the Genesee Lime Company two miles southwest of Honeoye Falls. The basal layer, specially rich in corals, outcrops over an area of half an acre near an old limekiln three miles west of Honeoye Falls near a north and south road one and one-eighth miles west of Spring creek. Some of the lower tiers outcrop in the road south of Five Corners, and there are several field outcrops farther south in the region drained by Stony brook.

The fauna of the Onondaga limestone is very large; a list of species found in this formation, given in State Museum Bulletin 63, contains 3 fishes, 39 crustaceans, 13 cephalopods, 3 pteropods, 38 gastropods, 15 lamellibranchs, 48 brachiopods, 4 crinoids and 30 corals; total 193.

MARCELLUS BLACK SHALE

The blue Onondaga limestone is succeeded by black, carbonaceous shales and soft, dark impure limestones to the thickness of 41 feet in the Livonia salt shaft but somewhat thinner on the line of outcrop. On these quadrangles this shale is terminated at the top by the Stafford limestone, and it constitutes the lower division of the " Marcellus shale," as described by Hall and Vanuxem.

The lower beds are mostly calcareous and fossiliferous, while the upper are composed mainly of densely black bituminous and pyritiferous shale in which occur spherical concretions six inches to one foot, six inches in diameter.

This formation is rich in hydrocarbons and is the source of the natural gas produced by the shallower gas wells of this region. Many of the concretions are septaria and the cavities within them occasionally contain a small quantity of petroleum. On account of the compact character of this rock, gas wells terminating in it are not very productive except when a crevice or large pocket is penetrated. Fossils are abundant, specially in the lower more calcareous part on this formation.

The following species were found in the Marcellus shale and limestone in the Livonia salt shaft, in the upper black shale and concretions:

Plates of Aspidicthys and Dinichthys halmodeus (*Clarke*)
Orthoceras nuntium *Hall*
O. subulatum *Hall*
Tornoceras uniangulare (*Conrad*)
Cyrtoceras citum *Hall*
Pleurotomaria rugulata *Hall*
Styliolina fissurella *Hall*
Panenka lincklaeni *Hall*
P. equilatera *Hall*
Nuculites nyssa *Hall*
Pterochaenia fragilis (*Hall*)
Liopteria laevis *Hall*
Pterinopecten dignatus *Hall*
Actinopteria muricata *Hall*
Orbiculoidea minuta *Hall*
Liorhynchus limitare (*Vanuxem*)
Chonetes mucronatus *Hall*

The following additional species occur in the more calcareous beds near the base of the formation:

Phacops rana *Green*
Orthoceras incarceratum *Clarke*
O. lima *Hall*
Tentaculites gracilistriatus *Hall*
Pleurotomaria lucina *Hall*
Aviculopecten *cf.* fasciculatus *Hall*
Modiomorpha subalata (*Conrad*)
M. concentrica *Hall*
Cypricardinia indenta (*Conrad*)
Microdon bellistriatus (*Conrad*)
Nuculites oblongatus *Conrad*
Palaeoneilo plana (*Conrad*)
Tropidoleptus carinatus (*Conrad*)
Spirifer audaculus *Conrad*
Ambocoelia umbonata (*Conrad*)
A. praeumbona *Hall*
Athyris spiriferoides (*Eaton*)
Coelospira camilla *Hall*
Terebratula *sp.*
Stropheodonta inequistriata (*Conrad*)
Leptostrophia perplana (*Conrad*)

Orthothetes pandora *Hall*
O. bellulus *Clarke*
Orthis *cf.* lenticularis *Hall*
Chonetes deflectus *Hall*
C. lineatus (*Conrad*)
C. *cf.* yandellanus *Hall*
Pholidops hamiltoniae *Hall*
Stictopora incisurata *Hall*
Stereolasma rectum *Hall*

The Marcellus beds are covered on this quadrangle except for a small exposure under the Erie Railroad bridge over Little Conesus creek a mile south of Avon.

STAFFORD LIMESTONE

This formation takes its name from Stafford, Genesee county, where it is well exposed. It is eight feet three inches thick at Lancaster, Erie county, but diminishes gradually toward the east, and at its extreme eastern exposure on Flint creek, Ontario county, is but four inches thick.

On this quadrangle it is a hard blue limestone, in one stratum 14 to 18 inches thick with a few inches of calcareous shale above and below.

There are no exposures of the Stafford limestone on these quadrangles but it may be seen below the second dam on Conesus outlet west of Ashantee, and in the bed of Little Conesus creek east of the Erie Railroad bridge.

The Stafford limestone is rich in fossils at every exposure and a list published in State Museum Bulletin 49 contains the names of 118 species which have been collected from it. This stratum occurs in the Livonia salt shaft at the depth of 823 feet and contained the following forms:

Phacops rana *Green*
Orthoceras aedipus *Hall*
O. *cf.* marcellense *Hall*
Loxonema delphicola *Hall*
Pleurotomaria sulcomarginata (*Conrad*)
P. itys *Hall*
P. lucina *Hall*
Meristella barrisi *Hall*

Camarotoechia sappho *Hall*
C. horsfordi *Hall*
Chonetes scitulus *Hall*
C. mucronatus *Hall*
Strophalosia truncata *Hall*
Ambocoelia umbonata (*Conrad*)
Orthothetes arctostriatus *Hall*
Spirifer subumbona *Hall*
S. audaculus (*Conrad*)
Atrypa recticularis *Linné*
Panenka lincklaeni *Hall*
P. aequilatera *Hall*
Pterinopecten exfoliatus *Hall*
Actinopteria muricata *Hall*
Aviculopecten bellus *Conrad*
Styliolina fissurella *Hall*

CARDIFF SHALE

The shales succeeding the Stafford limestone and formerly known as upper Marcellus, are richly bituminous, though in a somewhat less degree than those below, for about sixty feet gradually becoming more argillaceous and lighter colored, and passing into the next higher formation.

The only exposure of the Cardiff shale on this quadrangle is along Little Conesus creek between the Erie Railroad bridge and the Avon reservoir. In the Livonia shaft section these beds were penetrated at 753 to 823 feet and the following species were found in them:

Tornoceras uniangulare (*Conrad*)
Orthoceras subulatum *Hall*
O. nuntium *Hall*
Cyrtoceras *sp.*
Pleurotomaria rugulata *Hall*
P. capillaria (*Conrad*)
Bellerophon leda *Hall*
Liopteria laevis *Hall*
Modiella pygmaea (*Conrad*)
Pterochaenia fragilis (*Hall*)
Actinopteria muricata *Hall*
Buchiola retrostriata *v. Buch*
Actinopteria (small) *sp.*
Panenka lincklaeni *Hall*

Pterinopecten dignatus *Hall*
Nuculites triqueter *Conrad*
Modiomorpha *cf.* subalata (*Conrad*)
Liorhynchus limitare *Vanuxem*
Productella spinulicosta *Hall*
Strophalosia truncata *Hall*
Orbiculoidea minuta *Hall*
Styliolina fissurella *Hall*
Reptaria stolonifera *Rolle*

SKANEATELES SHALE

This formation is a bed of soft dark clayey shales quite bituminous and pyritiferous in some parts and containing fossils but sparingly, though a few thin calcareous lentils are composed almost entirely of compressed shells.

It is 145 feet thick and is terminated at the top by a stratum of hard calcareous sandy shale containing cyathophylloid corals in abundance.

Skaneateles shale is exposed along Little Conesus creek below the Avon reservoir, but is not seen elsewhere on these quadrangles.

Its place in the Livonia shaft section is 608 to 753 feet below the top.

The following fossils occur in these beds:

Phacops rana *Green*
Cryphaeus boothi *Green*
Tornoceras uniangulare (*Conrad*)
Orthoceras exile *Hall*
Gomphoceras *sp.*
Pleurotomaria rugulata *Hall*
Bellerophon leda *Hall*
Pterochaenia fragile (*Hall*)
Liopteria laevis *Hall*
Panenka equilatera *Hall*
Palaeoneilo fecunda *Hall*
Orthonota undulata *Conrad*
Chonetes scitulus *Hall*
C. lepidus *Hall*
C. mucronatus *Hall*
Liorhynchus multicostum *Hall*
L. limitare (*Vanuxem*)
Styliolina fissurella *Hall*
Crinoid stems

LUDLOWVILLE SHALE

This formation consists of beds of shale varying in character from black and bituminous to light colored sandy and calcareous. Calcareous concretions are quite common, and 65 feet above the base and near the top there are even layers of limestone one to two feet thick.

The Ludlowville shale is terminated at the top by the Tichenor limestone.

The basal hard layer, which is a coral reef at Centerfield, Ontario county, and a calcareous sandstone in the Livonia shaft section, is exposed at an old mill site on Little Conesus creek near the Avon reservoir, but is almost entirely devoid of fossils.

Along Gates creek two miles north of Allens Hill 15 to 20 feet of the shales next below the Tichenor limestone are exposed.

This formation was named from its exposure along the shore of Cayuga lake near Ludlowville, Tompkins county. It extends across central and western New York and is everywhere richly fossiliferous. Lists of the fossils composing its fauna may be found in volume 1 of the Report of the State Geologist for 1893 and in State Museum Bulletin 63.

TICHENOR LIMESTONE

A stratum of limestone about one foot in thickness overlies the Ludlowville shale from Cayuga county to Lake Erie. It was known by the geologists of the early State Survey as the Encrinal limestone and serves as a bench mark in the stratigraphy of the western part of the State. The name Encrinal limestone was applied to the stratum on account of the abundance of crinoid fragments which it contains and of which it is, at some localities, almost entirely composed.

A calcareous stratum of somewhat similar appearance to the Tichenor limestone which occurs at the base of the Ludlowville shale and outcrops at Centerfield on the Canandaigua quadrangle, on the Attica quadrangle and other places in western New York, has sometimes been erroneously identified as the Encrinal, hence a more specific name has proved desirable. The favorable exposure in Tichenor gully on the west shore of Canandaigua lake suggested the present name. A small exposure on Gates creek near the old milldam is the only one on these quadrangles where Tichenor appears. The following is a partial list of the fossils that occur in it:

Phacops rana *Green*
Orthoceras caelamen *Hall*

Diaphorostoma lineatum (*Conrad*)
Lyriopecten orbiculatus *Hall*
Spirifer mucronatus *Conrad*
Sp. granulosus (*Conrad*)
Heliophyllum halli *Edwards & Haime*
Favosites argus *Hall*
F. arbusculus *Hall*
Eridophyllum *sp.*

Heads of Megistocrinus and other crinoids are sometimes found in the soft shale that immediately overlies the limestone.

MOSCOW SHALE

Succeeding the Tichenor limestones there are 147 feet of shale, in which calcareous concretions and thin calcareous lenses, composed largely of crinoid and other fossils, are common. The principal part of the shale is light bluish gray and quite calcareous, but at some horizons it is quite dark. Iron pyrite in nodules is common, specially in the upper beds and occasionally occurs in the shape of casts of small fossils.

East of Canandaigua lake the upper limit of this formation is the base of the Tully limestone which does not extend west of the town of Gorham, Ontario county, but in its place there is found at some exposures a thin layer of iron pyrite separating the blue Moscow shale from the black Genesee.

The upper part of the Moscow shale, with overlying pyrite layer and Genesee shale, is exposed along Hemlock creek south of Richmond Mills, and the base of the formation on Gates creek (sometimes called Beebe brook). Its place in the Livonia shaft section is 280 to 427 feet from the top.

This formation is very rich in fossils. For lists of species see 13th Report of the State Geologist, volume 1, 1893, and State Museum Bulletin 63.

PYRITE LAYER. HORIZON OF TULLY LIMESTONE

The formation of hard limestone, named from its best development at Tully, Onondaga county, where it has a thickness of 28 feet, thins out toward the west and disappears on the east side of Canandaigua lake. Westward across the Canandaigua and Honeoye quadrangles lentils of iron pyrites from one to four inches thick and two to ten rods across, occur in the horizon of the Tully limestone so frequently as to appear at nearly every exposure of the Moscow-Genesee contact. When freshly exposed the stratum is extremely hard and refractory, but it softens and disintegrates in very old exposures, its position in the walls of ravines being usually indicated by a thin rust-colored band.

Fossils of 48 species have been identified from this layer in Ontario and Livingston counties. A full description of the pyrite lentils and a list of its fossils may be found in State Museum Bulletin 69, 1903.

GENESEE BLACK SHALE

Overlying the pyrite layer or, in its absence, the Moscow shale, there is a bed of black bituminous shale similar in appearance to the Marcellus shale 500 feet lower in the strata. As commonly used, the term applied to these strata has included the succeeding Genundewa limestone, the dark West River shale and the black Middlesex shale above it. As here used, the term Genesee black shale designates the strata between the Tully horizon and the Genundewa limestone, which on these quadrangles have a total thickness of 85 to 90 feet. The shales are mostly densely black and contain a proportion of hydrocarbons sufficiently large to produce, when freshly broken, a natural fetid odor.

Pyrite in small nodules is common. Rows of spherical concretions and a few thin flags of fine grained calcareous sandstone, also occur.

Fossils, except a few plant remains, are almost entirely absent from the black shale and are rare in the lighter beds. The following have been obtained from the Genesee shale in this region:

Conodont teeth
Pleurotomaria rugulata *Hall*
Probeloceras lutheri *Clarke*
Bactrites aciculum (*Hall*)
Styliolina fissurella *Hall*
Pterochaenia fragilis (*Hall*)
Lingula spatulata *Hall*
Orbiculoidea lodensis *Hall*
Liorhynchus quadricostatus *Hall*

Exposures of Genesee shale may be found on the Honeoye quadrangle in two ravines on the east side of the valley two miles north of the village of Honeoye, along the Hemlock outlet one to two miles north of Hemlock village, and in the ravine on the west side of Conesus lake near Eagle point.

GENUNDEWA LIMESTONE

This designation has been applied to a band of thin impure limestones separated by partings of a few inches or feet of black shale, the whole having a total thickness of six to eight feet.

Some of the limestone layers are very uneven and somewhat nodular, while others are even and compact; one of the latter, twelve to fourteen inches thick, has been utilized to a limited extent for building purposes.

The limestones are composed principally of the minute shells of the pteropod Styliolina fissurella Hall and the formation was formerly known as the " Styliola band." These shells give the limestone a sandy appearance after long exposure. This formation is exposed in two ravines two miles northeast of Honeoye and in the bed of Whetstone brook two miles northwest of Honeoye. It may be seen in a gully near the first bridge over the Hemlock outlet below Hemlock village, and in a larger ravine half a mile farther north. It appears fifty feet above the lake level in the ravine near Eagle point, Conesus lake.

Fossils are abundant in this formation, and the fauna is of peculiar interest owing to the appearance of many forms not known to occur in the rocks below.

A list of fossils numbering forty-eight species, obtained from the Genundewa strata, may be found in State Museum Bulletin 63.

WEST RIVER DARK SHALE

Succeeding the Genundewa limestones there are 65 to 75 feet of dark gray shale in which there are interstratified beds of black shale one to three feet thick, at intervals of three to eight feet, which, in walls of ravines, give this formation a broadly banded appearance. Calcareous concretions are common; some of these are septaria and have been known under the names " petrified turtles," " niggerheads " and others of similar character. A few thin flags of calcareous sandstone also occur.

At the top the passage to the succeeding black Middlesex shale is through several alternations of dark and black shale in a few feet.

The West River shales are exposed along Whetstone creek two miles northwest of Honeoye; in all the large ravines toward the west to Hemlock lake; on Conesus lake in the ravines between Old Orchard point and McPherson point, on the east side, and between Eagle point and Long point on the west side.

Fossils are rare in the West River beds. A few individuals of the following species occur:

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

MIDDLESEX BLACK SHALE

A bed of black shale similar in appearance to the Genesee beds, succeeds the West River shales to the thickness of 30 to 35 feet. As the transition to the adjacent formations is gradual both above and below, the assigned thickness is somewhat arbitrary. It may be recognized beneath the lighter Cashaqua shale as far east as Cayuga county, where it ceases to be separable from the West River shale. Toward the west it is more distinctly differentiated from the adjacent formations and on the shore of Lake Erie it is a homogeneous band of black slaty shale six feet thick.

This formation is exposed in the ravines in the Honeoye Lake valley and in the region two miles south of Richmond Mills. It is finely displayed on the road one-half mile southeast of Hemlock and in the ravine at Glenville. It also appears in all of the ravines on both sides of Conesus lake in the vicinity of McPherson point.

Fossils are exceedingly rare in the Middlesex shale. The following occur:

Plant remains
Fish remains
Conodonts
Sandbergeroceras syngonum *Clarke*
Ontaria suborbicularis (*Hall*)

CASHAQUA SHALE

The black shales are succeeded by nearly 200 feet of light colored bluish gray or olive shale, in which thin flags occur occasionally, and a few thin layers of black shale are interstratified. Calcareous concretions, and thin concretionary layers, continuous for but a short distance, are common in the higher portion of the formation.

Occupying a position between two heavy beds of black shale it is easily recognized by its lighter color and peculiar structure, wherever it is exposed, from Seneca lake to Lake Erie, and its peculiar and interesting fauna has made it the subject of careful study, the results of which, with a list of its fossils, may be found in State Museum Bulletin 63 and Memoir 6.

The Cashaqua beds are abundantly displayed in a very large number of ravines on these quadrangles. Among the more favorable and accessible exposures are the upper beds of Whetstone creek two miles west of Honeoye and the lower along the road half a mile southeast of Hemlock; along Canadice outlet above the Glenville mills; in Shurger's glen two and one-half miles west of Hemlock; in all of the large ravines on both sides of Conesus lake, and the upper beds at the mouth of the two large ravines on the east side of the valley half a mile south of the head of the lake.

RHINESTREET BLACK SHALE

The band of black shale that succeeds the Cashaqua shale and has a thickness on these quadrangles of 30 to 40 feet, was formerly known as the "upper black band." It was designated as above in State Museum Bulletin 63, from its exposure at the locality in the Canandaigua lake valley known as Rhinestreet, where it is 22 to 25 feet thick. It increases rapidly toward the west and on Lake Erie is 150 to 185 feet thick.

It is a well-defined band of slaty, bituminous black shale between formations of much lighter color, and, having greater power of resistance to erosive forces than those beds, it frequently produces cascades in the ravines along the line of outcrop.

It appears at most of the exposures of the upper Cashaqua beds in these quadrangles. It is seen to great advantage in the walls of the amphitheatre in the ravine of Whetstone creek half a mile south of the Honeoye-Hemlock road. It is also well exposed in Shurger's gully two and one-half miles west of Hemlock; in the two ravines half a mile south of the head of Conesus lake, east side, and in a Delaware, Lackawanna & Western Railroad cut, at the west line of the Wayland quadrangle.

The fauna of the Rhinestreet shale is very limited. The following list shows the species that have been identified from it:

Polygnathus dubius *Hinde*
Prioniodus spicatus *Hinde*
P. erraticus *Hinde*
Palaeoniscus devonicus *Clarke*
Acanthodes pristis *Clarke*
Spathiocaris emersoni *Clarke*
Lunulicardium velatum *Clarke*
Pterochaenia fragilis (*Hall*)
Leptodomus multiplex *Clarke*
Lingula *cf.* ligea
Plant remains are common, sometimes occurring in masses.

HATCH SHALE AND FLAGS

Next above the Rhinestreet shale there is a partial return to the conditions in the Cashaqua beds below, though the light shales are harder and less calcareous, and flags and thin sandstones are more frequent. A few bands of black shale are interbedded, but on the whole the principal lithologic difference between this formation and Cashaqua shale is in the proportion of sandy sediment, which is considerably larger in these beds and increases upward to the top, where they are succeeded by the Grimes sandstones.

About 200 feet of strata are embraced within this formation, which was named from its abundant exposure on Hatch hill at Naples, Ontario county. There are many small exposures of these rocks in fields and ravines and along the highways, but only a few are sufficiently extensive to afford opportunity for satisfactory examination of them. The best are along the roadside and in a small ravine two miles southwest of Honeoye; in some small gullies on the west side of Canadice lake; along the roadside two miles north of Cemetery hill; in the north ravine near the head of Conesus lake, and the Calabogue ravine at Conesus, where the entire formation may be seen under favorable conditions. In the Canaseraga creek valley the lower part of all the ravines on the east side between West Sparta and Dansville show Hatch shales and flags. They also appear on the west side northward from Cumminsville.

Fossils are very rare here. The softer shales in the lower beds contain a few forms like those found in the Cashaqua. The sandier beds are quite barren except of plant remains. The collector may expect to find:

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

GRIMES SANDSTONE

This formation is composed principally of even layers of sandstone from six inches to three feet thick, some of which are rather soft and shaly, while others are hard and calcareous. The aggregate thickness is not far from fifty feet.

It appears on the next quadrangle toward the east in the Grimes gully at Naples, where it contains a small brachiopod fauna allied to the Ithaca fauna and other forms not known elsewhere.

Though these sandstones outcrop in many places on the Wayland quadrangle there are very few good exposures of the entire formation.

The entire section is shown in the Calabogue ravine below the lower bridge in the village of Conesus. The sandstones are quite barren of fossils except at the top, where a 14 to 16 inch layer is very hard, calcareous and concretionary and contains large irregularly shaped concretions so frequently as to almost form a continuous layer. It bears a close resemblance to a stratum in this horizon in Tannery gully, Naples, and like that one, contains brachiopod shells quite abundantly, but mostly in so fragmentary condition as to preclude identification.

Entire valves of a small Rhipidomella and Productella spinulicosta occur and loose spines of a larger Productella are abundant. Fragments of Liorhynchus may also be recognized.

The Grimes sandstones may be seen at the Delaware, Lackawanna & Western Railroad culvert in the Culberson gully three and one-half miles north of Dansville, in other ravines and quarries in the east side of the Canaseraga valley, and on the west side at the mouth of the Bradner creek ravine half a mile northwest of Woodville.

GARDEAU FLAGS AND SHALE

Light bluish gray sandstones and flags separated by beds of blue, olive or black shales succeed the Grimes sandstone for about 500 feet. In general stratigraphy this formation is much like the Hatch shale and flags, but many of the sandstones and some of the shale beds are thicker than are seen in that formation. It is the surface rock over a large area on these quadrangles, the drift cover of which, except in a few localities, is quite thin, and field outcrops are frequent. Almost innumerable ravines and small gullies on the hillsides show rock sections embracing some part of the Gardeau beds.

Among the best exposures on these quadrangles are: in Reynold's gulf, three miles north of Springwater; along Calabogue creek above the mill at Conesus; the Culberson ravine above the railroad; the Bradner creek ravine north of Woodville; and at Stones Falls and Stony brook glen south of Dansville.

Fossils are rare, but a few brachiopods known in the Ithaca fauna occur in some of the sandstones, and a few lamellibranchs and cephalopods common in the Cashaqua shales are found in soft shales, especially in the upper part of the formation.

The following is a partial list of the species occurring in the Gardeau beds:

Manticoceras oxy *Clarke*
Palaeotrochus praecursor *Clarke*
Grammysia elliptica *Hall*
Leptodesma robustum *Hall*
Productella lachrymosa *Hall*
P. spinulicosta *Hall*
Ambocoelia umbonata (*Conrad*)
Atrypa hystrix *Hall*
Orthothetes chemungensis *Conrad*
Liorhynchus mesacostalis *Hall*
Hydnoceras tuberosum *Conrad*
Aulopora *sp.*
Crinoid stems

NUNDA SANDSTONE

(Portage sandstone of early reports)

A heavy band of light bluish gray sandstone succeeds the Gardeau flags in central New York. It is a strongly marked feature of the stratigraphy of the region and is of considerable economic value as the source of fine building stone.

The formation is nearly 200 feet thick in the Genesee river section, but thins out toward the west and barely reaches Lake Erie. It is less homogeneous toward the east, some parts becoming shaly, but it is traceable to the Seneca lake valley.

On the Genesee river and farther west fossils, except plant remains, are extremely rare, but on the Wayland quadrangle and eastward, there are found lenticular masses of crinoidal limestone that contain brachiopods and other fossils in large numbers.

Except in the southern part of the Wayland quadrangle, the position of these sandstones is too high to permit of good exposures, but they are well displayed for nearly a mile along the Pittsburg, Shawmut & Northern Railroad two miles southeast of Perkinsville. Extensive quarries on the hill east of Dansville are in these beds, and they have also been quarried on the south face of the hill one and one-half miles north of Perkinsville. Blocks from a fossiliferous lentil at the south end of the hill four miles east of Wayland have been utilized as firestone in that vicinity. Calcareous slabs from this lens, or possibly another one, lie on the north face of the hill one and one-half miles southeast of Wayland.

The fossils contained in these lentils have not been listed, except in the case of the large one on High point on the Naples quadrangle three miles east of this quadrangle, from which 32 species have been obtained. For list, see State Museum Bulletin 63.

WISCOY BEDS

About 200 feet of light and dark shales and soft sandstones that contain a fauna bearing some resemblance to that of the normal Portage and on that account have been considered as a separate formation, succeed the Nunda sandstone on the Genesee river. Though acquiring an increase of sandy material and appearing mainly as a bed of rather soft olive sandstone, on the Wayland quadrangle this formation is readily distinguished from the harder, lighter colored and usually more fossiliferous sandstones and harder shales of the normal Chemung beds by which it is overlain.

There is a small exposure of Wiscoy beds by the side of the Pittsburg & Shawmut Railroad where it crosses the south line of the quadrangle, and a more extensive one from two miles south of Patchenville to the south line of the quadrangle. Crinoid stems, small brachiopods and a small Orthoceras occur here. The large cephalopod Manticoceras oxy Clarke appears occasionally in these beds.

With the increase of sand in the sedimentation toward the east, a few brachiopods which are not found at Wiscoy appear.

CHEMUNG SHALE AND SANDSTONE

About 450 feet of the lower beds of this formation compose the surface rock on the high land in the extreme southern part of the Wayland quadrangle. In lithologic character they are not materially different from the Gardeau beds, except that the sandstones are lighter colored and more micaceous.

Fossils are rare in the lower 300 feet but are in very great abundance in the higher sandstones exposed on this quadrangle. These may be seen to good advantage along the roadside three-fourths of a mile northeast of Loon lake, where the rock is crowded with large brachiopods. Hydnoceras nodosum Hall occurs here also.

The rock lies near the surface over this region and small field exposures are frequent, but there are no extensive outcrops.

DIP

The average dip of the base of the Onondaga limestone between Honeoye Falls and the salt shaft at Livonia is about 33 feet per mile toward the south. On an east and west line, though made variable by frequent undulations of the strata, this limestone is on the whole nearly level.

As all of the formations above the Onondaga up to the Wiscoy shale, except the Stafford limestone and the Rhinestreet black shale, thin out more or less rapidly toward the west, the dip in that direction varies also with the contact line used as a base, but is nowhere appreciable except on careful measurement. The deep and narrow valleys partly occupied by Conesus, Hemlock and Honeoye lakes are blocked at the south ends by enormous beds of gravel, sand and clay which compose a part of the great moraine of the second glacial epoch. The areas intervening between the lakes and the moraine are level beds of rich alluvium. The Genesee river valley in the northwest corner of the Honeoye quadrangle; the Canaseraga valley near Dansville; the bed of a small lake near Wayland and another at South Lima, are of similar character.

A striking exhibition of the force of glacial action occurs in a small amphitheatrical valley of Stony brook at Five Corners, four miles west of Honeoye Falls. The bed rock, Bertie waterlime, is but slightly exposed, but a very large quantity of Lockport dolomite has been transported southward a distance of at least twelve miles and deposited here. The sloping bank on the east side of the little valley is almost covered by blocks of the brown scraggly rock, some of which are twelve to fifteen feet across and six to eight feet thick. They lie so close together that they present the appearance of a broken escarpment, extending toward the north for 60 to 70 rods.

Large blocks of the dolomite are common in this vicinity and a morainic mass of this rock covers several acres half a mile west of this locality, but is mostly in smaller blocks.

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 153

GEOLOGY OF THE BROADALBIN QUADRANGLE, FULTON-SARATOGA COUNTIES, NEW YORK

BY

WILLIAM J. MILLER

New York State Education Department

Science Division, June 23, 1911

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

MY DEAR SIR:

I have the honor to transmit herewith the manuscript of a report entitled *The Geology of the Broadalbin Quadrangle,* accompanied by a geological map. This report has been prepared under my direction by Professor William J. Miller, and is recommended for publication as a bulletin of the State Museum.

Very respectfully

JOHN M. CLARKE

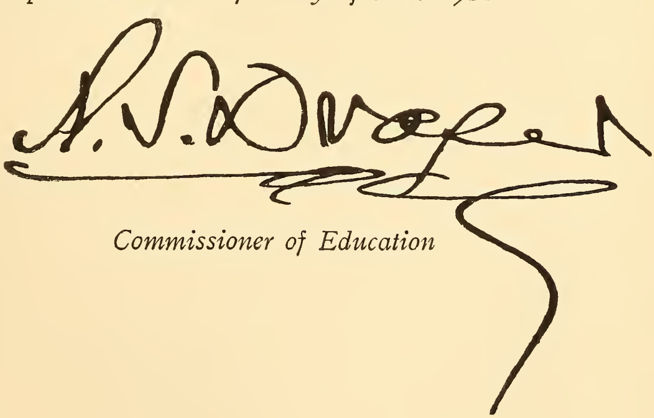
Director

STATE OF NEW YORK

EDUCATION DEPARTMENT

COMMISSIONER'S ROOM

Approved for publication this 27th day of June 1911



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INTRODUCTION

The Broadalbin quadrangle (see map in pocket of back cover) represents about 218 square miles and is bounded by latitude lines 43° and 43° 15′ N., and longitude lines 74° and 74° 15′ W. The geographic position is along the southeastern border of the Adirondacks with the Fulton-Saratoga county line passing nearly north and south through the middle of the territory. A few square miles of the northwest corner lie in Hamilton county. The principal villages are Northville and Broadalbin in Fulton county, and Batchellerville and Galway in Saratoga county. Sacandaga Park, the well-known summer resort, is located just across the river from Northville. The Fonda, Johnstown and Gloversville Railroad has its terminal at Northville which village, during the summer season, is an important gateway to the southern Adirondacks. The region was formerly heavily forested but practically all of the first growth timber has been removed. The highlands of the north, which are in most respects typically Adirondack in character, are still pretty densely covered with second growth. These highlands are very sparsely settled while the lowlands are mostly well occupied. Next to farming, perhaps the chief industry is the manufacture of gloves, factories being located at both Northville and Broadalbin.

GENERAL GEOGRAPHY AND GEOLOGY

In general the quadrangle presents a fairly rugged topography and for some portions the term mountainous might well be applied. The maximum range in altitude is from less than 720 feet, where the Sacandaga river leaves the sheet, to over 2020 feet about two and one-half miles west of Northville.

As shown on the topographic map, two mountain masses stand out conspicuously in the northwestern and the northeastern portions of the quadrangle respectively. The importance of these features may be best appreciated by viewing them from the low divide between Northville and Edinburg, from where they appear like mountain ridges rising abruptly above the surrounding country. The western highlands show elevations commonly from 1800 to 2000 feet, while the eastern highlands generally run from 1600 to 1800 feet above the sea.

Between the highlands lies a broad lowland district (elevation 720 to 850 feet) extending from Northville southward nearly to Broadalbin. The lowest part is occupied by a great level stretch of swamp land known as the "Vly" and by the Sacandaga river flats. The central northern portion, between Northville and Edinburg, is hilly with altitudes of from 900 to 1300 feet. The southern portion of the quadrangle is mostly covered with deep drift and is characteristically hilly with elevations of from 800 to 1200 feet.

The drainage of the district presents some unusually interesting features. The largest stream is the Sacandaga river, a branch of the Hudson, which enters the sheet from the northwest. At Northampton this river suddenly swerves sharply to a north-northeast course which is held for the eight miles past Batchellerville to the map limit, whence it cuts across a wide belt of Precambric rock to empty into the Hudson at Luzerne. Little less remarkable is the course of Kennyetto creek which has its source in the western part of the Saratoga sheet and, after a west-southwesterly course for some fifteen miles to Vail Mills, suddenly swerves to the north-northeast for over eight miles to empty into the Sacandaga at Northampton. Hans creek also shows a similar change in its course. This remarkable tendency of the streams to turn back on their courses will be explained in a later portion of this report [see page 54].

The watershed or division of drainage between the Sacandaga and Mohawk rivers passes across the southern part of the sheet so that only about one-third of the map area drains into the Mohawk.

The largest south flowing stream is Chuctanunda creek which reaches the Mohawk at Amsterdam.

Geologically considered the district shows a great variety of rock formations and structures. The highlands of the north consist of rocks which belong to the oldest (Precambric) known formations of New York State. They comprise very ancient sediments and igneous rocks which have been profoundly changed from their original condition. No less than four distinct types of these rocks have been recognized within the quadrangle.

Another great set of formations younger in age and resting upon the Precambric belongs to the Paleozoic system. All the lowlands of the district are occupied by these formations which are ancient sediments such as limestones, sandstones and shales and which have not been greatly changed from their original condition.

The most recent deposits of the quadrangle are of Pleistocene age.[1] They are vastly younger than the Paleozoics and include the most recent deposits of the earth. They are merely superficial deposits of sand, gravel and clay irregularly scattered over the country and were formed either during or after the Glacial epoch (Ice age) when New York was buried under a great sheet of ice.

The structure or arrangement of the rock masses has been very noticeably affected by displacements or faulting of the earth's crust. The quadrangle is unusual for its number of faults, no less than fourteen with considerable displacement having been located. The most prominent topographic features of the quadrangle are due to faulting as, for example, the steep fronts of the highland masses already described.[2]

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[1] A chapter on the Pleistocene (glacial) geology of the quadrangle has not been included in this bulletin because Professor Brigham, who has carefully studied the glacial history of this and the neighboring Gloversville, Amsterdam, and Fonda sheets, has already presented a brief report (see paper below cited) and a more elaborate account will soon be forthcoming.

[2] The following list comprises the principal papers having a bearing upon the geology of the quadrangle:

1823. Steele. Geology of Saratoga Co. Mem. Board Agric. State N. Y. Vol. 2.

1842. Vanuxem. Geology of the 3rd Dist. N. Y.

1843. Mather. Geology of the 1st Dist. N. Y.

1893. Darton. Geology of the Mohawk Valley, 13th An. Rept. N. Y. State Geologist.

1894. Darton. Faulted Region of Herkimer, Fulton, Montgomery, and Saratoga Counties. 14th An. Rept. N. Y. State Geologist.

1899. Kemp & Hill. Precambric Formation in parts of Warren, Saratoga, Fulton, and Montgomery Counties. 19th An. Rept. N. Y. State Geologist.

1900. Cumings. Lower Silurian System of Eastern Montgomery Co. N. Y. State Mus. Bul. 34.

PRECAMBRIC ROCKS

The most ancient rocks, which are of Precambric age, occupy about two-fifths of the area of the quadrangle. The term "Precambric" is used because these rocks have not, as yet, been correlated with either the Archean or the Algonkian. They include both sediments and igneous masses which have been highly metamorphosed, and represent a portion of the southern border of the large Precambric area of the Adirondacks and underlie all the Paleozoic rocks of the quadrangle.

GRENVILLE SERIES

The rocks of the Grenville series are the most ancient of the Precambrics and consist of highly metamorphosed sediments. These rocks represent old sandstones and shales together with some limestones which have been so thoroughly crystallized and foliated that most of the original sedimentary characters have been obliterated. Within the quadrangle proofs of the sedimentary origin of the Grenville consist in the occurrence of many layers of widely different composition; of crystalline limestone and quartzite strata; and of graphite and garnet crystals. While in the field the writer particularly observed the relation of the Grenville to the other rock masses, but not even a suggestion of any older formation could be found.

Varieties of Grenville. The Grenville, which is so abundantly and magnificently shown and which presents extreme variations in mineralogy, is exhibited under so many different facies that it would be hopeless to attempt a description of them all. After studying many specimens and microscopic sections, a careful selection of the most characteristic facies has been made and the descriptions of these immediately following will perhaps give the best idea of the Grenville within the quadrangle:

1 Crystalline limestone. This rock, which is medium to coarse grained and calcitic, is sometimes pure and white but it is often mottled with green serpentinous material (ophicalcite) which is probably derived by the decomposition of pyroxene. It is in thin layers

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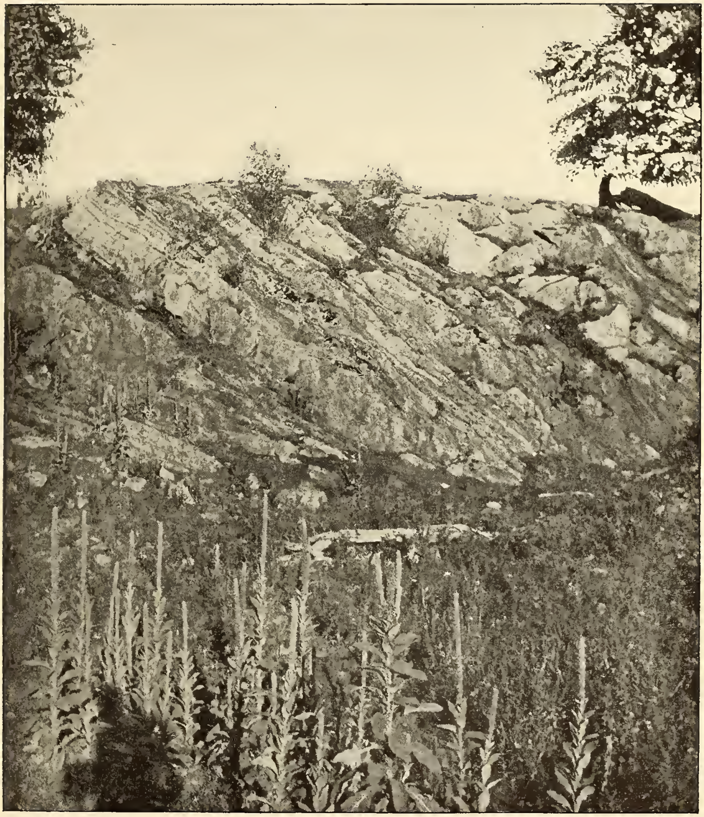
1900. Prosser. Notes on Stratigraphy of Mohawk Valley and Saratoga Counties. N. Y. State Mus. Bul. 34.

1908. Brigham. Glacial Geology of Amsterdam, Fonda, Gloversville and Broadalbin quadrangles, N. Y. State Mus. Bul. 121, p. 21–31.

1910. Ulrich & Cushing. Age and Relation of the Little Falls Dolomite of the Mohawk Valley. N. Y. State Mus. Bul. 140, p. 97–140.

1911. Miller, W. J. Preglacial Course of the Upper Hudson River. Geol. Soc. Am. Bul. 22:177–186.

Plate I



W. J. Miller, photo

Grenville gneiss showing stratification and steep dip. The rock is chiefly quartzite interbedded with thin layers of gray gneiss. Three-fourths of a mile north-northeast of Batchellerville.

and closely involved with thin-bedded, gray, feldspathic and quartzitic gneisses. The only outcrop actually observed is in the bed of Cadman creek just below the bridge three-fourths of a mile north-northwest of Barkersville. Although other small occurrences may have escaped notice, it is certain that the limestone is present only in small amount.

2 Quartzite. The rock from one and one-quarter miles northeast of Batchellerville is perhaps the most typical and is coarse grained, light brown to almost white, and made up of nearly pure quartz with occasional very thin layers containing small flakes of badly decomposed mica. The rock is foliated, highly granulated and often stained with iron oxid. A thin section shows[1] 96 per cent quartz; 2 per cent orthoclase; 1 per cent biotite mostly changed to chlorite; and small amounts of epidote, zircon, apatite and zoisite. The epidote occurs in fine euhedral prismatic crystals which are sometimes distinctly twinned and show a pleochroism from greenish yellow to reddish brown to lavender blue. A thin section from north of Northville shows a total absence of feldspar. In some cases, as one mile northwest of Mosherville, the quartzite is quite feldspathic and filled with graphite flakes.

3 A dark to pinkish gray, distinctly banded gneiss rich in garnet, sillimanite and pyroxene. Under the microscope the rock shows 20 per cent orthoclase; 5 per cent plagioclase (chiefly andesine); 25 per cent garnet; 20 per cent quartz; 10 per cent pyroxene — pale brown, euhedral, monoclinic crystals — probably augite; 10 per cent sillimanite in long slender prisms; 5 per cent biotite; 2 per cent magnetite; 1 per cent pyrite and chalcopyrite; and 1 per cent each of epidote and graphite. The garnets are as large as one-quarter of an inch across, of very clear amethystine color, and distributed through the whole rock. The biotite is largely concentrated in distinct layers. This rock outcrops finely at Glenwild. Rocks very similar to these except for lack of pyroxene are prominently exposed two and one-half miles northwest of Cranberry Creek and two miles northeast of Northville.

4 A very straight, light and dark banded, highly feldspathic gneiss which in thin section shows 60 per cent orthoclase, microcline, and microperthite in about equal amounts together with a little plagioclase; 20 per cent quartz; 10 per cent biotite; 5 per cent sillimanite; 5 per cent garnet of amethyst color; and a little zircon.

[1] Only a close approximation to the mineral composition (volumetric proportions) is intended in this and the following sections of Precambric rocks.

The whole rock shows decided evidence of severe dynamic metamorphism, the feldspars especially being crushed and granulated. Such rock is common on the mountain side one and one-half miles south of Batchellerville.

5 A light gray, medium-grained, rather massive looking gneiss occurring in abundance one and one-half miles southeast of Fox Hill and consisting of 30 per cent orthoclase; 15 per cent plagioclase-oligoclase to andesine; 40 per cent quartz; 10 per cent garnet; 5 per cent biotite; and a little zircon. Other gneisses similar to this but very fine grained and lacking garnet are prominent at the base of Bald Bluff and also two miles west of Cranberry Creek.

6 Light gray leaf gneiss. This rock is medium to coarse grained, highly granulated, and contains 25 per cent orthoclase; 20 per cent microcline; 5 per cent microperthite; 10 per cent oligoclase; 35 per cent quartz; 4 per cent biotite; and traces of magnetite, garnet, zoisite, and zircon. It is a fine example of leaf gneiss, the quartz crystals being drawn out into long flat forms. Good outcrops occur two miles south of Batchellerville and similar rocks, but containing some garnet, occur well up the face of Bald Bluff and along the road one-half mile northwest of Northville.

7 A distinctly straight and thin banded, dark, hornblendic gneiss in large exposures three miles northeast of Northville. It contains 18 per cent microperthite; 15 per cent orthoclase; 10 per cent microcline; 5 per cent plagioclase (mostly oligoclase); 20 per cent hornblende in fine green pleochroic crystals; 18 per cent quartz; 5 per cent biotite; 5 per cent garnet; 2 per cent magnetite; 1 per cent zoisite; and small amounts of zircon, pyrite, and apatite. A rock similar to this but not clearly banded and richer in plagioclase feldspar is abundant along the northern border of the Grenville area southwest of Sacandaga Park.

8 A highly schistose rock showing thin, white and dark gray bands and containing 15 per cent orthoclase; 8 per cent plagioclase (oligoclase to andesine); 50 per cent quartz; 10 per cent garnet; 15 per cent biotite; and 2 per cent epidote and zircon in fine crystals. The garnet and biotite are present in tiny specks and flakes respectively. This is a fine illustration of a highly granulated and dynamically metamorphosed, banded sedimentary rock. Large exposures occur two miles west-southwest of Cranberry Creek and one mile east of Fox Hill.

9 White feldspar, quartz gneiss from large outcrops toward the top of Bald Bluff. It is characterized by the total absence of dark colored minerals and consists of 34 per cent orthoclase; 20 per cent

microcline; 10 per cent microperthite; 5 per cent plagioclase; 25 per cent quartz; 5 per cent garnet; and a very little zircon. The rock is pretty well granulated and is perfectly white except for an occasional large, light amethyst-colored garnet which stands out prominently in the white matrix.

Igneous rocks in the Grenville. Closely involved with the true Grenville sediments are occasional masses of what appear to be undoubted igneous rocks. A fine illustration occurs on the mountain side one and one-half miles due south of Batchellerville where there is a considerable belt (about ten feet wide) of very porphyritic, dark, hornblendic, thoroughly gneissoid rock included within typical Grenville and parallel to its foliation. The thin section shows 20 per cent plagioclase (oligoclase to labradorite); 10 per cent orthoclase; 50 per cent hornblende; 10 per cent biotite; 8 per cent quartz; 2 per cent magnetite; and a little apatite and zircon. It is holocrystalline and has the composition of a quartz diorite. The phenocrysts are sharp edged crystals of feldspar often an inch long and mostly arranged parallel to the foliation but some are at various angles.

Another igneous looking rock occurs in the Grenville toward the top of Bald Bluff. This rock is very dark grey, medium grained and distinctly gneissoid. It contains 10 per cent orthoclase; 20 per cent plagioclase (chiefly labradorite but with some andesine); 30 per cent hypersthene (brown pleochroic); 20 per cent green hornblende; and 20 per cent biotite. Still another rock from two miles northeast of Northville is similar to this except that it is richer in feldspar and hypersthene and lacks the biotite. These last two rocks have the composition of hypersthene gabbro or norite.

The examples above cited are illustrations of others which have been noted in the field and the composition, texture, and field appearance all strongly argue for their igneous origin. The texture and field relations show the intrusive character of the rocks and that the intrusions probably took place practically parallel to the bedding planes of the sediments. The gneissoid structure proves that the intrusions must have occurred well before the cessation of the dynamic forces of compression which developed the foliation of the Grenville. On the other hand these rocks are older than the nonmetamorphosed dike rocks below described.

Areal distribution of the Grenville. The Grenville is by far the most widespread formation of the quadrangle, its areal extent of over sixty square miles being much greater than that of all the other Precambrics combined. In addition to this the Grenville is also prominent in the areas of mixed gneisses below described but it is there too intimately associated with the other rocks to admit of separate mapping. Even in the areas actually mapped as Grenville the rock is not always pure because at times small masses of igneous rocks are intimately associated. In such cases the writer has mapped as Grenville all areas where the sediments greatly preponderate. On the adjoining Saratoga sheet the Grenville is also extensive so that it is much more prominent along the southeastern than the southwestern border of the Adirondacks.

As shown on the accompanying geologic map the Batchellerville-Barkersville area is the largest within the quadrangle. A strike of from north 30° to 50° east with southerly dip of from 30° to 60° is very common over all the area except the northeast portion where the strike is north 80° east with dip 20° south and the extreme south where the strike is north 80° east with dip nearly vertical. Nearly all the varieties above described are to be found, the feldspar-quartz-biotite-garnet gneisses being by far the most common. As already stated, limestone has been observed at but one locality and such a small amount in this large Grenville mass is not a little surprising. Quartzites, which must have been derived from very pure sandstones, are quite common and three fairly well-defined belts are especially noteworthy [see map]. One of these belts, about a mile long and a third of a mile wide, lies just to the northeast of Batchellerville. Much of the quartzite is very pure and in thin to thick beds with strike north 30° west, dip 30° south and apparently showing a thickness of hundreds of feet. The second quartzite belt, about two miles long and one-half mile wide, lies southeast of Fox Hill. The rock is thin-bedded and much like a quartz schist with frequent thin layers of mica. It strikes mostly north 70° west dip 20° south. A third belt comprises all of the Grenville tongue just north of North Galway. It is a very pure quartzite and the beds, which stand nearly vertical, strike north 80° east. The four inliers[1] in the vicinity of North Galway are also of quartzite. Throughout this great area the Grenville is unusually pure and free from closely involved igneous intrusions except around Johnnycake lake and in the region to the east of Parkersville, but even in these cases the sediments greatly preponderate.

In the area northeast of Northville no limestone and little or no quartzite has been noted. Frequently granitic and syenitic rocks

[1] The term "inlier" is here used as defined in Scott's Geology, 2d edition, p. 384.

in small masses have been encountered, as e. g. one and one-half miles west and two and one-half miles northwest of Edinburg, but, on the whole, the rocks are decidedly Grenville and have been so mapped. For the most part they are feldspar-quartz-biotite-garnet gneisses with occasional hornblende or sillimanite gneisses. The strike is generally northeast and dip from 20 to 40° south.

Two small outcrops of the quartzite may be seen along Butler creek (below the falls) at Edinburg where the creek has just cut through the Potsdam, but they are too small to be shown on the geologic map.

North of Northville the small area shows chiefly feldspar-quartz-garnet-gneisses with a distinct belt of pure quartzite along the northern border. These rocks strike east-west and dip 45° south.

The Grenville area southwest of Sacandaga Park is characterized chiefly by feldspar-quartz-biotite-garnet gneisses and schists. Toward the west these rocks are rather massive looking, dark gray and rich in hornblende; while toward the northeast and south they are clearly banded, contain sillimanite and lack hornblende, and frequently have in them small outcrops of granitic and syenitic rocks. The strikes and dips of this area are very variable.

In the area west of Cranberry Creek the rocks are, toward the north, mostly thin bedded, very schistose, granulated, and severely dynamically metamorphosed. Toward the south, in the Precambric tongue, they are mostly thin-bedded feldspar-quartz-garnet gneisses, at times associated with small masses of good porphyritic syenite or granite. Throughout this area the strike is fairly constant north 40° east, dip 30° south.

Stratigraphy and thickness of the Grenville. From the above it is evident that the great bulk of original Grenville sediments were shales, often sandy and carbonaceous, and that these were associated with smaller amounts of pretty pure sandstone and impure limestone. It was hoped that the largest Grenville area might furnish some clew to the stratigraphy of these ancient sediments and, although no conclusive results have been obtained, some suggestive observations have been made. From a point three-quarters of a mile north-northeast of Batchellerville to a point one and one-half miles southeast of Fox Hill is four miles and the line connecting these points passes, at right angles to the strike, over an apparently regular succession of Grenville strata. The dip of the beds is from 20° to 30° to the southeast. Taking the average dip as 25° the thickness of the Grenville in this partial section would be nearly 10,000 feet which is very small compared with recent estimates of Professor Adams for the Grenville of Canada. Beginning at the west the base of this section is quartzite, in thin to thick beds, about 800 feet thick, which grades into graphitic (feldspar-quartz-garnet-biotite) rather thin-bedded gneisses approximately 1500 feet thick. Then come something like 6000 feet of thicker bedded feldspar-quartz-garnet-biotite gneisses which are succeeded by about 500 feet of thin bedded quartzites. Finally, at the summit of the section, come at least 1000 feet of gray garnet gneisses. The upper quartzite is not thought to be a repetition of the lower quartzite because it is thinner bedded, more impure, and is not succeeded by the graphitic beds. There is, of course, the possibility that profound faulting has affected the section but there is no evidence for this in the field.

SYENITE

The syenite as here described is regarded as being of the same age and general character as similar rocks so common in the Adirondacks. Within the quadrangle the rock shows its igneous origin by its composition and uniform character in large masses as well as by its relation to the Grenville. It is clearly intrusive into, and therefore younger than, the Grenville as proved by frequent inclusions of the latter rock within its mass. In the field the homogeneous appearance of the syenite is in marked contrast to the variable Grenville. The rock always shows a distinct gneissic structure which is often so straight and well developed as to give a schistose appearance. The color of the fresh rock is greenish to light gray and it weathers to a light brown. The main mass of the rock is usually medium grained but it is frequently fairly porphyritic with phenocrysts (up to one-half inch) of feldspar more or less drawn out parallel to the foliation. In thin section the syenite is usually highly granulated and this, together with the frequent schistose character, indicates that it has been subjected to very intense compression.

Perhaps the best representative of the average syenite of the quadrangle is the mass forming the high hill to the north of Northville. Under the microscope slides from this rock contain on an average: 25 per cent orthoclase; 18 per cent microperthite; 8 per cent plagioclase (oligoclase); 22 per cent quartz; 15 per cent hornblende; 6 per cent garnet; 5 per cent magnetite; together with a little apatite, zircon and zoisite. This rock is much like Cushing's typical Loon lake syenite except that the pyroxene is here entirely replaced by hornblende. This rock is greenish gray and fine grained except for occasional small porphyritic feldspars. The garnet and magnetite are very fine grained and scattered through the rock.

An extreme variation of the syenite from near the top of Buell mountain is notable for high quartz (25 per cent), magnetite (10 per cent) and biotite (15 per cent) and failure of hornblende.

Another variation of the rock which in the field, two and one-half miles north-northeast of Batchellerville, looks like typical syenite shows in the slide: 45 per cent orthoclase; 10 per cent plagioclase (andesine to oligoclase); 20 per cent quartz; 20 per cent hornblende (changing to chlorite); 5 per cent magnetite; and small amounts of zircon, apatite and zoisite. This variety is notable for its high hornblende content and lack of microperthite. In still other cases biotite and hornblende occur in the same slide.

The failure of green pyroxene in the syenite here harmonizes with the observations of Cushing regarding the Adirondack syenites in general, namely, that in the more quartzose varieties the hornblende is likely to predominate even to the complete exclusion of the pyroxene.

The syenite from the Round lake area is generally pretty quartzose, has biotite instead of hornblende, and is unusually massive in appearance though clearly gneissoid. It is certainly an intrusive rock of syenitic or granitic makeup and in the absence of evidence to the contrary is classed with the other syenite of the quadrangle.

In the small area directly west of Cranberry Creek the rock is a pure syenite but very porphyritic and gneissoid.

The following analysis of what is regarded as the most typical syenite, from the quarry, near the river, one mile northwest of Northville, has been made for the writer by Professor E. W. Morley:

SiO_2	66.35
Al_2O_3	14.09
Fe_2O_3	1.81
FeO	4.49
MgO	1.05
CaO	3.16
Na_2O	3.32
K_2O	4.08
H_2O	.35
TiO_2	1.00
P_2O_5	.40
MnO	.17
S	.04
Cl	.02
F	.03
BaO	.03
ZrO	trace
	100.39

The norm and position of this rock in the quantitative classification are as follows:

	Per cent	Mol.	Ilm.	Apat.	Orth.	Alb.	An.	Mag.	Diop.	Hyp.	Qtz.
SiO_2	66.35	1.106	....	....	254	318	82	....	12	63	377
Al_2O_3	14.09	.138	....	....	44	53	41	....	....	....	.....
Fe_2O_3	1.81	.011	....	....	....	....	....	11	....	....	.....
FeO	4.49	.063	13	....	....	....	....	11	3	36	.....
MgO	1.05	.026	....	....	....	....	....	....	2	24	.....
CaO	3.16	.056	....	10	....	....	41	....	5	....	.....
Na_2O	3.32	.053	....	....	....	53	....	....	....	....	.....
K_2O	4.08	.044	....	....	44	....	....	....	....	....	.....
H_2O	.35	....	....	....	....	....	....	....	....	....	.....
TiO_2	1.00	.013	13	....	....	....	....	....	....	....	.....
P_2O_5	.40	.003	....	3	....	....	....	....	....	....	.....
MnO	.17	.003	....	....	....	....	....	....	....	3	.....
S	.04	....	....	....	....	....	....	....	....	....	.....
Cl	.02	....	....	....	....	....	....	....	....	....	.....
F	.03	....	....	....	....	....	....	....	....	....	.....
BaO	.03	....	....	....	....	....	....	....	....	....	.....
ZrO	trace	....	....	....	....	....	....	....	....	....	.....

Qtz...	22.62	Sal.= 86.25
Orth..	24.46	
Alb...	27.77	
An...	11.40	
Diop..	1.17	Fem.= 14.08
Hyp..	7.45	
Mag..	2.55	
Ilm...	1.98	
Apat..	.93	
	100.33	

$$\text{Class, } \frac{\text{Sal.}}{\text{Fem.}} = \frac{86.25}{14.08} < 7/1 > 5/3 = \text{II, Dosalane}$$

$$\text{Order, } \frac{Q}{F} = \frac{22.62}{63.63} < 3/5 > 1/7 = 4\text{, Austrare}$$

$$\text{Rang, } \frac{K_2O + Na_2O}{CaO} = \frac{97}{56} < 7/1 > 5/3 = 2\text{, Dacase}$$

$$\text{Subrang, } \frac{K_2O}{Na_2O} = \frac{44}{53} < 5/3 > 3/5 = 3\text{, Adamellose}$$

The Sal-Fem ratio brings the rock pretty close to the Persalane class, while the alkalicalcic ratio closely approaches that of Rang 3 (Tonalase) and the Subrang approaches Dacose.

Mode calculated from measured sections

	Total diameters	Relative volumes	Sp. gr.	Units by weight	Percentage weights
Microperthite	1687	19.68	2.6	4386	18.10
Orthoclase	1824	21.28	2.6	4742	19.57
Plagioclase	1243	14.49	2.63	3269	13.48
Hornblende	1248	14.54	3.2	3994	16.48
Quartz	1935	22.57	2.65	5128	21.17
Magnetite	240	2.80	5.25	1260	5.20
Garnet	330	3.84	3.7	1221	5.04
Zircon	9	.10	4.5	41	.17
Apatite	17	.20	3.2	54	.22
Zoisite	40	.47	3.26	130	.54
	8573	99.97		24225	99.97

This rock which, under the old classification, is a quartz-hornblende-syenite is, under the new classification, a hornblende-adamellose.

The high magnetite content of the measured sections calls for more iron oxid than is shown in the analysis, but it must be remembered that the amount of magnetite varies notably even in very short distances so that in the particular slides measured it runs higehr than in the material analyzed. Also the titanium most likely replaces iron oxid in the magnetite to form a titaniferous magnetite thereby lessening the necessary amount of iron oxid.

A comparison of this syenite with the granite porphyry and with certain other Adirondack rocks is given in a table on page 21.

GRANITE PORPHYRY

The typical granite porphyry presents a striking contrast to the typical syenite as regards texture, mineralogical composition, and general appearance in the field. It is an unquestioned igneous rock of gray to pinkish gray color, thoroughly gneissoid, homogeneous in large masses, and intrusive into the Grenville. Three minerals — feldspar, quartz, and biotite — are always prominent to the naked eye. In the typical rock a finely developed porphyritic texture never fails, the phenocrysts of feldspar, often an inch or more in length, being more or less flattened out parallel to the foliation. These phenocrysts are imbedded in a fine-grained mass of feldspar, quartz and biotite. Often quartz also occurs in large crystals (phenocrysts) which have been so thoroughly flattened out parallel to the foliation as to present a decided leaf-gneiss effect. The rock, in thin section, always shows evidence of severe crushing and granulation. The granulation of the feldspar phenocrysts is often visible to the naked eye.

The features will perhaps be best brought out by a description of the most representative rock from each of the areas shown on the geologic map. What may be regarded as the most typical granite porphyry of the quadrangle occurs in the area one and one-half miles north of Northville and contains on the average about: 20 per cent microperthite; 20 per cent microcline; 12 per cent orthoclase; 10 per cent oligoclase to andesine; 30 per cent quartz; 6 per cent biotite; 1 per cent magnetite: and small amounts of apatite, zircon and zoisite. This rock is light pinkish gray and with phenocrysts of microcline. The analysis and quantitative classification of a sample rock from this area is given below.

A representative granite from two and one-half miles west-southwest of Sacandaga Park is similar in composition to the rock just described except that it is slightly richer in microperthite and quartz and lower in orthoclase. This rock is gray weathering to brown, thoroughly gneissoid and granulated, and with phenocrysts of microperthite. The leaf-gneiss structure is beautifully developed owing to the flattening out of quartz into large plates.

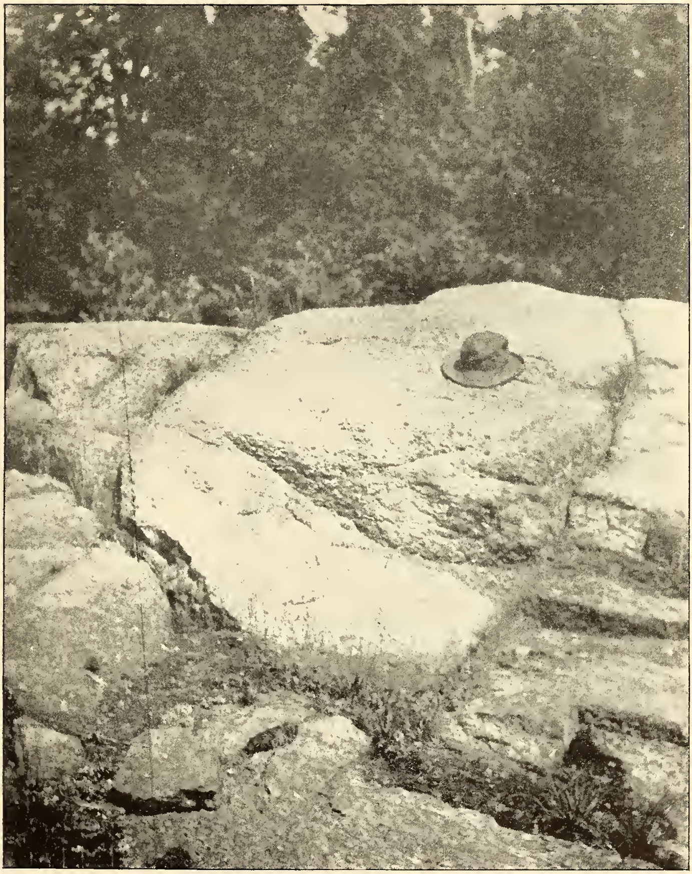
Very similar in composition to these rocks is that from the small area east of Batchellerville, except for a high biotite content and the presence of 1 or 2 per cent of garnets scattered through the mass. This granite is thoroughly gneissoid and granulated but exhibits nothing of the leaf-gneiss effect. The reason for the garnets here is not at all certain, but they may be due to a slight assimilation of the surrounding Grenville by the molten granite.

From these descriptions it is seen that the typical granite porphyry differs from the typical syenite chiefly in its prominent porphyritic character, higher quartz and biotite content, presence of microcline, and total absence of hornblende.

Perhaps the best illustration of granite porphyry which presents certain features very similar to the syenite is that from the area just west of Sacandaga Park. A slide shows: 35 per cent orthoclase; 12 per cent microperthite; 18 per cent oligoclase to andesine; 25 per cent quartz; 7 per cent biotite; 2 per cent magnetite; and 1 per cent zoisite, zircon, apatite and garnet. Mineralogically this rock is almost exactly like the more acid syenite except for the substitution of biotite for hornblende. The boundary line between the granite and syenite here can not be drawn with accuracy because of the apparent gradation of the one rock into the other and this fact, together with the failure to find any evidence of one of these rocks cutting the other, leads to the belief that the granite and syenite are of practically the same age and that they are differentiation products of the same magma.

The following analysis of what is regarded as the most typical granite (above described), from one and three-fourths miles north-northwest of Northville, has been made for the writer by Professor E. W. Morley:

Plate 2



W. J. Miller, photo

Granite porphyry showing a typical outcrop with its jointing. One-half mile southwest of Sacandaga Park.

$Si\ O_2$	
$Al_2\ O_3$	71.45
$Fe_2\ O_3$	13.83
$Fe\ O$	1.10
$Mg\ O$	1.91
$Ca\ O$	.56
$Na_2\ O$	1.44
$K_2\ O$	2.62
$H_2\ O$	6.09
$Ti\ O_2$	.32
$P_2\ O_5$	.42
$Mn\ O$	.03
$Ba\ O$	.17
S	.02
Cl	.02
F	.03
$Zr\ O$	.01
	.02
	100.04

The norm and place of this rock in the quantitative chemical classification are calculated as follows:

	Per cent	Mol.	Ilm.	Apat.	Orth.	Alb.	An.	Cor.	Mag.	Hyp.	Qtz.
$Si\ O_2$	71.45	1.191	....	....	390	252	50				
$Al_2\ O_3$	13.83	.135	....	....	65	42	25	....	....	31	468
$Fe_2\ O_3$	1.10	.007	....	....	....	....	....	3	....	....	.....
$Fe\ O$	1.91	.026	5	....	....	....	....	....	7	....	.....
$Mg\ O$	.56	.014	....	....	....	....	....	....	7	14	.....
$Ca\ O$	1.44	.026	....	.7	....	....	....	....	....	14	.....
$Na_2\ O$	2.62	.042	....	....	....	....	25	....	....	....	.....
$K_2\ O$	6.09	.065	....	....	....	42	....	....	....	....	.....
$H_2\ O$	.32	....	....	....	65	....	....	....	....	....	.....
$Ti\ O_2$	.42	.005	....	....	....	....	....	....	....	....	.....
$P_2\ O_5$	.03	.0002	5	....	....	....	....	....	....	....	.....
$Mn\ O$	.17	.003	....	.2	....	....	....	....	....	....	.....
S	.02	....	....	....	....	....	....	....	....	3	.....
Cl	.03	....	....	....	....	....	....	....	....	....	.....
F	.01	....	....	....	....	....	....	....	....	....	.....
Ba O	.02	....	....	....	....	....	....	....	....	....	.....
Zr O	.02	....	....	....	....	....	....	....	....	....	.....

Qtz.	28.08	Sal. = 93.49
Orth.	36.14	
Alb.	22.01	
An.	6.95	
Cor.	.31	
Hyp.	3.64	Fem. = 6.08
Mag.	1.62	
Ilm.	.76	
Apat.	.06	
	99.57	

$$\text{Class, } \frac{\text{Sal.}}{\text{Fem.}} = \frac{93.49}{6.08} > 7/1 = \text{I, Persalane}$$

$$\text{Order, } \frac{Q}{F} = \frac{28.08}{65.10} < 3/5 > 1/7 = 4, \text{ Brittanare}$$

$$\text{Rang, } \frac{K_2O + Na_2O}{Ca\ O} = \frac{107}{26} < 7/1 > 5/3 = 2, \text{ Toscanase}$$

$$\text{Subrang, } \frac{K_2O}{Na_2O} = \frac{65}{42} < 5/3 > 3/5 = 3, \text{ Toscanose}$$

The potash-soda ratio is such that the rock comes close to subrang 2, Dellenose.

Mode calculated from measured sections

	Total diameters	Relative volumes	Sp. gr.	Units by weight	Percentage weights
Microperthite	1788	19.50	2.6	4648	18.95
Orthoclase	1155	12.64	2.6	3003	12.24
Microcline	1810	19.74	2.6	4706	19.18
Plagioclase	1014	11.06	2.63	2667	10.87
Quartz	2717	29.63	2.65	7200	29.35
Biotite	500	5.45	3.00	1500	6.12
Magnetite	90	.98	5.25	473	1.93
Zoisite	60	.65	3.26	196	.80
Zircon	21	.22	4.5	94	.38
Apatite	13	.14	3.2	42	.17
	9168	100.01		24529	99.99

According to the old classification this rock is a biotite-granite-porphyry while under the new classification it is a biotite-granophyro-toscanose.

From the above it is seen that the Northville syenite and granite, though in different classes, fall in exactly corresponding orders, rangs, and subrangs and this, together with the fact that the syenite is close to the Persalane border, shows that these two rocks are closely related in the quantitative chemical classification. Thus the field relations, examination of thin sections and chemical composition of these two rocks, which present such a marked difference in appearance, afford practically conclusive proof that they are of the same age and represent differentiation products from the same magma, the granite representing merely somewhat more salic (richer in quartz and feldspar) portions of the cooling magma.

In the following table the Northville syenite and granite are compared with certain other carefully studied Adirondack rocks:

	1	2	3	4	5	6	7
SiO_2	66.35	64.47	62.41	61.01	71.45	66.72	68.50
Al_2O_3	14.09	10.51	18.75	15.36	13.83	16.15	14.69
Fe_2O_3	1.81	1.11	2.49	2.98	1.10	1.23	1.34
FeO	4.49	7.37	4.91	7.77	1.91	2.19	3.25
MgO	1.05	5.21	.61	.78	.56	.73	.26
CaO	3.16	3.10	3.17	4.05	1.44	2.30	2.20
Na_2O	3.32	2.21	3.09	3.68	2.62	4.36	3.50
K_2O	4.08	3.63	4.25	3.90	6.09	5.66	5.90
H_2O	.35	.93	.41	.49	.32	.77	.40
TiO_2	1.00	.....	.....	.....	.42	.....	......
P_2O_5	.40	.25	.....	.....	.03	.....	.03
MnO	.17	.....	.....	.08	.17	.07	.10
S	.04	.12	.....	.....	.02	.....	......
Cl	.02	.....	.....	.....	.03	.....	......
F	.03	.....	.....	.....	.01	.....	......
BaO	.03	.....	.....	.....	.02	.....	.05
ZrO	trace	.....	.....	.....	.02	.....	......
CO_2	.....	.58	.....	.....	.....	.....	......
	100.39	99.49	100.09	100.10	100.04	100.18	100.22

1 Quartz-hornblende-syenite (Adamellose) from 1 mile northwest of Northville. E. W. Morley, analyst.
2 Syenite, gneissoid (Adamellose). Whitehall, N. Y. W. F. Hillebrand, analyst. N. Y. State Mus. Bul. 138, p. 45.
3 Augite-syenite (Adamellose). Ticonderoga, Essex co. M. K. Adams, analyst. N. Y. State Mus. Bul. 138, p. 45.
4 Augite-syenite (harzose). 3½ miles north of Tupper Lake Junction. E. W. Morley, analyst. N. Y. State Mus. Bul. 115, p. 514.
5 Biotite-granite-porphyry (Toscanose). 1¾ miles north-northwest of Northville. E. W. Morley, analyst.
6 Augite-syenite (Toscanose). Little Falls, N. Y. E. W. Morley, analyst. N. Y. State Mus. Bul. 115, p. 514.
7 Quartz-syenite (Toscanose). 2½ miles south of Willis pond, Altamont, Franklin co. E. W. Morley, analyst. N. Y. State Mus. Bul. 115, p. 514.

These analyses represent rocks of the syenite-granite series from widely separated places in the Adirondacks and they serve to illustrate the close chemical relationship existing between the rocks of the series. Still other analyses may be found in Museum Bulletins 115 and 138.

Numbers 1, 2, 3, and 4, in the quantitative system, all belong in class 2 (Dosalane) and order 4 (Austrare). The first three are in rang 2 (Dacase) and subrang 3 (Adamellose) while the fourth is in rang 3 (Tonalase) and subrang 3 (Harzose).

Numbers 5, 6, and 7 are all in class 1 (Persalane) ; order 4 (Brittanare) ; rang 2 (Toscanase) ; and subrang 3 (Toscanose).

Thus, according to the chemical classification, the only important difference between the first four and the last three is that of class and even this is not always sharp as shown in the cases of the Northville syenite and granite.

MIXED GNEISSES

Under this heading are included various gneisses but chiefly more or less intimate mixtures of Grenville, syenite, and granite. For most part the Grenville appears to predominate but because of the presence of so much other rock it is thought best to map these mixed gneisses separately. It is often difficult to draw the boundary lines between these gneisses and the other rocks because anything like sharp contacts are wholly lacking. The Grenville has been much cut up by intrusions of syenite or granite so that small masses of good igneous rock and good Grenville often exist in close proximity. At times rather clear-cut inclusions of Grenville occur within the igneous masses. Again, gneisses are commonly seen which could scarcely be called good Grenville nor yet good syenite or granite, but which in every way look like rocks which may have resulted from the incorporation, by fusion, of Grenville into the molten masses. The more the writer observes these mixed gneisses along the western and southern border of the Adirondacks, the more is he impressed with the very strong evidence in favor of assimilation.

A great variety of gneisses is shown in the area northeast of Batchellerville. Grenville is present to a greater or less extent throughout the area and is at times very pure as, for example, where it forms the wall rock of the feldspar mine on the south side or just east of the end of the branch road shown on the map. Porphyritic granitic looking gneiss is abundant from the mine northward, while syenite shows in large exposures one-third of a mile south of the mine. South of the branch road gray, rather massive, granitelike gneisses are common.

Due north of Northville the mixed gneiss area, with numerous outcrops, affords a fine illustration of intimately associated Grenville, syenite, and granite. The continuation of this area to the west of the river well shows the passage of the mixed gneisses into pure syenite through uninterrupted exposures. The Grenville generally preponderates but often massive syenitic rocks are present. One and one-quarter miles due north of Buell mountain a mass (forty or fifty feet across) of typical thin-bedded Grenville quartzite forms a clearly defined inclusion in the syenite.

In the area west-northwest of Cranberry Creek the Grenville is frequently intimately associated with masses of granite porphyry or syenite. The Grenville is often badly twisted and looks like inclusions or masses more or less melted in with the igneous rock.

PEGMATITE DIKES

Numerous pegmatite dikes have been found cutting through the Grenville, syenite, and granite. A few of the larger and more accessible ones are located as follows: At the feldspar mine two and one-half miles north-northeast of Batchellerville; two miles north of Edinburg; two miles northeast of Northville; and about two miles west of Sacandaga Park. These dikes are apparently all nonmetamorphosed and they cut through the country rock in very irregular shaped masses and stringers. A description of the pegmatite at the feldspar mine north of Batchellerville will be fairly illustrative of the other occurrences. This rock has recently been described by Mr E. S. Bastin of the U. S. Geological Survey and the following extracts are from his report:[1] "The rock is a granite pegmatite which has been worked from two open pits. Quartz occurs in pure masses several feet across and also in graphic intergrowth with feldspar. The feldspar is light gray microcline, finely intergrown with small amounts of albite. It occurs in pure masses, the largest four feet across, and the feldspars of some of the coarser phases of the graphic granite are three feet across. The finer grained parts of the pegmatite contain 'books' of muscovite oriented in every direction. Biotite is not abundant, but one flat crystal observed was four feet long and three feet wide. Beryl, of dark blue-green color, translucent to transparent, is moderately abundant. The pegmatite for two or three feet next to the contact of the pegmatite with the schist at this pit is an irregular or arborescent intergrowth of quartz and feldspar inclosing some large muscovite 'books.' The pegmatite is intrusive, with sharp contacts with a light gray to dark gray quartz-biotite-feldspar gneiss of variable character. The contact in some places parallels the foliation and in other places cuts sharply across it."

Whether the pegmatite is older or younger than the black basic dikes below described has not been determined within the quadrangle. However, just beyond the map limits, and in an abandoned feldspar mine two and one-half miles west-northwest of Cranberry Creek, a pegmatite and a basic (diabase?) dike may be seen in sharp vertical contact and the basic rock cuts the pegmatite thus proving the greater age of the latter in this case at least.

[1] Feldspar Deposits of the United States, U. S. G. S. Bul. 420.

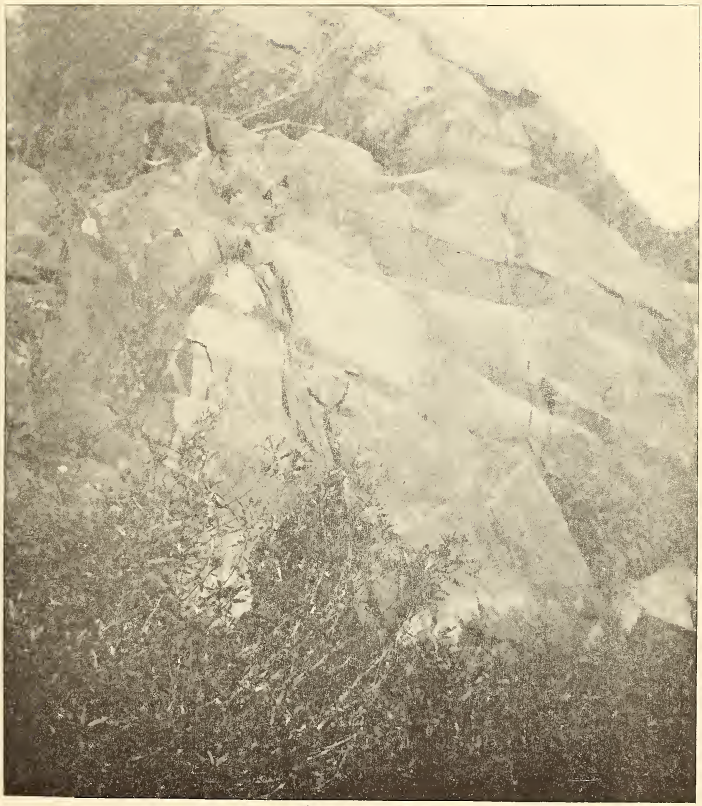
GABBRO AND DIABASE DIKES

With one or two possible exceptions, these black dike rocks represent the latest igneous activity of the district. Some are true gabbros while others are diabases. In all, nine of these dikes — four west of Northville, four in the vicinity of Batchellerville and one at Barkersville — have been noted, but more than likely others occur in the woods. The dike at Barkersville is somewhat gneissoid and for this reason is rather doubtfully classed with the other eight, all of which appear to be entirely devoid of metamorphism. In all cases the rock is hard and fresh, due to the fact that the decomposed material has all been removed by ice erosion. These basic rocks are certainly younger than the Grenville, syenite, or granite since these latter have all been cut by the dikes. Also the eight non-metamorphosed dikes were certainly intruded after the cessation of the pressure which produced the foliation of the Precambric rocks. That they are of Precambric age has not been proved within the quadrangle itself, but their close similarity to such rocks occurring in the Adirondacks, and the fact that no such rocks have been seen cutting the Paleozoic in this part of the State, leaves little room for doubt regarding their Precambic age. The gneissic structure of the Barkersville dike suggests that it is older than either the nonmetamorphic basic dikes or the pegmatite, but its mineral composition is almost precisely like that of the Batchellerville dikes.

The variations in these rocks will perhaps be best shown by describing several types. A thin section from the dike one mile northeast of Batchellerville shows: 60 per cent lath-shaped plagioclase (andesine to labradorite); 25 per cent hypersthene (faintly pleochroic); 10 per cent biotite (much changed to chlorite); and 5 per cent magnetite (much changed to leucoxene). This rock is a true hypersthene diabase with the ophitic texture beautifully shown. The dike is about 400 yards long and of varying width up to 100 feet. The rock is fine to medium grained, weathers brown on the immediate surface, shows no sharp contacts, and strikes parallel to the general foliation of the Grenville. In close proximity to the dike the Grenville is usually badly twisted, probably due to the force of intrusion of the molten rock. The composition of the dike at Barkersville is almost exactly like this except for a little hornblende and pyrite.

The dike three-quarters of a mile west-northwest of Northville shows about: 50 per cent basic plagioclase; 25 per cent hyper-

Plate 3



W. J, Miller, photo

Dikes of basic rock (norite) cutting hornblende syenite. One mile north-northwest of Northville and at the edge of the river.

sthene; 15 per cent hornblende; 5 per cent biotite; and 5 per cent magnetite. This rock is a non-metamorphosed, medium grained hypersthene gabbro or norite which, in every way, greatly resembles the dike gabbros of the North Creek sheet now being studied by the writer and which, in that region, seem to be older than the fine grained diabases.

A slide from the basic dike rock one mile north-northwest of Northville contains: 35 per cent plagioclase (labradorite with some andesine); 15 per cent orthoclase (some with albite twinning); 20 per cent hypersthene (pale green to reddish brown pleochroism); 25 per cent hornblende; 5 per cent magnetite; and a little pyrite and zircon. The rock shows a fine grained granitoid texture which, because of its unusual composition, should be called a hornblende-orthoclase-hypersthene gabbro or norite. At this locality there is not a single dike but rather a number of small branching tongues which are beautifully shown in relation to the syenite. Some of the branches cut through the syenite very irregularly while others are perfectly parallel to the gneissic bands. There is no sign of contact metamorphism along the very sharp contacts with the greenish gray syenite.

PALEOZOIC ROCKS

The Paleozoic formations, which are all of Cambric and Ordovicic ages, occupy about three-fifths of the area of the quadrangle. Because of their distinct stratification, fossil content, and lack of metamorphism they present sharp contrasts to the Precambric rocks. These strata have been little disturbed by folding or tilting except near the faults where the dip is often pronounced. Because of the faulting the general Paleozoic dip can not be well determined, but from Barkersville southward it is something like seventy-five or eighty feet per mile southwestward.

POTSDAM SANDSTONE

The Potsdam sandstone, which is of upper Cambric age, is the oldest Paleozoic formation of the district. It everywhere rests upon the Precambric, being separated from the ancient gneisses by a profound unconformity. The absence of Lower Cambric strata here and their presence along the eastern border of the State clearly shows that the Cambric sea encroached upon the land from the east. Speaking of the Potsdam sandstone of the Adirondack region Cushing says:[1] "It is thickest on the northeast, thinning out to disappearance both to the south and west. As, furthermore, it appears to be the upper beds which persist, and the lower ones which disappear in these directions, it seems certain that, so far as the immediate region is concerned, the marine invasion came on it from the northeast." This accounts for the fact that, in the Broadalbin region, the Potsdam is so thin and represents only the upper part of the formation. In Clinton county it is thickest, being certainly over one thousand feet. The evidence is clear and concise that, within the quadrangle, the Potsdam was deposited on a fairly uneven surface [see page 51] which accounts for the rapid local changes in the strata from place to place. Although the formation is widespread under cover of later sediments, the present outcrops are limited to a few comparatively small areas as shown on the geologic map.

The base of the Potsdam in the southeastern portion of the quadrangle is characterized by a coarse conglomerate of unusual interest. The best exhibitions of this basal member are in the vicinity of Kimball's Corners one-half mile northeast of North Galway. Here are fine exposures of Grenville quartzite and the conglomerate, resting upon the Grenville, shows in large almost continuous outcrops for nearly half a mile. The actual contact may be seen at one or two points as shown in plate 5. The conglomerate varies in thickness from nothing to eight or ten feet and the grayish-white fragments, ranging in size up to two or three feet, are often angular so that the term breccia might well be applied. The fragments are imbedded in a matrix of sand and are all of quartzite which have been directly derived from the immediately underlying Grenville by wave action. The surface on which the conglomerate was deposited was locally very irregular and the large boulders seem to have got into the small depressions along the shore as shown by the occurrence of heavy beds of conglomerate either side of a little tongue or ridge of Grenville near Kimball's Corners. Only at times is there evidence for very crude stratification and this, together with the large size and angular character of the fragments suggests a rapid deposition of the material. Above the conglomerate there is very little sandstone, the succeeding passage beds being within a few feet, so that the Potsdam is represented nearly altogether by the conglomerate.

Smaller outcrops of similar conglomerate practically in contact with the Grenville occur one-third of a mile southeast of North

[1] N. Y. State Mus. Bul. 95, p. 354.

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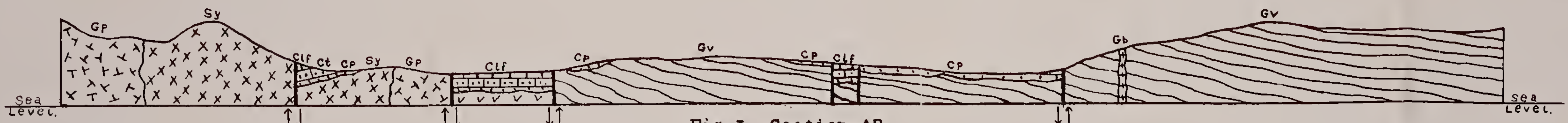

Fig. I. Section AB.

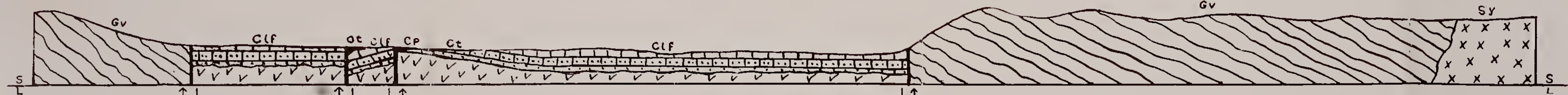

Fig. 2. Section CD.

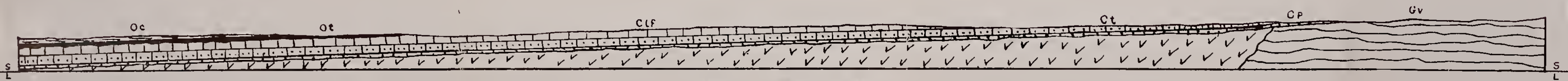

Fig. 3. Section EF.

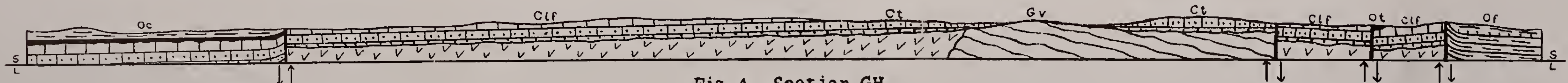

Fig. 4. Section GH.

Figures 1-4 Structure sections across the Broadalbin quadrangle. The positions of the sections and the meaning of the symbols is shown on the accompanying geologic map. Vertical scale is twice the horizontal.

Galway and at the edge of the Amsterdam reservoir. A fine exposure of the coarse conglomerate occurs in the bed of the small stream (wrongly placed on the map) one-third of a mile due north of Barkersville. Other outcrops are one-quarter of a mile west of the last named locality and along the creek one-half mile southwest of Barkersville.

A very similar conglomerate, at the base of the Potsdam, has been described by Smyth[1] as occurring at several points on Wells and Grindstone islands in the Thousand Island region. Cushing[2] has also described a coarse conglomerate at the base of the very thick Potsdam in Clinton county but there the rock is red and contains much comparatively fresh feldspathic material.

Three-fourths of a mile southwest of Barkersville, and along the road, there is a large outcrop of typical Potsdam sandstone which is gray, fine-grained, thin-bedded, and frequently ripple-marked. In the creek one mile north-northeast of Mosherville typical Potsdam sandstone is exposed and though no contact is visible the rock doubtless comes against the Hoffman's Ferry fault.

An excellent Potsdam section may be seen along the creek at Edinburg. The section comprises chiefly typical looking sandstone but there are certain notable variations. The lowermost layer exposed (just below Latcher's falls) is a hard, gray, quartzitic rock which greatly resembles the Grenville. This layer is practically in contact with Grenville quartzite which may be seen in a very small outcrop about one hundred feet below the falls. In the lower portion of the falls there are two distinct beds of sandy conglomerate from one to three feet thick and containing pebbles as much as one or two inches in diameter. Between the conglomerate beds there is a distinct shaly layer containing the fossil shells of Lingula. At the crest of the falls there are two or three thin layers of good dolomitic limestone. The thickness of Potsdam below the highway bridge at Edinburg is estimated at from forty to fifty feet with a general dip of from two to four degrees to the southeast. Just above the bridge about ten feet of typical thin-bedded sandstones are exposed.

A mile west of Edinburg, and on the same creek, is a large outcrop of thin-bedded Potsdam sandstone in actual contact with the Grenville. The lowest beds are dark gray, quartzitic, and look much like the Grenville. The dip is 15 degrees to the southeast.

Half a mile east-southeast of Northville are numerous exposures

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[1] 19th An. Rept. N. Y. State Geologist, 1899, p. 299.
[2] N. Y. State Mus. Bul. 95, p. 355.

of the sandstone in close proximity to the Precambric. Conglomerate was not observed here but dolomitic and calcitic beds even within a few feet of the Precambric are more prominent than at Edinburg. The dip varies considerably but is mostly toward the southeast and apparently some thirty or forty feet of Potsdam is present. The sandstone containing rotten calcareous beds may be seen along the road due east of Northville. Typical sandstone outcrops one and one-half miles southeast of Northville and also in the south end of Gifford valley where the dip is about 4 degrees southwestward.

On Bunker hill the sandstone is finely exposed in a quarry where a thickness of about fifteen feet of the rock is shown. Certain beds are beautifully ripple-marked and occasionally there are yellowish to reddish-brown iron stained layers. The dip is 10 degrees southeast.

On Roberts creek, two and one-half miles southwest of Cranberry Creek village, and also three-fourths of a mile due south of this locality there are good outcrops of typical thin-bedded Potsdam near the Precambric and dipping five degrees to the southwest. The thickness is estimated at about forty feet.

From the above description it is seen that the Potsdam varies in thickness from nothing to about fifty feet and that the lithologic character changes rapidly in short distances.

THERESA FORMATION

The Theresa formation constitutes a perfect transition series between the Potsdam sandstone and the Little Falls dolomite. It was named by Cushing three years ago in the Thousand Islands region and, as modified from its original usage, it now applies only to the Potsdam-Little Falls passage beds so commonly present in New York. Lithologically the formation consists of alternating beds of pure, gray, fine-grained sandstone and bluish-gray, fine-grained, dolomitic limestones. The beds are seldom more than a foot thick. The sandstone layers bear a remarkable similarity to the underlying Potsdam, while the limestone layers are practically indistinguishable from those of the overlying dolomite formation. Cavities, lined with calcite and quartz crystals and similar to those of the Little Falls formation, are frequently found in the limestone beds. The sandstone beds often, and the limestone beds sometimes, show cross-bedding and ripple marks. Toward the base of the formation the limestone layers are occasionally sandy and contain pebbles up to half an inch in diameter.

Plate 4

N. H. Darton, photo

Glaciated surface of Potsdam conglomerate. The largest boulders are nearly three feet across. One and one-half miles a little south of west of Mosherville.

Plate 5

N. H. Darton, photo

Potsdam conglomerate on Grenville quartzite. One and one-half miles a little south of west of Mosherville.

Plate 6

W. J. Miller, photo

Potsdam sandstone at Latcher's falls in the village of Edinburg

Downward the Theresa formation is in no sense sharply separated from the Potsdam and no distinct line can be drawn. Even in what must certainly be regarded as Potsdam, an occasional thin layer of limestone occurs. Upward the transition to the Little Falls dolomite is less gradual, the top of the Theresa, within the quadrangle, apparently being marked by a rather massive bed of sandstone of unusual thickness (five feet) and prominence. This sandstone bed, which has heretofore been mistaken for the Potsdam, outcrops one-half of a mile south of Mosherville; one-fourth of a mile southwest of Parks Mill; one and one-third and two miles west and one and one-half miles southwest of Galway; one-half of a mile north-northeast of West Galway; in the northern end of Gifford valley, etc. What appear to be small cryptozoon forms, not over an inch in diameter, have been noted one-fourth of a mile east of North Galway; one mile northwest and one and one-half miles southwest of Galway. Oolite has been observed one-fourth of a mile east of North Galway and also in drift fragments three-fourths of a mile east of Northampton.

Within the map limits no fossils (except cryptozoon) have been found and the relation of these beds to the fossiliferous Hoyt limestone of the Saratoga region is not exactly known. While it is possible that the upper part of the Broadalbin passage beds may correspond to the Hoyt limestone of Saratoga, it is certain that the Hoyt limestone, as such, does not reach the Broadalbin sheet nor do any of its fossils so far as known. In view of these facts the writer finds it necessary to class together all the transition beds as Theresa and so map them on the Broadalbin sheet.

No continuous section has been found within the map limits but a mile south of East Galway, there is an excellent section showing all but the uppermost beds in nearly continuous outcrop down to the Potsdam. The thickness is here approximately two hundred feet with perfect transition to the Potsdam well shown. Westward from this locality to Parks Mill and Mosherville there are many outcrops of the Theresa formation. Another excellent display of the formation is in the ridge between Galway and the Amsterdam reservoir where the lowest beds are not visible but the thickness must be nearly two hundred feet.

According to Ulrich and Cushing[1] the Hoyt limestone, close to one hundred feet thick near Saratoga, is regarded as a basal phase of the Little Falls dolomite and the Theresa (passage) beds are

[1] N. Y. State Mus. Bul. 140, p. 99, 112.

there a little over fifty feet thick. On this basis the passage beds rapidly thicken westward to two hundred feet on the Broadalbin sheet. If, however, we regard the Hoyt limestone as an upper phase of the passage series, and this is a very possible view since Ulrich and Cushing say that the same trilobite fauna ranges through both the Hoyt and the Theresa, the strata between the Potsdam and Little Falls show an increased thickness of only fifty feet westward to the Broadalbin sheet.

In the vicinity of North Galway there are many good outcrops of the Theresa formation and this locality is of special interest because there the passage beds may be seen resting directly upon the Precambric. Three-fourths of a mile northeast of North Galway dolomitic limestone beds, with occasional small quartz pebbles, are practically in contact with the Grenville while two hundred yards west of this a two foot layer of sandstone occurs very close to the Grenville. It is clear that the Potsdam is not present here and that the passage beds rest directly upon the Precambric. The significance of this overlap is discussed on page 51.

Along the road just east of North Galway the section is as follows:

Feet	
1.	Oolitic and cryptozoon limestone beds
14.	Alternating dolomitic limestone and sandstone beds
7.	Interval — but doubtless alternating limestone and sandstone
3.	Thin-bedded sandstone, rather calcareous
25.	Dolomitic limestone, sometimes sandy to pebbly
	Potsdam conglomerate not exposed and very thin if present
	Precambric Grenville quartzite

Between Northampton and West Galway the line separating the Theresa and Little Falls formations is difficult to draw because of heavy drift. One mile south-southeast of Northville there are large exposures of typical passage beds. Near Edinburg no outcrops were noted but, judging by the distribution of Potsdam and dolomite ledges and the drift fragments, the Theresa formation must swing around something as shown on the geologic map. In Gifford's valley upper beds of the formation are well exposed, especially along the road by Mr Gifford's house, where the heavy bed of sandstone and immediately overlying dolomite are shown. Two miles north-northwest of Cranberry Creek a small area of these rocks comes against the Noses fault. One and one-half miles northeast of Mayfield, and along Roberts creek, the formation is pretty well exposed and the transition character of the beds is shown. The dip is from 3 to 5 degrees southwestward and the thickness is estimated at 150 feet.

LITTLE FALLS DOLOMITE

Of the Paleozoic formations, the Little Falls dolomite (upper Cambric) is the most prominent and widespread within the quadrangle. With certain minor exceptions the formation presents a remarkably uniform character throughout. Typically the rock is pale bluish-gray, fine-grained, crystalline, dolomitic limestone, which when freshly broken exhibits a glimmering surface. The rock is often rather arenaceous and in a few cases a pale pink tint has been noted. The weathered surface is generally light gray to pale buff in color. The rock is distinctly bedded, the layers ranging in thickness from less than an inch to eighteen inches, with a usual thickness of six to twelve inches. A striking feature, which may nearly always be observed in the outcrops, is the occurrence of cavities lined with quartz crystals and frequently accompanied by dolomite or calcite crystals. The quartz crystals, remarkable for clearness and perfection of form, are popularly but erroneously called diamonds.

A rather persistent feature of the dolomite is the presence of angular chert fragments about twenty to forty feet above the base of the formation. This chert is sometimes white and sometimes dark colored and is often a prominent constituent of the rock through a thickness of several feet. Some of the localities where the chert is well shown are: in the creek at Parks Mill and on the hillside just to the south; two-thirds of a mile west of Galway; one mile east-northeast of Mayfield; on the west side of Bunker hill; two miles northwest of Cranberry Creek; just southeast of Northville; in the north end of Gifford valley; on the river two miles south-southeast of Northville; and two and one-half miles north of Batchellerville.

A mile east, as well as a mile and a half southwest, of Galway several feet of thin calcareous, sandy shaly beds have been noted near the summit of the formation and these are probably the same as similar beds described in other sections of the lower Mohawk valley.

Since no complete section of the Little Falls dolomite is exposed within the map limits the thickness can only be approximated. Eastward from Galway the dip and extent of the formation appear to indicate a thickness of at least 200 feet. Northeastward from Mayfield there is a thickness of 160 feet with neither top nor bottom shown. Thus the thickness is practically the same as for the region around Saratoga (if the Hoyt limestone be excluded).

Among the many excellent outcrops in the region are the following: northeastward from Mayfield; the vicinity of Cranberry Creek; two miles north-northwest of Cranberry Creek; the west side of Bunker hill; in Gifford valley; just southeast, and two miles south-southeast, of Northville; two and one-half miles north, and one and one-half miles southwest, of Batchellerville; at Northampton and one mile northward; at Union Mills and one mile south-southeastward; three-fourths of a mile west, and two and two and one-half miles east, of Broadalbin; at several points between Perth and West Galway; on the road east of West Galway; and at many places within the dolomite areas around Galway.

An important feature of the dolomite formation is the existence of a distinct erosion surface at its summit. Within the quadrangle, with one or two possible slight exceptions, the Tribes Hill limestone is absent and the Black River-Trenton limestone (generally the Lowville) everywhere rests upon the eroded surface of the dolomite. Near Rock City Falls (Saratoga sheet) such Ordovicic (Black River) limestone clearly rests upon an eroded surface of the dolomite. One and one-half miles southwest, and one mile south, of Galway similar phenomena may be observed and, at the first named place, a few pieces of the dolomite are included in the overlying limestone. Along Kennyetto creek, two miles east of Broadalbin, the Trenton-Lowville is practically in contact with the dolomite and the very perceptible dip of both formations to the west shows clearly that the Trenton-Lowville occupies a depression in the surface of the dolomite. Three-fourths of a mile east of Mayfield and also at Kegg's quarry (just east of Cranberry Creek) the Lowville is practically in contact with the dolomite although at the latter place a slight touch of the Tribes Hill limestone may be present.

TRIBES HILL LIMESTONE

The Tribes Hill limestone as recently named by Ulrich and Cushing[1] comprises essentially the "fucoidal beds" so long known in the Mohawk valley and is to be correlated with the lower portion of the Beekmantown of the Champlain valley. According to

[1] N. Y. State Mus. Bul. 140, p. 99.

these authors the old Beekmantown or Calciferous of the Mohawk valley should be divided into a lower mass of Little Falls dolomite (Upper Cambric) and an upper mass of Tribes Hill limestone (Ordovicic), the two being separated by a distinct unconformity.

This Tribes Hill limestone, which attains a thickness of 168 feet at Cranesville on the Mohawk river, is almost, if not entirely, absent from the Broadalbin sheet. Just off the map, and close to the Haines quarry, one and one-half miles north of Mayfield, there are a few feet of bluish-gray, fine-grained, thin-bedded, fucoidal layers clearly underlying the Black River-Trenton limestone near the quarry. These fucoidal layers the writer regards as Tribes Hill. Near Kegg's quarry, one-half mile east of Cranberry Creek, the Lowville is almost in contact with the dolomite. The quarry itself was filled with water at the time of the writer's visit but specimens of the gasteropod (Ophileta) so common to the Tribes Hill formation were found in limestone fragments about the quarry and this strongly suggests the presence of a touch of the Tribes Hill here. Along the creek, two miles east of Broadalbin, the Lowville is almost in contact with the dolomite so that very little, if any, Tribes Hill comes in here. In other parts of the quadrangle there is no positive evidence of the occurrence of Tribes Hill limestone.

The unconformity between the Little Falls and the Tribes Hill in the Mohawk valley is of considerable consequence because it shows that the Cambric period in this part of the State, at least, closed with the land above water and undergoing erosion. Again, Ulrich and Cushing have shown that the summit of the Tribes Hill in the Mohawk valley is also marked by an eroded surface thus producing an unconformity between the Tribes Hill and the overlying Black River-Trenton. Thus the Chazy is absent from this part of the State and during Chazy time the land must have been above water and suffering erosion. This fact is especially significant with reference to the Broadalbin sheet because the Tribes Hill, though doubtless originally present in considerable amount, has been almost, if not completely, removed during this erosion period so that with the inauguration of Black River-Trenton time those limestones were deposited directly upon the Little Falls dolomite.

BLACK RIVER–TRENTON LIMESTONES

As a result of recent changes in the nomenclature of the Lower Paleozoic formations of northern New York, the term "Black River" is no longer applied to a single limestone formation but rather to a group of three formations. The Black River group, as now recognized by the Survey, comprises the Lowville, Watertown, and Amsterdam limestones and of these only the Lowville and Amsterdam limestones appear to be present in the lower Mohawk valley. The missing Watertown corresponds to the well known Black River limestone of the Black River valley. Because of the thinness and small areal extent of the Black River-Trenton limestones they are shown together on the accompanying geologic map.

Lowville limestone. The Lowville (former "Birdseye") formation is commonly present within the map limits, but it is never more than a few feet thick. The following description of this limestone by Darton[1] for the Mohawk valley well applies to the Broadalbin district: "The Birdseye is in greater part an impalpably fine-grained, light dove-colored limestone more or less filled with dark-colored, vertical, columnar fucoidal stems. It weathers to white or a light ash gray tint, which is an especially characteristic feature. Owing to its very fine grain and compact structure its fracture is smooth or conchoidal and the texture of the rock is rather brittle. The ends of the dark fucoidal stems which are spotted over the surface of the bedding planes resemble birds' eyes, and from this feature the [old] name of the formation is [was] derived. It is in moderately heavy, regular beds and has a vertical cleavage [jointing]." The so-called fucoidal stems have, in recent years, been referred to the genus Tetradium of the branching corals. Within the map limits these stems are replaced either by calcite or sandy clay and are not always present.

The Lowville is well exposed at two points on Kennyetto creek two miles east of Broadalbin where a few feet of the typical rock may be seen in layers less than a foot thick and containing rather imperfect coral stems. In the vicinity of Kegg's quarry, east of Cranberry Creek, the rock is well developed showing a thickness of a few feet of dove-colored, very compact limestone with many large, yellowish, vertical coral stems. Near the limekiln these beds are seen to alternate with dolomitic beds which bear a close resemblance to the Little Falls dolomite. Similar alternating beds are also shown close to the map edge east of Mayfield. Along the eastern border of the Black River-Trenton area at Galway the Lowville is thinly present but the exposures are not so good. In a quarry beyond the map limit and two miles south-southeast of Perth several feet of typical Lowville beds are exposed.

The Lowville is always thin (generally under ten feet) in the

[1] 47th An. Rept. N. Y. State Mus. p. 616.

lower Mohawk valley and is sometimes absent altogether, as at Canajoharie. Around Little Falls the thickness is from twenty to twenty-five feet, while in the Black river valley it shows a thickness of fifty or sixty feet and is always present and characteristically developed.

Amsterdam limestone. The Amsterdam limestone, though generally under ten feet in thickness, appears to be very persistent over the region and is usually easily recognizable both faunally and lithologically. It comprises chiefly the pure, massive, gray, crystalline limestone which has been so much quarried in the district and which directly underlies the very typical Trenton. This massive limestone apparently continues eastward across the Saratoga sheet and to Glens Falls where it is quarried as marble. The relation to the Trenton is finely shown in Christie's quarry (at the map edge) one-half of a mile east of Mayfield where three feet of heavy bedded Amsterdam limestone is in contact with the Trenton. In the Haines quarry (off the map) north of Mayfield fine large specimens of the characteristic columnar coral (Columnaria alveolata) occur in the Amsterdam limestone.

Within the quadrangle good outcrops of the Amsterdam occur along the fault east of Mayfield; in quarries one and three-fourths miles southwest, three-fourths of a mile east, and two miles north-northeast of Cranberry Creek; in a quarry two miles east of Broadalbin; one-fourth of a mile and one and two-thirds miles east, one mile south, and one and one-half miles southwest of Galway. At most of these places the overlying Trenton is shown. At the localities east of Cranberry Creek and Broadalbin the cup coral (Streptelasma) has been noted in the formation.

Trenton limestone. This formation, which is clearly of lower Trenton age, is easily recognizable by its lithologic character and the abundance of its characteristic fossils. It always consists of dark, thin-bedded, irregular, compact limestones with distinct shale partings. The Trenton outcrops at all the localities above cited for the Amsterdam limestone. In addition to these there is an excellent exposure of about fifteen feet of Trenton along the creek at North Broadalbin which is a fine place for collecting fossils. Also in Christie's quarry, at the map edge east of Mayfield, there is an excellent exposure showing three feet of Amsterdam limestone capped by twelve feet of dark, thin-bedded Trenton with distinct shale partings and here, too, is a good place for fossil collecting.

The Trenton attains a maximum thickness of at least twenty feet with the summit not present as shown in the quarry one and two-third miles east of Galway. The contact with the overlying shale is nowhere visible so that any accurate determination of thickness can not be made.

Among the fossils noted in the Trenton limestone of the area are: the coral — Monticulipora (Prasopora) lycoperdon (Say); crinoid segments; bryozoa; brachiopods — Orthis (Dalmanella) testudinaria (Dalman) and Rafinesquina alternata (Con.) Hall and Clarke; gastropod — Murchisonia bellicincta (Hall); and the arthropod — Trinucleus concentricus (Eaton).

In the Black River-Trenton area south of Broadalbin it is impossible to accurately place the boundary lines because of heavy drift deposits, but this limestone is certainly present here between the Little Falls dolomite on the east and the Canajoharie shale on the west. Along the creek one-half mile north of Vail Mills fragments of Lowville in the drift show nearness to rock in place and in the quarry two miles south-southeast of Perth the rock is exposed.

CANAJOHARIE SHALE

The shales of the lower Mohawk valley have recently been carefully studied by Doctor Ruedemann of the New York Survey and certain important results which have been obtained will be published in a forthcoming paper. Doctor Ruedemann has very kindly given the writer advanced statements regarding the shales of the Amsterdam-Broadalbin region and in a letter dated November 16, 1910 he says: " The real Utica shale is in the lower Mohawk valley underlain by about three hundred feet of black shale that has a different fauna and belongs with the uppermost Trenton. This shale I propose to call from its best outcrop the Canajoharie shale." Heretofore all of the black shale of this region has been called Utica. The shales of the southwestern portion of the Broadalbin sheet, which rest directly upon Lower Trenton limestone, are certainly of Canajoharie age.

The formation consists of dark gray to black, fine-grained, thin and straight bedded shales usually rather calcareous, especially toward the base. The dark color is due to the presence of finely divided and partially decomposed organic matter, though nothing like a workable coal bed is known to exist in the formation.

On the geologic map the only Canajoharie shale area extends from North Broadalbin westward to the vicinity of Munsonville and thence southward to the map corner and represents the northeastern extension of the great shale area around Amsterdam and Gloversville. South of Vail Mills and in the vicinity of Munsonville no outcrops occur because of heavy drift covering, but the presence of underlying shale is proved by the numerous shale fragments in the drift.

Good exposures have been found in the creek just east of Mayfield station; on Kennyetto creek one mile west, one mile northwest, and two miles north of Broadalbin; three miles west-southwest of Broadalbin; at the lower road crossing on Beaver creek; and in the creek just west of North Broadalbin. A mile south of North Broadalbin the Canajoharie and Trenton are almost in contact but the exposures are poor. Along Kennyetto creek, west of Broadalbin, the shale beds are strongly disturbed and show dips up to 25 or 30 degrees in varying directions. This disturbance is doubtless due to proximity to the Broadalbin fault.

Nothing like a complete section occurs within the quadrangle so that the thickness of the formation can not be accurately determined. The summit is nowhere present, but judging by the dip and relation to the other formations there are probably at least one hundred feet of the shales here.

Graptolites are common near the base of the formation, especially along the creek just east of Mayfield station.

UTICA SHALE

The one small area of Utica shale is shown near the southeast corner of the geologic map. Lithologically the Canajoharie and Utica shales are indistinguishable but the recent work of Doctor Ruedemann shows an important faunal distinction based largely upon the graptolites. The thickness of the Utica, within the map limits, can not be determined because only the upper portion is present and this is practically in contact with the overlying Frankfort. The small area of the map is merely a tongue of the great shale area extending for miles eastward. Good exposures occur along the small creek a mile east of Galway. The shale mass here lies against Galway fault no. 1 and close to the fault the strata dip from 25° to 30° southeastward and away from the fault due to the updrag as a result of the displacement.

FRANKFORT SHALE

The Frankfort formation is represented by a single small area on the geologic map and this at the extreme southeast corner where it is sharply faulted against the Little Falls dolomite. The formation consists of alternating thin beds of shale and sandstone, the shale bearing a close resemblance to the Utica and the sandstone layers being dark gray, fine grained and weathering to yellowish-brown. A yellow sandy clay soil is characteristic of the Frankfort area. There is no sharp line of demarkation between the Utica and Frankfort but, in passing upward, the beginning of the sandy layers is taken to mark the base of the Frankfort. Doctor Ruedemann states, in a letter to the writer, that the Frankfort which shows a thickness of about three hundred feet at its type locality swells to a thickness of fifteen hundred feet or over in the lower Mohawk valley.

FAULTS

The Broadalbin quadrangle is of unusual interest because of the number of well-defined faults. They belong to the well-known series of the Mohawk valley although several of the faults within the quadrangle are here described for the first time. All are of the normal or gravity type with displacements usually ranging from about one hundred feet to over fifteen hundred feet. So far as can be determined the hade is always very steep if not vertical and with but two or three exceptions the strike is north-northeast. The topography of the district is largely dependent upon the faulting. The age of the faults is not precisely known but they are usually considered to have been formed during the great Appalachian revolution which so profoundly affected the physiography of the eastern United States, producing the Appalachian mountains and causing a general uplift, above sea level, of the Paleozoic sediments in New York State.

THE NOSES FAULT

From the standpoint of both length and amount of displacement this is one of the two greatest Mohawk valley faults. Where it crosses the Mohawk river, near Yosts or about five miles below Canajoharie, a picturesque gorge has been cut through the uplifted Little Falls dolomite. The sharp high cliffs along the fault and on opposite sides of the river have given rise to the name "Noses." According to the measurements of Prosser and Cumings[1] the thick-

[1] 15th An. Rept. N. Y. State Geologist, p. 643-44.

Plate 7

W. J. Miller, photo

A portion of the "Noses" fault scarp as shown by Buell mountain two and one-half miles west of Northville. The Little Falls dolomite, lying at 800 feet, is sharply faulted against the syenite of the mountain which rises to 2020 feet. View taken from the south end of Gifford valley.

ness of the formations at this point shows that the displacement is at least five hundred feet. The fault line is not straight but its general course is northward to northwestward from the Mohawk river to where it cuts across the northwestern corner of the Broadalbin quadrangle. This fault has been traced for a distance of at least thirty miles.

The Noses fault enters the sheet two and one-half miles north-northeast of Mayfield from which point it strikes north-northeast along a fairly straight line through Gifford's valley and thence off the map. The upthrow side is on the west. Because of heavy drift piled against the fault scarp the fault plane is at no point visible, but the line of fracture can be pretty accurately traced. Every evidence points to a very steep if not vertical fault plane. A good idea of the amount of displacement may be obtained in Gifford's valley where the base of the Little Falls dolomite is sharply faulted against the Precambric under Buell mountain. The base of the dolomite here lies at an elevation of 800 feet, but there are something like 200 feet of Paleozoics below the dolomite so that the Precambric surface is about 600 feet above sea level. On top of Buell mountain the Precambric lies at 2020 feet which makes a difference of 1420 feet in elevation of the Precambric on opposite sides of the fault, all due to faulting. If we add the unknown thickness of Precambric eroded from the mountain top since the faulting occurred we get a total displacement of the fault here of at least 1500 feet. The dolomite beds dip toward the fault plane at angles of from five to twenty degrees and this is quite the reverse of the updrag effect in the shales along this fault west of Johnstown as well as along most of the Mohawk valley faults. A small but very distinct fracture, which appears to be a branch of the main fault, runs through Gifford valley. This fault is clearly traceable by means of the topography and by the brecciated zone, and although its throw could not be exactly determined, it is probably not over fifty feet. It downthrows to the east.

The presence of this little outlier of Paleozoics in Gifford valley is due to the fact that the sediments have been sharply faulted against the base of the mountain and have thus been protected against entire removal by erosion since the faulting.

On the divide, about a mile south of Gifford valley, the throw of the Noses fault has diminished by two or three hundred feet. Two miles south of the valley a small wedge of the Theresa formation lies against the fault plane. West of Cranberry Creek the base of the dolomite comes against the fault at about 800 feet elevation which means that the Precambric rock surface on the east side of the fault lies at an altitude of something like 600 feet. But the Precambric just west rises to 2140 feet so that the amount of displacement is here at least 1540 feet.

JACKSON CREEK FAULT

One and one-half miles west-northwest of Cranberry Creek a fault, apparently a branch of the Noses fault, strikes southwest through the Precambric and has its upthrow side on the west. It has been traced for two miles as a distinct topographic feature and by occasional outcrops of brecciated Grenville. Such brecciated Grenville is beautifully exhibited where the fault runs parallel to the private road near the map edge. This fault probably joins the Noses fault to the east of Jackson summit on the Gloversville sheet.

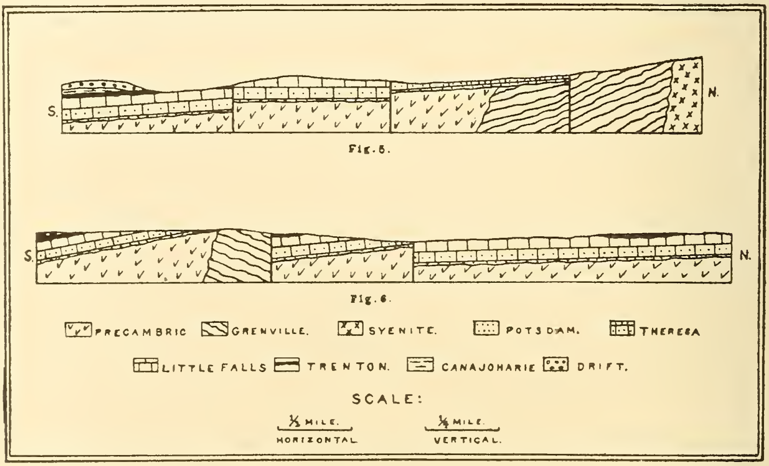

Fig. 5 North south section from a point two miles west of Cranberry Creek to a point one-half of a mile southeast of Mayfield station
Fig. 6 Northeast-southwest section from a point one mile east-northeast of Cranberry Creek to a point one and one-half miles due north of Mayfield

ROBERTS CREEK FAULT

One and one-half miles west of Cranberry Creek another distinct fracture branches off the Noses fault. It strikes a little east of south and can be traced for about two miles after which its course is uncertain. The upthrow side is on the west which accounts for the presence here of the tongue of Grenville gneiss extending out from the main Precambric area. Potsdam sandstone rests upon the Grenville on the west side and this is followed by the Theresa formation which, on the Gloversville sheet, is followed in regular order by the Little Falls dolomite, Black River-Trenton limestone, and Canajoharie shale. These strata all show a dip of several degrees westward due to the faulting. On the downthrow side a wedge of Black River-Trenton limestone is faulted against the Grenville, this limestone in turn being followed in regular order (downward) by the Little Falls dolomite and Theresa formation. The displacement, where the section (fig. 6) crosses the fault, is about four hundred feet.

SACANDAGA PARK FAULT

This, the most important branch of the Noses fault within the quadrangle, leaves the main line of fracture at a point about one and one-half miles southwest of Sacandaga Park. The place of divergence is wholly obscured by drift but the fault, which strikes north-northeast, is readily traceable along the eastern foot of the ridge of porphyritic granite at Sacandaga Park, thence through the western edge of Northville and along the eastern foot of the high hills north of Northville. The upthrow side on the west consists wholly of the various Precambric formations as shown on the map. The downthrow side, so far as can be determined, consists of Little Falls dolomite, but heavy drift completely conceals all Paleozoic rocks near the fault. The nearest outcrops are dolomite, such as those on the western side of Bunker hill (along the railroad) and in the little creek at the southeast edge of Northville. The best evidence to show the character of the rock on the downthrow side close to the fault comes from a deep well along the river at the west edge of Northville. This well was drilled to a depth of several hundred feet and the first rock struck is reported to have been a limestone which is doubtless the Little Falls dolomite. The displacement of the fault has not been accurately determined, but, comparing the altitudes of the Precambric rock on opposite sides, it must be at least five or six hundred feet.

MAYFIELD FAULT

This is a small fracture which can be distinctly traced from a point just northeast of Mayfield for one and one-half miles along a north 70° east strike. It probably passes through the northern part of Mayfield village but is there drift covered. The fault plane is almost vertical and the scarp is much more clearly shown in the field than on the map. The upthrow side is on the north and consists of Little Falls dolomite which, near the fault, contains white chert and is more or less broken. Dolomite also makes up the downthrow side except for a long narrow wedge of Trenton limestone with more or less Lowville limestone. This limestone wedge, which is never over seventy-five yards wide, is badly broken and shows varying dips. The Little Falls dolomite here shows a thickness of about one hundred and fifty feet and, at the map edge, the Trenton is sharply faulted against its base so that the displacement is approximately one hundred and fifty feet. This fault seems to cross the Roberts creek fault at right angles near the railroad but the relations are here wholly uncertain because of heavy drift.

CRANBERRY CREEK FAULT

This interesting dislocation runs nearly parallel to the Noses fault, the writer having traced it with considerable certainty along a north-northeast strike from a point about one mile north-northeast of Mayfield, past the village of Cranberry Creek, to a point about one and one-half miles south of Sacandaga Park. Its northern extremity is obscured by drift. Between Cranberry Creek and Mayfield the relations are somewhat complicated because of the Roberts creek cross fault which causes the upthrow side to be now on one side and now on the other, due to tilting of the strata during the adjustment of the earth blocks and we have here a fine illustration of pivotal faulting.

One mile north-northeast of Mayfield the upthrow is on the east with lower Little Falls dolomite (containing chert) faulted against upper dolomite. Fault breccia is here shown and the throw of the fault must be something over one hundred feet. A mile farther northwestward the dolomite comes against the Grenville so that here the upthrow side is on the west with an amount of throw probably in the neighborhood of two hundred feet. Just after crossing the Roberts creek fault the relation is again changed and the upthrow is on the east because of the wedge of Black River-Trenton on the west side. Where the fault crosses Jackson creek the relation changes again so that the upthrow side is on the west. This is shown by the small area of the Theresa formation. From here northward the upthrow continues on the west. Where the fault crosses Cranberry creek the strata are disturbed and good exposures of the cherty beds of the lower Little Falls dolomite are seen on the upthrow side. From a point about a mile north of

Cranberry Creek village the fault is clearly traceable as a topographic feature and by frequent outcrops of fault breccia. On the west side of Bunker hill a small mass of Trenton limestone is faulted against lower (cherty) beds of the dolomite so that the amount of displacement is here approximately represented by the thickness of the dolomite formation or about two hundred feet.

NORTHVILLE FAULT

This fault passes through the depression just east of the village of Northville. Its strike is nearly north and south and the upthrow side is clearly on the east. The relations are well shown at only one point and this is along the creek at the southeastern edge of the village. Here are exposed about twenty-five feet of horizontal, cherty Little Falls beds, the rocks being considerably broken or brecciated. Within two hundred yards eastward and on the hillside are large outcrops of Precambric. Immediately to the north and to the south of these Precambric ledges, Potsdam sandstone outcrops close to the fault on the upthrow side. Three-fourths of a mile south of these Precambric ledges the Theresa formation is well shown on the upthrow side.

This fault probably connects with the Sacandaga Park fault in the depression north of Northville but the relations are wholly obscured by drift. The amount of the dislocation at the southeast edge of the village is probably about two hundred feet since the lower dolomite is there faulted against the Precambric.

BUNKER HILL FAULT

This fault, showing a strike of north 40° east, passes across the top of Bunker hill and has its upthrow side on the east. Where it crosses the road on the hill, Potsdam sandstone is exposed in a large quarry and shows a dip of 10° toward the southeast. To the east and south of the quarry no outcrops were found but the passage beds of the Theresa formation are thought to come in as shown on the map. Within a few hundred yards to the west of the quarry upper dolomite and Trenton limestone are exposed. Since the Potsdam is brought up to the level of the Trenton, the amount of displacement must be measured by the combined thickness of the Little Falls and Theresa formations which here are approximately three hundred feet. This fault is probably only a southward extension of the Northville fault but the utter lack of outcrops across the river makes it impossible to positively connect the two. Southwest of Bunker hill the course is purely conjectural but it may connect with the Cranberry Creek fault as shown on the map.

BATCHELLERVILLE FAULT

The Batchellerville fault is here described for the first time, and considering the boldness of topographic form due to the faulting it is not a little surprising that earlier observers have not called attention to it. From the standpoint of amount of displacement, and possibly also of length, this fault takes rank as one of the greatest along the southern border of the Adirondacks. The upthrow side is on the east and this is of particular interest because we have here by far the greatest of the few Mohawk valley faults which show upthrow on the east side.

From a point two and one-half miles southeast of Northampton the fault is clearly traceable northward along the base of Bald Bluff where it gradually changes strike to the north-northeast and then passes on a nearly straight line along the base of the mountain through Batchellerville and to the map limit. The northern extension of the fault has not been investigated but it certainly runs some two or three miles beyond the map. The southern extremity of the fault is completely drift covered so that the relations there are not well shown. In spite of the fact that the actual fault plane is everywhere talus or drift covered it can be pretty accurately mapped.

Except for a small area to the north, the upthrow side consists of a great block of Grenville gneiss which everywhere dips at angles of from 15° to 30° away from the fault. Close to the fault on the downthrow side, east of Northampton, there are no actual outcrops but the numerous drift fragments make it quite certain that the Theresa transition beds are present as shown on the map. From Bald Bluff northward all the available evidence points to the presence of Little Falls dolomite on the immediate downthrow side except possibly near Batchellerville where the Potsdam or passage beds from the vicinity of Edinburg may reach across the river. The dolomite, which outcrops at several places along the western side of the river, always dips at a low angle toward the fault. On the mountain side, just above the feldspar mine (two and one-half miles north-northeast of Batchellerville) fault breccia indicates minor fracturing which most likely accompanied the major faulting.

The amount of dislocation may be fairly well determined by comparing the altitude of the Precambric on each side of the fault.

Plate 8

W. J. Miller, photo

The Batchellerville fault scarp as seen toward the northeast from Northampton. The crest of the scarp is about 1000 feet above the valley.

The crest of the Grenville fault block, between Bald Bluff and Batchellerville, rises to eighteen hundred feet or over within a mile of the fault. On the downthrow side the Little Falls dolomite lies at an altitude of seven hundred feet but the Precambric is buried under the Potsdam and Theresa formations and a part of the dolomite. The thickness of these formations here is not exactly known but to say that the Precambric near the fault is buried three hundred feet is approximately correct. This means that the Precambric on the downthrow side is now at an altitude of four hundred feet or fourteen hundred feet lower than that on the upthrow side. Thus if we allow for even a small amount of erosion along the crest of the fault-block, the displacement is in the neighborhood of fifteen hundred feet.

A feature of interest in connection with this fault is the rapid diminution of throw along the southern portion. On the western side of Bald Bluff the throw reaches nearly its maximum, while, in spite of the heavy drift, it is certain that the fault has completely disappeared within two or three miles southward.

EDINBURG FAULTS

The faults here described are named from the fact that they occur in the town of Edinburg and near the village of the same name. The writer is indebted to Mr J. W. Latcher of Edinburg for assistance in locating certain important outcrops in this vicinity. That at least two dislocations occur approximately as shown on the map is quite certain, but very accurate work is impossible because of the deep drift and scarcity of exposures.

Of these two faults the more prominent one follows along the eastern base of Fraker mountain (Stony Creek sheet) and thence strikes nearly southwest to cross Butler creek about one mile west of Edinburg. Farther southward the region is heavily drift covered. North of Fraker mountain the fault has not been studied. The upthrow side is on the west and the Grenville, in great ledges, forms a pretty distinct fault-scarp. Heavy drift almost completely conceals the downthrow side but the rock appears to be chiefly Little Falls dolomite. A good dolomite outcrop occurs just below the road crossing on a little creek near the map edge and two and one-half miles north-northeast of Edinburg. This rock dips slightly eastward and is within one-third of a mile of the fault at the base of Fraker mountain. The thickness of the Paleozoics here is probably in the neighborhood of two hundred feet which means that the

Precambric surface lies at about five hundred feet. The Precambric on the west side (Fraker mountain) of the fault rises to over fifteen hundred feet so that, disregarding subsequent erosion, the amount of displacement near the map edge is approximately one thousand feet. Dolomite was formerly exposed near the road one mile northeast of Edinburg. Black shale fragments may be seen along the road one-half mile north of Edinburg and this suggests that shale may now exist under cover of the drift or a small shale mass may have been completely removed by ice erosion.

The second and much smaller fault passes just north of Edinburg and strikes a little to the north of east. Its exact location and relations are rather obscure, except that the upthrow side is on the south and at the village are excellent exposures of Potsdam sandstone dipping toward the southeast.

HOFFMAN'S FERRY FAULT

This has long been known as one of the greatest Mohawk valley faults and as usual the upthrow is on the west. Just north of Hoffman's Ferry (on the Mohawk river) the displacement is estimated at 1300 feet by Cumings[1] and at 1600 feet by Prosser.[2]

Where this fault enters the Broadalbin quadrangle, one and three-fourths miles southwest of Galway, Black River-Trenton limestone may be seen sharply faulted against the upper portion of the Theresa formation and the amount of displacement is estimated at two hundred and fifty feet. The limestone is in the form of a narrow wedge crowded against the fault plane and showing varying dips. One-half of a mile west-northwest of Galway lower dolomite beds containing chert are faulted against lower beds of the Theresa formation and the displacement is about equal to the height of the hill here, or two hundred feet. East of North Galway the dolomite comes against the Precambric so that the displacement is about two hundred and fifty feet. [*See* fig. 7.] The occurrence of the small separated masses of Precambric against the fault in this vicinity is due to the faulting and later erosion of the scarp. A mile north of Mosherville Potsdam sandstone outcrops in the creek with Precambric a little to the north. The relations of the fault are here not clearly shown but judging by the elevation of the Precambric just to the north, the throw is probably in the

[1] N. Y. State Mus. Bul. 34, p. 450.
[2] *loc. cit.* p. 476.

neighborhood of two hundred feet. This fault continues on a north-northeast course across the Saratoga sheet toward Corinth. The throw increases northward until, in the town of Corinth, it reaches a thousand feet or more.

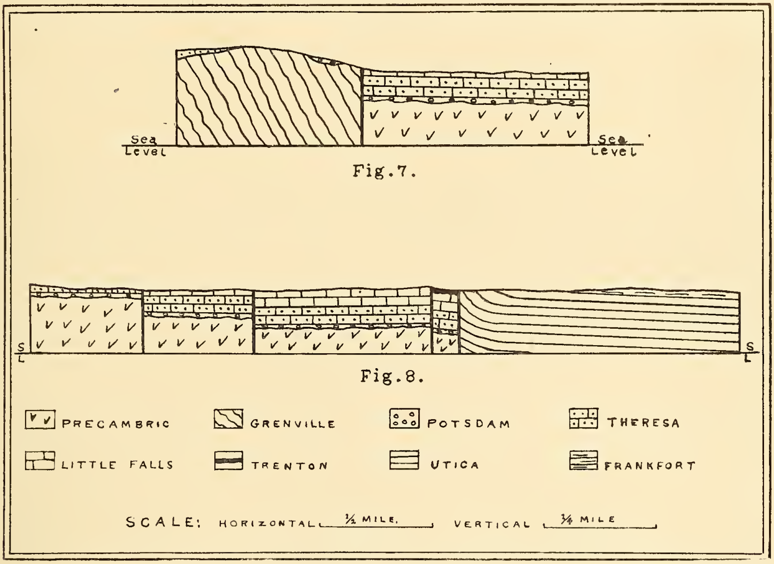

Fig. 7 Northwest-southeast section across the Grenville tongue and the Hoffman Ferry fault three-fourths of a mile east of North Galway

Fig. 8 Section passing through Parks Mill and to a point at the map edge two miles east-southeast of Galway

GALWAY FAULT NO. I

According to the geologic map of the Amsterdam quadrangle this important fault is a branch of the Hoffman's Ferry fault. It enters the Broadalbin sheet one and one-fourth miles south of Galway and, after continuing northwesterly for two and one-half miles, leaves the map one and two-thirds miles east of Galway. The upthrow side is on the west. South of Galway Frankfort shales are faulted against upper Little Falls dolomite. Thus the displacement must be measured by the combined thickness of Black River-Trenton limestone, black shale, and a small portion of the Frankfort. In the vicinity of Amsterdam the black shale is from twelve hundred to fourteen hundred feet thick and although it is probably less here the displacement of the fault no doubt is more than one thousand feet.

East of Galway a small fracture branches off on the north side and in about a mile again joins the main fault. A well-defined block of Black River-Trenton limestone is included between the main fault and this branch and where the branch crosses the road near the four corners the fault plane is exposed showing Trenton in contact with dolomite. On the downthrow side of the main fault here Utica black shale comes against the Black River-Trenton and the shale dips 25 degrees away from the line of fracture due to updrag during the faulting [*see* fig. 8].

GALWAY FAULT NO. 2

This is another branch of the Hoffman's Ferry fault which enters the sheet one and one-third miles south-southwest of Galway; passes through the eastern edge of the village of Galway; and leaves the map two-thirds of a mile east-southeast of Parks Mill. About a mile still farther eastward it seems to join Galway fault no. 1. The upthrow side is on the west and from Galway southward a large wedge of Black River-Trenton limestone is faulted against the dolomite. The amount of throw is not definitely known but at Galway it is quite certainly under one hundred feet. The relations are well shown near the schoolhouse in Galway village. Where the fault leaves the map the Little Falls dolomite comes against the Theresa formation and the throw has increased to over one hundred feet.

About a mile northeast of Galway a small branch fracture strikes north-northeast through Parks Mill and then dies out rapidly. The fault plane is exposed in the bed of Glowegee creek where the lower dolomite beds (with chert) are in contact with the passage beds of the Theresa formation.

BROADALBIN FAULT

The Broadalbin fault strikes northeast-southwest along a very straight line past the northern edge of the village of Broadalbin, and is one of the few Mohawk valley faults with upthrow on the east side. The fault plane is nowhere visible but the outcrops are so distributed as to permit fairly accurate mapping. The downthrow side is entirely of Canajoharie shale which outcrops near the fault one and one-half miles west, and in the creek three-fourths of a mile north, of Vail Mills; and one mile south of North Broadalbin. In large outcrops west and northwest of Broadalbin the shale beds are considerably tilted. On the upthrow side the Little Falls dolomite is exposed at only one place, three-fourths of a mile west of Broadalbin. In the village, however, the dolomite was struck under thirty feet of drift in a well on the Husted place. A mile south of North Broadalbin Trenton and Canajoharie outcrop close together. Where the fault crosses Kennyetto creek numerous fragments of the Trenton and Lowville limestones make the presence of these formations almost certain here. The southward extension of the fault is completely drift covered but it probably disappears near the map edge. Northward it has disappeared before reaching the point one mile south of North Broadalbin where Trenton and Canajoharie are in normal position. Just west of Broadalbin the dolomite lies about sixty feet above the Canajoharie shale and to this must be added the whole thickness of Black River-Trenton limestone and an unknown thickness of shale in order to give the amount of dislocation. Darton estimates the throw here at two hundred feet and it is quite certainly not more than this.

TROUGH FAULTING

The Batchellerville and Noses faults run approximately parallel and are about six or seven miles apart, the great escarpment of Precambric rock of the one fault facing the equally great escarpment of the other. In other words we have here a fine illustration of trough faulting, the whole country between the Batchellerville and Noses faults being a great depressed block much of which now lies fully one thousand feet below the level of the scarps on either side. A glance at the Broadalbin sheet will show the extent of this fault block which occupies at least seventy-five square miles or all of the region between the following points: Three miles north of Batchellerville; two and one-half miles northwest of Northville; two miles west of Mayfield; and two miles southeast of Northampton. On the State geological map the deep indentation caused by the northward extension of the Paleozoic rocks to Northville roughly corresponds to this depressed block, although recent mapping by the writer shows that the Paleozoics should extend at least six or eight miles farther northward along the Sacandaga river. This great trough block is not perfectly simple because, on the west side especially, a number of minor fractures have considerably modified it and some of these minor faults are so arranged, as at Northville, that small trough fault blocks are included between them.

Eastward from the great trough block and lying between the Batchellerville and Hoffman's Ferry faults is a great upraised block (horst) of Precambric rock covering at least one hundred square miles and including all of the high country in the northeastern portion of the Broadalbin and the northwestern portion of the Saratoga quadrangles. It comprises the large tongue of Precambric rock shown on the State geologic map between Saratoga Springs and Northville.

The profound influence of trough faulting upon the topography in this region strongly suggests the occurrence of similar phenomena well within the Adirondacks. As Professor Cushing stated several years ago, the topography of the eastern Adirondacks often suggests faulting of this sort but positive proof has heretofore failed. The finding of such a large and clear-cut trough fault at the southern margin of the Precambric area greatly strengthens the belief that faulting of this kind has had an important influence upon the topography of the eastern Adirondacks.

PHYSIOGRAPHY

PRECAMBRIC PHYSIOGRAPHY

During Grenville times the physiography was very simple, the whole Adirondack region being covered by ocean water and receiving an immense accumulation of sediments. Then came a time of intrusion of tremendous igneous rock masses into the Grenville. The whole region was uplifted some thousands of feet above sea level. We have no knowledge of the character of the topography of this land mass when it was high above the sea, but we know that it underwent erosion for a vast length of time extending into the early Paleozoic era.

PALEOZOIC PHYSIOGRAPHY

It is certain that, during the Lower and Middle Cambric, the Adirondack region was above water and suffering erosion because Lower and Middle Cambric strata are everywhere absent from the region and there is not the slightest evidence that they ever were present. During the long Prepotsdam time the ancient Adirondack land mass had become worn down to the condition of a peneplain or almost smooth surface and the Potsdam (Upper Cambric) sea encroached from the northeast upon this peneplain during its gradual subsidence. By the work of Kemp, Smyth, Cushing, and the writer it is now known that the surface of this peneplain was more or less uneven, the greatest unevenness being along the northeastern border of the Adirondacks and the smoothest surface along the southwestern border. The smoothest surface on the southwest is just what would be expected because that region was longest a land surface, thus affording opportunity for cutting away nearly all irregularities. Within the Broadalbin quadrangle all but a few miles of this ancient shore line have been lost to view due to the extensive faulting and the portions not thus faulted out are most heavily drift covered. However, certain phenomena are very clearly exhibited, especially between Barkersville and North Galway, and give us important additional information for the southern Adirondacks.

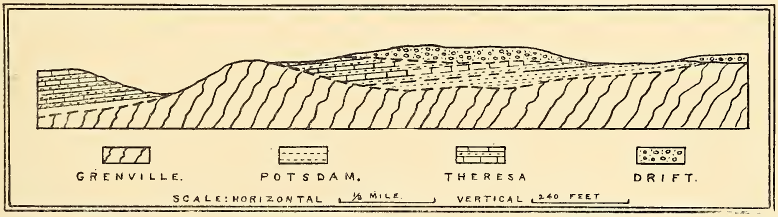

Fig. 9 Section passing from a point two-thirds of a mile south of Barkersville south-southwestward through North Galway. The overlap of the Theresa transition beds upon the Precambric hillock is clearly shown

In the vicinity of North Galway the evidence is conclusive that the Precambric surface on which the Potsdam was deposited was fairly uneven. The tongue of Grenville quartzite which extends out so prominently here is very significant because the same quartzite stood out as a ridge in the shallow Potsdam sea and was never covered with Potsdam sandstone or conglomerate. So far as can be determined the Potsdam is wholly absent around this Grenville tongue except along the east side of the southern border where it is entirely represented by the coarse conglomerate. Elsewhere the passage beds of the Theresa formation rest directly upon the Grenville, thus overlapping the Potsdam. This feature is perhaps best shown along the road three-fourths of a mile northeast of North Galway where the passage beds are practically in contact with the Grenville and show a low southwesterly dip. [*See* fig. 9.] On the south side of the Grenville tongue the passage beds show a southwesterly dip of three or four degrees. The sandstone, and even limestone, layers close to the Grenville contain quartz pebbles up to one-half inch in diameter which were derived from the Grenville and deposited in the encroaching sea. The Grenville here certainly projects upward as much as fifty feet into the passage beds which means that, at the height of the Potsdam sea, this Grenville rose fully fifty feet above sea level. If we add to this the

4

thickness of the Potsdam sandstone as shown in the nearby areas, it seems clear that this Grenville mass must have risen fully seventy-five feet above the surrounding country (peneplain) just before Potsdam submergence. About two-thirds of a mile south-southwest of North Galway the passage beds are practically in contact with the Precambric so that we have here another, but smaller, hillock. The relations are not so well shown around the Grenville area on the west side of the Amsterdam reservoir but doubtless this, too, represents a low knob which rose above the general level of the peneplain. The locations of these knobs or hillocks have no doubt been largely determined by the very hard and resistant character of the quartzite which, of all the Grenville rocks, would stand out longest against atmospheric action prior to, and wave action during, Potsdam submergence.

North of Barkersville the mapping suggests an uneven surface but positive evidence was not found. In the small Potsdam area just east of Northville the beds are practically horizontal and they appear to occupy a depression in the Precambric but, because of nearness to the fault, the amount of unevenness can not be satisfactorily determined. Elsewhere within the quadrangle the character of the Precambric surface can not be studied.

During the early Paleozoic there were certain minor oscillations of level (already referred to) when at times the region was a low lying land area undergoing erosion. For most part, however, the whole district was under water and remained so until after the deposition of all the Paleozoic sediments when a great uplift, without folding but with some tilting of the strata, brought the whole Adirondack region (then mantled with sediments) well above the water. This uplift probably occurred at the close of the Paleozoic era. The simple elevation of this ocean bottom would have given rise to a comparatively smooth and featureless topography, but it is generally considered that the faulting of the eastern Adirondacks accompanied the uplift. As Cushing says:[1] "The forces which folded the region to the eastward affected the Adirondack district but slightly and the rocks are not folded. But in the reaction of the region from compression, tension faulting took place on a large scale, and its eastern portion was sliced by a series of meridional faults which cross it." According to this the topography of the Broadalbin district was that of the uplifted sediments which were greatly dissected and increased in ruggedness by the faulting.

[1] N. Y. State Mus. Bul. 95, p. 421–22.

POSTPALEOZOIC PHYSIOGRAPHY

In the northern Appalachians and in southern New England the great areas upraised at the close of the Paleozoic underwent vast erosion during the Mesozoic era so that by its close the well-known Cretaceous peneplain had been developed. There is considerable reason to think that this Cretaceous peneplain was developed more or less perfectly over the Adirondack region although there is no evidence in favor of this view within the Broadalbin quadrangle itself. Granting the presence of this peneplain, the topography of the Broadalbin district must have been rather smooth and featureless with the fault scarps practically removed by erosion.

This great peneplain was elevated about the close of the Mesozoic era and thus the region of the Broadalbin quadrangle was rejuvenated and the revived streams vigorously renewed their work of erosion which has continued to the present time. The present topography of the quadrangle, except for the local glacial deposits, is the result of this long period of erosion and most of the faults have again been made prominent as topographic features by the unequal erosion of the harder and softer rocks on opposite sides of the faults.

The detailed topography of the district has, of course, been quite appreciably affected by the distribution of glacial drift.

PRESENT SLOPE OF THE PRECAMBRIC SURFACE

The extensive faulting has precluded the possibility of studying the slope of the Precambric surface except in a limited way in the southeastern portion of the quadrangle. At Barkersville the Precambric surface clearly slopes southwestward at the rate of over one hundred feet per mile. From just north of Barkersville to the north end of the Amsterdam reservoir is about four miles and the difference in elevation of the Precambric is fully four hundred feet so that the general slope southwestward along this line is at least one hundred feet per mile. Similar results have been obtained by Professor Cushing and the writer in the Little Falls and Trenton Falls districts and also two or three miles northwest of Saratoga Springs. Thus we see that a southwestward slope of a little over one hundred feet per mile of the Precambric surface under the Paleozoics appears to be general along the southern Adirondacks.

One-half of a mile south of Round lake the Precambric lies at about 1550 feet while just north of Barkersville, and three miles distant, it lies at 1250 feet thus giving a southwestward slope of 100 feet per mile where the Precambric is not now covered by the Paleozoic. The slightly lessened slope in this case has been due to a reduction of level by erosion since the removal of the Paleozoic sediments. The Hoffman's Ferry fault may have somewhat affected the Precambric slope here but more than likely not enough to make any material difference in the result. In other portions of the quadrangle the faults have so affected the slope that any results are unsatisfactory.

DRAINAGE OF THE QUADRANGLE[1]

Sacandaga river. As a result of the Ice age the drainage of the quadrangle, including the four largest streams, has been very notably affected. The most striking change has taken place in the course of the Sacandaga. This river, after emerging from the Adirondacks, enters the Paleozoic lowland between Northville and Northampton and at the latter place turns back sharply (north-northeastward) on its course past Batchellerville and Day and then across a divide in the Precambric at Conklingville soon to enter the Hudson at Luzerne. It is certain that, before the Ice age, the Sacandaga river continued southward from Northville and was tributary to the Mohawk. Its preglacial channel doubtless passed between Broadalbin and Mayfield, because here the Paleozoic rocks are the lowest within the quadrangle. That the course past Conklingville is postglacial is proved by the gorge at that village; the almost imperceptible gradient of the river between Northampton; and by the perfectly aggraded character of the river channel between the two villages just named. The remarkable deflection of the course of this river was due to the great accumulation of glacial drift, especially in the interlobate moraine, acting as a dam across the southern portion of the Broadalbin sheet. The deflection was aided by the presence of the deep trough of the Batchellerville fault and also probably by a comparatively low preglacial divide at Conklingville.

According to borings for a dam site made by the New York Water Commission in the bed of the river at Conklingville, rock was not struck within two hundred feet. If the channel is thus drift filled it clearly means that the rock channel was cut prior to the last ice invasion. This seems to imply at least one earlier advance and retreat of the ice over the region since it is pretty cer-

[1] See paper by writer entitled Preglacial Course of the Upper Hudson River, in Geol. Soc. Am. Bul. 22:177-86.

tain that the river did not occupy this course in preglacial time. It would seem that the river channel which may have been cut during an interglacial epoch was drift filled during the last ice invasion

Fig 10 Sketch map showing the principal preglacial drainage lines of the Broadalbin quadrangle

and that the river has not yet removed this filling. This whole question, however, needs to be more carefully studied.

Kennyetto creek. The peculiar course of this stream has already been referred to. After flowing southwestward for many miles to

Vail Mills it turns back on itself by making a sharp swerve northward and then northeastward to empty into the Sacandaga river. The course of Hans creek is similar though not quite so striking. In preglacial time these streams were doubtless tributary to the Sacandaga when it flowed southward into the Mohawk (*see* figure 10). The accumulation of drift across the southern border of the quadrangle, which caused the northeastward deflection of the Sacandaga, also caused a deflection of Kennyetto and Hans creeks by forcing them to flow northward down the slope of the great drift dam (interlobate moraine).

Mayfield creek is postglacial in origin and has come into existence by finding a northeasterly channel down the slope of the morainic belt.

Batchellerville creek. During preglacial time the Batchellerville fault trough had in it a considerable stream (Batchellerville creek) which flowed south-southwestward, past Batchellerville and Northampton, as a tributary of the Sacandaga. The filling up or aggrading of this preglacial channel during the Ice age and the deflection of the Sacandaga northward through this filled channel affords a fine illustration of complete reversal of drainage.

Lake Sacandaga. Immediately after the final disappearance of the great ice sheet from this region, all of the present river flat area as well as the area of the great swamp known as the "Vly" were covered by the waters of Lake Sacandaga which has been named and described by Professor Brigham.[1] It is interesting to note that the great Sacandaga reservoir proposed by the State would almost exactly restore what was once a natural lake.

SUMMARY OF GEOLOGIC HISTORY

Because of the variety and complexity of the geologic problems involved it seems advisable to give, in regular order, a summary of the geologic history as exhibited within the quadrangle as well as some idea of the relation of this history to that of the Adirondacks in general.[2] The combination of such a variety of rock formations is due to the favorable situation along the border of the Adirondacks where the Precambric crystalline rocks are overlapped by the unaltered Paleozoic sediments.

The definitely known history of the quadrangle begins with this

[1] N. Y. State Mus. Bul. 121, p. 26.

[2] For this broader outlook upon the subject the writer feels especially indebted to Professor H. P. Cushing who, for many years, has so zealously and ably labored to unravel the intricate history of the Adirondack region.

district, as well as the whole Adirondack region, covered by ocean water. We know this because the most ancient formation, the Grenville, is sedimentary in origin and is abundantly represented, not only within the map limits, but also throughout the Adirondacks and in Canada. We have every reason to believe that the Grenville sediments were sandstones, shales and limestones of the ordinary kinds. Judging by the great but unknown thickness of the formation we are led to the conclusion that the oceanic conditions persisted for a great length of time which must be measured by hundreds of thousands, if not some millions, of years. The Grenville belongs to the most ancient rock group in New York State, or, so far as we know, in the world and, though any attempt to fix its age in years must be very general, it is certain that many millions of years have passed since its formation. The still more ancient land mass from which these sediments were derived and the very ancient ocean bottom upon which they were deposited have as yet not been recognized. That life of some kind was fairly abundant in the Grenville ocean is proved by the presence of graphite which is of organic origin.

After the Grenville sediments were deposited the whole Adirondack region, including the Broadalbin quadrangle, was elevated some thousands of feet above sea level. Tremendous masses of molten rock were intruded into the Grenville just before, during or after the uplift. It is highly probable that the intrusion occurred during the uplift because the force of elevation might also well have pushed the molten masses upward. These igneous rocks are represented within the quadrangle by the syenite and granite. In some cases the Grenville was left practically intact as, for example, the large area on the eastern side of the map; while in other cases it became more or less involved with the molten flood to give rise to a series of varied rocks as illustrated by the Grenville-Syenite areas on the map.

After this igneous activity all of the rocks were severely metamorphosed or changed from their original character by being compressed, folded and converted into gneisses. Thus we explain the gneissic or banded structure of all the rocks and the complete crystallization of the sediments.

Immediately after the great elevation above referred to, the whole land mass began to be eroded and this period of erosion extended over an immense length of time when rock materials of thousands of feet in thickness were removed. This we know because the folded and gneissic structures now at the surface must have been developed at great depth (thousands of feet) below the surface. Judging by the present rate of erosion of rock masses we believe that the erosion period had a duration of at least several million years extending into the early Paleozoic era.

Toward the close of this erosion period minor igneous intrusions occurred, such as are represented by the small dikes of gabbro or diabase of the quadrangle. These rocks are certainly much younger than the rocks already referred to as shown by their occurrence in the form of dikes and by their lack of metamorphism. Their fine-grained texture shows that they were cooled much nearer the surface than were the syenites and granites.

As a result of the vast erosion the whole land mass was worn down to near the sea level and presented only a moderate relief. Then a gradual sinking took place when the sea steadily encroached upon the land and caused a deposition of one layer of sediment (Paleozoic) after another upon the former land surface. The whole area of the quadrangle as well as most, if not all, of the Adirondack region was thus submerged. The deposition of these sediments, largely derived from a wearing away of the sinking land, upon the ancient gneisses has given rise to the profound unconformity now existing between the Paleozoic and Precambric.

The first deposit to form upon the sinking Precambric rocks of the quadrangle was the Potsdam (Upper Cambric) sandstone. The coarse conglomerate and sandstone now seen at the base of the Potsdam literally represents the boulders and sand accumulated along the encroaching shore line those millions of years ago. With a deepening of the water came the deposition of the alternating sandstones and limestones of the Theresa formation and above these the Little Falls dolomite (Upper Cambric).

After the deposition of the Little Falls there was a gentle upward oscillation of the area above sea level so that the Little Falls dolomite suffered erosion. This old eroded surface may be seen throughout the Mohawk valley and marks (by unconformity) the boundary between the Cambric and Ordovicic systems.

Next came a sinking of the land below the ocean surface when the Tribes Hill (Ordovicic) limestone was formed. This was followed by another gentle emergence of the land above the sea when a notable amount of erosion again took place. This emergence and consequent erosion is shown by the distinct unconformity now existing between the Tribes Hill and overlying Black River-Trenton in the Mohawk valley as well as by the practical absence of the

Tribes Hill from the Broadalbin sheet because it was removed during this time of erosion.

Another downward movement brought a return of marine conditions when the Black River-Trenton (Ordovicic) limestones were laid down. The profusion of animal life in the ocean of that time is proved by the abundance of fossils embedded in the rocks of Black River-Trenton age. After this the waters became muddy when the Canajoharie and Utica black shales were deposited and then the alternating sandstones and shales of the Frankfort (Ordovicic). Although the Frankfort is the youngest Paleozoic formation of the quadrangle, it is quite certain that still later sediments were here deposited but have since been removed by erosion.

After Paleozoic sedimentation there was a great uplift, most likely at the close of the Paleozoic era, which raised the region high above the sea level. Thus another vast erosion cycle was established to extend through all the millions of years to the present time. There is no evidence whatever that the region was ever again submerged below the ocean level. The Paleozoic sediments have been completely removed from those portions of the quadrangle where the Precambric rocks are now exposed, while they have suffered great erosion over the Paleozoic area itself.

Postpaleozoic erosion must have been vigorous during the long time of the Mesozoic era and there is good reason to think that, by the close of that era, the whole region was reduced to the condition of a fairly good peneplain (part of the well-known Cretaceous peneplain of the Appalachians) and that at the close of the Mesozoic the peneplain was upraised. According to this the present major topographic features are the result of erosion since this late Mesozoic uplift or rejuvenation of the region.

Another feature of great importance in the history of the quadrangle is the faulting or fracturing of the earth's crust which occurred sometime after the deposition of the Frankfort, since that formation is involved in the faulting. The exact date of this faulting is not known but it probably took place at the time of the great uplift at the close of the Paleozoic.

The most recent event of special interest in the history of the quadrangle was the existence of the great ice sheet during the Glacial epoch. Extensive superficial deposits and rock scorings bear testimony to the vigorous glaciation of the quadrangle. From the geologic standpoint this ice sheet was present only very recently and covered most of New York State.

ECONOMIC PRODUCTS

ROAD METAL

Road metal of good quality is abundant within the borders of the quadrangle. To get the best results a road metal should be homogeneous, hard and possess a good binding or cementing power. Among the Precambric rocks the Grenville is perhaps least valuable because the rocks of that formation are mostly micaceous and the presence of the slippery mica flakes in the crushed stone tends to prevent a proper binding. The porphyritic granite is also not a first class road metal because of the mica content. The syenite, though still little used, should furnish very satisfactory road material since the rock is hard, pretty homogeneous, free from mica, and rich in iron minerals. The iron minerals on decomposition would supply a cement. During the summer of 1910 a large quarry, for State road work, was opened in the syenite along the river road just north of Northville.

By far the best rock in the whole district for road building is the gabbro or diabase which occurs in the small dikes shown on the map. The supply of this rock is not large but enough is available to build many miles of highway. This rock, commonly called "trap rock," is black, hard, very homogeneous and very rich in iron minerals. Its durability and binding power are scarcely surpassed by any other kind of road rock.

Among the Paleozoic rocks the Potsdam sandstone and the passage beds of the Theresa formation are of little value as road metal because of the tendency to crumble under the traffic. The Little Falls dolomite, especially where freest from sand grains, is better adapted for road work. A large quarry in the dolomite has been opened on the George Close farm about one and one-half miles east of Mayfield and on the railroad. The rock is crushed at the quarry and shipped for road metal and is said to be of good quality. Some of the beds here have a pink color and all of the rock is very compact and homogeneous. The Trenton limestone has been considerably used, especially on the State road between Amsterdam and Broadalbin. A large quarry for this purpose was opened in the Trenton about two miles south-southeast of Perth. The rock gives good satisfaction except perhaps that it is too soft.

In the State road work during 1909 glacial boulders or erratics were largely used in the vicinity of Broadalbin. Although fairly good results seem to be obtained with this readily available material, the chief objections are the heterogeneous character of the material and the presence of so much mica which affects the binding power.

BUILDING STONE

Building stone of good quality is common throughout the Precambric areas, but the comparatively slight demand for such stone has prevented any extensive exploitation. One and one-half miles north-northeast of Northville a quarry has been opened in the mixed gneisses. This rock, though called granite, is really a Grenville facies of the mixed gneisses. It is a gray, medium grained rock, rich in feldspar, quartz, biotite, mica and garnet. The rock takes a high polish and has been used in Northville especially for tombstones in the cemetery on the north side of the village.

Building stone of fine quality may be obtained from the Potsdam, especially where the sandstone beds are regular and the cementing material is silica. There is a large quarry in such rock on Bunker hill and the nearness to the railroad affords good shipping facilities. Stone from the Trenton and Little Falls formations has been locally used to a small extent.

LIMESTONE FOR QUICKLIME

An excellent limestone used in the production of quicklime is obtained from the Amsterdam formation. A number of quarries have been opened and in nearly every case this heavy bedded, pure, crystalline limestone just below the Trenton is preferred. The only quarry and kiln now in operation within the map limits is three-fourths of a mile east of Cranberry Creek. This is known as the Kegg quarry. Mr Haines owns two quarries, one just off the map and one and one-half miles north of Mayfield and now in operation, while the other is two miles southwest of Cranberry Creek and temporarily closed.

Other quarries in the Amsterdam formerly worked are: In the small area east of Mayfield; on the west side of Bunker hill; two miles east of Broadalbin; and one and three-fourth miles east of Galway.

On the Beecher farm, one and one-fourth miles north of Northampton, the Little Falls dolomite has been tried for quicklime. This rock is said to make a lime which sets very hard but is objectionable because hot water is necessary for slaking.

FELDSPAR

Although feldspar is the most common mineral among the Precambric rocks it is never likely to become commercially important except in the pegmatite dikes or veins [*see* page 23]. Feldspar is a valuable mineral used in the manufacture of porcelain and chinaware. During 1909 the only mine in operation was the one owned by the Claspka Mining Co.[1] of Trenton, N. J., and situated two and one-half miles north-northeast of Batchellerville. Many acres in this vicinity are rich in pegmatite veins although mining has been carried on at but two points. The feldspar is very pure and the deposit is no doubt a large one, but the mineral is generally so intimately associated with quartz that a considerable expense is involved in separating them. The feldspar is drawn to Northville, from which point it is shipped to Trenton, N. J.

MICA

Mica is very commonly distributed through the Precambric Grenville rocks in small flakes but only the large, clear (muscovite) mica is valuable. Much prospecting has been done for this mineral but no mine has been successfully operated. A mine was operated for a time two miles north-northeast of Northville and just beyond the map limit.

GRAPHITE

Graphite, or so-called black lead, has been frequently noted in the form of small flakes in the Grenville. So far as observed it is most bundant in the rocks to the northeast of Batchellerville and, about one and one-fourth miles east-northeast of that village, a prospect cut some thirty or forty feet long has been run into the Grenville, but real mining has never been attempted. The graphite occurs irregularly in flattened masses, sometimes five or six inches long and half an inch thick, between the layers of thin-bedded Grenville. The Grenville rocks east of Batchellerville are much like those farther eastward in Saratoga county where graphite is being mined and it is quite possible that a workable deposit may sometime be found.

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[1] This property has recently been acquired by the Adirondack Spar Co. of Glens Falls.

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Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 509 ALBANY, N. Y. DECEMBER 15, 1911

New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 154

GLACIAL GEOLOGY OF THE SCHENECTADY QUADRANGLE

BY

JAMES H. STOLLER

New York State Education Department
Science Division, May 22, 1911

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

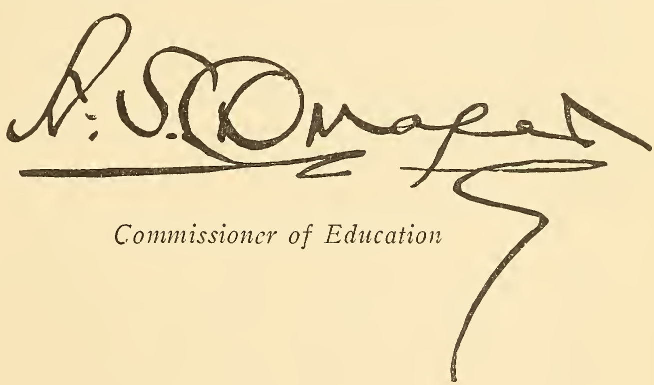
Dear sir:

I beg to communicate to you herewith for publication as a bulletin of the State Museum a manuscript entitled *Glacial Geology of the Schenectady Quadrangle,* which has been prepared for this division by Professor J. H. Stoller.

Very respectfully
John M. Clarke
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 24th day of May 1911



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GLACIAL GEOLOGY OF THE SCHENECTADY QUADRANGLE

BY

JAMES H. STOLLER

The bedrock of the area comprised in the Schenectady topographic sheet consists of the sandstones and shales of the Lorraine formation. The present report has to do with the materials overlying the bedrock, that is, the soils and earthy materials of whatever kind, whether fragmentary or more or less compacted, including clays, sands, gravels, hardpan, loose stones and boulders. These surface materials (excepting such additions as are of recent origin, as stream alluvium and blown sand) were brought to their present location by the agency of moving ice or by the flooded waters resulting from the melting of the ice. They are deposits of the Pleistocene, or Glacial period.

The distribution of these deposits, especially those laid down during the epoch of flooded waters, was determined largely by the general topography of the region, as due to the slope and surface features of the bedrock. A brief description of the more important of these topographic features will therefore first be given.

TOPOGRAPHY DUE TO ROCK SURFACES

THE MOHAWK CHANNEL

The area under consideration is crossed by the Mohawk river which pursues a zigzag course across the southern half of the sheet. Where the river enters the area, at its western edge, its valley is broad and bounded by rocky slopes rising, on the north side, to the Glenville hills which attain an elevation of upward of 1000 feet and, on the south, to hills of still greater height. This portion of the valley, therefore, exhibits the features characteristic of a river valley of mature development.

The valley further widens toward the east forming a broad basin, filled with a thick mass of gravel and sand, through which the river has cut its way dividing into several streams which unite at the site of the old city of Schenectady. Rocks are exposed only on the northern slope of this basin, its southern boundary being a bluff of clay and sand forming the edge of the great sand plain that stretches southeast from Schenectady to Albany. There is evidence, however, that there is a rocky bluff, buried by the sand and clay deposits, lying to the south of the surface bluff. The borings made in 1899 by the United States Board of Engineers on Deep Waterways[1] show that near South Schenectady the bedrock stands at an elevation of 320 feet and that it then abruptly falls off to 210 feet beneath the valley of the Poentic kill, a southern tributary to the Mohawk basin, about three-fourths of a mile to the north, beyond which rock was not reached. How far eastward the rock-bluff extends is not known. The streams which enter the basin from the south flow on clay bottoms, not having cut their beds deep enough to expose rock. Eastward from Schenectady, near the margin of the sand-covered area, rock shows at the level of 340 feet.

Below Schenectady the valley gradually narrows and rocks outcrop on the slopes on both sides of the river.

Just east of Aqueduct there is an abrupt change in the features of the valley. Here the flood plain of the river comes to an end and the stream enters a narrow gorge bounded by nearly vertical walls of rock. This portion of the Mohawk valley, as will be more fully explained farther on, has been formed since the melting of the ice of the Glacial period.

Where the gorge ends near Vischer Ferry the valley again widens, forming a basin, but no rocks are seen on its slope until near Dunsbach Ferry where they appear on both sides of the river. Borings made by the Deep Waterways Survey[2] met with no rock at a depth of 65 feet below the surface of the basin.

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[1] Deep Waterways Report, pt 1, p.540, plate 30; House Doc. v. 71, 1900.
[2] *Op. cit.* p.522.

THE BALLSTON ROCK-CHANNEL

The name *Ballston Channel* has been given by Woodworth[1] to the topographic feature described by him as follows: "From near Schenectady an old rock-channel trends north north-eastward by Ballston toward Saratoga."

In the present account this rock-channel will be limited to the broad troughlike depression, extending from near East Line, in the northern part of the sheet, in a general direction about 20 degrees west of south and joining the Mohawk valley west of Aqueduct. A low divide, at about 300 feet A. T., occurs in the bottom of the trough at about one-third of its length from the southern end. North of this divide lies Ballston lake, a narrow body of water, occupying the deepest portion of the channel. The outlet stream of the lake flows sluggishly northward for a mile and then turning eastward descends to the Round lake basin, described below. South of the divide the drainage is to the Mohawk river by Alplaus creek which enters the channel from the west through a narrow defile cut into the rocks. The altitude of Ballston lake is 285 feet; the slopes of the channel on either side of the lake rise to upward of 400 feet A. T. The width of the channel taken across the southern end of the lake is a little less than a mile. The floor of the channel, especially its middle portion and on either side of the divide, consists of bare rocks or rocks thinly covered with detritus. Rocks are exposed on both slopes of the channel, especially in the Ballston lake region.

As stated by Woodworth,[2] this rock-trough has been determined partly by structure. On the slopes at either side the rocks are generally horizontal in position. In the floor of the trough west of the lake, however, there is a line of outcrop following the axis of the channel, where the rocks are nearly vertical in position. This outcrop is best seen near the station Timeson on the trolley line about one and a half miles north of Ballston Lake station. Outcrops of vertical or highly inclined strata parallel with the axis of the trough occur farther to the north. They are well shown near where Mourning kill turns northerly in its course; and again east of the same stream, along the road, near the northern edge of the map.

THE ROUND LAKE DEPRESSION

About four miles east of the Ballston rock-channel there is a large depression, somewhat circular in outline, in the bottom of

[1] Ancient Water Levels, N. Y. State Mus. Bul. 84, 1905, p.75, 76.

[2] *Op. cit.* p.76.

which lies Round lake. The floor of this depression is largely covered with materials of Glacial age but on the slopes, at their lower levels, there are frequent exposures of rock. Rock appears only a few feet above the level of the lake on the northern side where the rock-valley, through which the outlet stream of Ballston lake flows, opens into the depression. Exposures of rock appear at several places on the road, recently macadamized, running southeasterly from Maltaville. On the south side of the depression, rock is seen on the banks of the stream below the pond at Usher.

Concerning this depression and that in which lies Saratoga lake, four miles to the north, with an elevation of 204 feet, Woodworth says: "It seems probable that Round and Saratoga lakes are unfilled depressions marking the site of an old valley west of the present Hudson gorge." J. H. Cook, in a paper read before the American Association for the Advancement of Science in 1908, gives additional facts indicating that an old rock-channel, now covered, extends southerly from the Round lake region, intersecting the valley of the Mohawk below Vischer Ferry.

THE GLENVILLE ROCK BASIN

I give this name to the extensive depressed area bounded to the west by the slope of the Glenville hills and on the north and east by the more gradual and broken slope of the Charlton hills. The basin is drained by two streams: Alplaus kill, which lies at the base of the Charlton slope, emerging from the basin at High Mills where it enters a gorge that opens into the Ballston channel; and a creek, unnamed on the topographic sheet, that skirts the base of the Glenville hills and joins the Alplaus creek in its course through the southern end of the Ballston channel. Both these streams receive small tributaries. One of these marks the extension of the basin to the south where it opens into the Mohawk channel.

For the most part the rock underlying this basin has but a thin covering of soil. The Alplaus kill traverses lacustrine deposits, as will be later explained, but the streams draining the rest of the basin show frequent exposures of rock.

MODIFICATIONS OF ROCK TOPOGRAPHY PRODUCED DURING THE PLEISTOCENE PERIOD

GENERAL ICE EROSION

The yielding nature of the shales and argillaceous sandstones was favorable to extensive abrasion by the moving ice sheet. The extent to which the rock surfaces were generally modified by this cause can not well be determined, but in some localities evidences of ice erosion are conspicuous.

In the Glenville hills region there are many terracelike stretches with bedrock of sandstone or shaly sandstone, detached fragments of which are scattered on the surface. It is inferred that these fragments of rock were produced by the process of plucking, or loosening of joint blocks by moving ice. The leveled surfaces may have resulted from the more ready removal, by ice abrasion, of the less resistant shales that are interstratified with the layers of sandstone.

In the same region there is a valley which is judged to have originated by ice erosion. It is indicated by the contour lines of the sheet and lies a short distance west of the road which runs southwesterly at a distance of about one and a half miles east of Town House Corners. The valley is in the form of a narrow troughlike depression about one and a half miles in length and five or six hundred feet in diameter. It is excavated in the bedrock; outcrops of shaly sandstone, horizontal in position, show on both slopes. In cross section the valley is U-shaped and its depth, taken near the middle portion, is estimated at 40 feet. The valley opens at its southern end in the general depression of the Mohawk channel. The bottom is not occupied by a stream and there is a divide in the middle portion which seems to render improbable the view that the valley as a whole is of stream origin. The slopes are clean-cut, evenly rounded and closely parallel. No glacial scratches were found in the vicinity but the direction of the valley coincides well with that of the striae found elsewhere.

GLACIAL SCRATCHES

In general the bedrock where exposed is worn and broken at the surface, because of weathering. In considerable portions of the area, therefore, glacial scratches are infrequent or lacking. They have been observed in the following localities:

1 North of the city of Schenectady on surfaces of sandstone in

quarry near the Troy branch of the New York Central & Hudson River Railroad, 42° west of south.

2 In a quarry about a mile to the east of the former, 22° west of south.

3 Two miles north of Rexford Flats on sandstone exposed at the roadside, 38° west of south.

4 At the 600-foot level on a branch of road running north from Hardin's crossing, on the Amsterdam trolley line, on sandstone exposed at roadside, 35° west of south.

5 Near the western margin of the sheet at an elevation of 780 feet on the road running east-west from the north-south road that passes through Town House Corners, on sandstone at roadside, 57° west of south.

The readings as above given are magnetic north.

PROBABLE AGENCY OF ICE IN THE FORMATION OF THE BALLSTON CHANNEL

Evidences that the Ballston channel is an old rock-channel have been referred to above. It presents, however, a number of features which indicate that the old stream-formed valley was deepened and widened by ice erosion during the glacial period. The general shape of the valley in cross section conforms rather to the type of an ice-made valley. The bottom is broad and the slopes where the valley is most fully developed, along the southern half of Ballston lake, are somewhat steep and smoothly planed. It will be noted that the

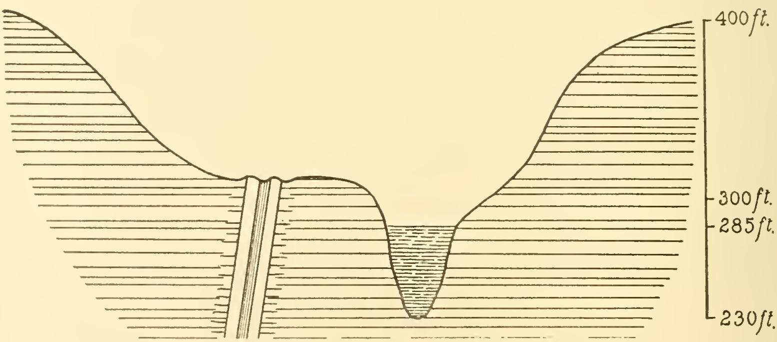

Fig. 1 Diagram showing topography and rock structure as seen in section across Ballston hannel at about one mile north of the southern end of Ballston lake. Vertical scale 100 feet to he inch. Horizontal scale one-fourth of a mile to the inch

lake does not lie in the middle line of the trough, but to the eastern side. West of the lake the shore, for the most part rocky, rises somewhat sharply to a level of about 35 feet above the surface of the lake; beyond this the floor of the channel is continued to the base of the slope. Its surface shows many minor elevations and depressions. The elevations are in part due to the vertical position of the strata which in places appear as ridges where beds of sandstone alternate with the softer shales. Moreover, on both sides of the lake the rocks are horizontal in position. Thus erosion appears to have taken place more destructively across the faces of the rocks than on their edges. Glacier ice, with its inclosed fragments of hard rock, would more probably produce this condition than would running water. In this connection the somewhat remarkable depth of the lake at its southern end merits consideration. A sounding taken by the writer at a point about 400 feet from the southern end of the lake showed a depth of 109 feet. Another sounding taken at a point about half a mile from the southern end showed a depth of 55 feet. This narrow and deep depression somewhat abruptly terminating at the head of the lake, suggests the gouging action of glacier ice rather than river erosion.

The general direction of the axis of the channel, coinciding well with the direction of the glacial striae of the general region, is in harmony with the view here expressed. The deductions made from these data are as follows:

It is highly probable that a preglacial stream heading to the north followed the course of the present Ballston channel, finding its bed in the line of the vertical outcrops of rock, and joined the Mohawk near Schenectady. The valley made by this stream was in glacial times scoured out and enlarged by ice erosion. At a later time as will be explained farther on, after the melting of the ice, powerful currents, diverted from the flooded Mohawk, swept northward through the open channel, producing some further erosive effects and finally, with the passing of the flooded epoch, leaving the channel in its present features.

THE MOHAWK GORGE

As already stated the Mohawk river beginning near Aqueduct occupies a channel which has been formed in postglacial times. The evidences of this may be briefly stated as follows: An abrupt change in the features of the valley begins just west of Aqueduct. From a broad valley, with (on the north side) a gentle slope and wide flood plain, there is a transition to a narrow, deep valley or gorge. The cliffs on either side, below Aqueduct, are nearly vertical and about 140 feet in height. There are no high, gently sloping hills or uplands, with crests parallel to the river, such as are characteristic of the valley west of Schenectady. There is no flood plain and there is little deposit in the bed of the stream. The stream flows on bedrock and the island in the river north of Vischer Ferry is of rock. The process of excavation of the bed is still going on; there is a fall of 25 feet from the State dam at Aqueduct to a point about one mile west of Vischer Ferry, a distance of about five miles.

These features abundantly justify the conclusion that the gorge is of a late geological origin. It does not follow, however, that the section of the Mohawk valley above the head of the gorge extending westward to Schenectady, or somewhat beyond Schenectady, belongs to the old Mohawk channel. There are evidences favorable to the view that this section is in origin a part of the Ballston channel. The latter merges with the Mohawk channel west of Aqueduct. It seems probable that the stream from the north which in preglacial times coursed through the Ballston channel joined the Mohawk at a point near Schenectady. When the Mohawk was shifted from its

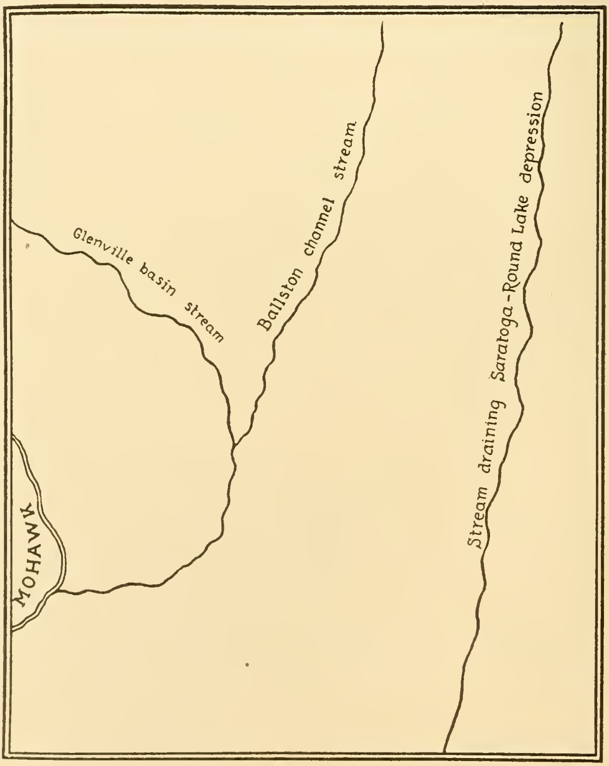

Fig. 2 Sketch map showing probable preglacial drainage of the area of the Schenectady quadrangle

Plate 1

The Mohawk river at Aqueduct, three miles east of Schenectady. At this place the river enters a postglacial gorge, the wall of which, 140 feet high, is dimly shown in the middle background of the picture.

course, due to the filling up of its channel, beginning near Schenectady, with deposits of Glacial age, it took possession of this portion of the Ballston channel as far as Aqueduct and from there on cut a new channel in the rocks.

The location of the buried channel of the preglacial Mohawk from near Schenectady eastward has not been determined. The borings already referred to indicate that there is a depression in the bedrock in the locality north of South Schenectady. Along a line extending from the bank of the river, at a point about three-fifths of a mile west of the Schenectady waterworks to a point near South Schenectady no rock was struck. Unfortunately the borings were made only to a depth of 195 feet above sea level, so that the vertical extent of the depression was not determined.

SURFACE DEPOSITS

Having noticed the more general topographic features of the area as determined by the underlying rock surfaces and the modifications of these features by erosion during the glacial period, we may describe the deposits or surface materials of Pleistocene age.

UNMODIFIED TILL

By this is meant the materials derived from the ice sheet, whether left from the bottom or dropped from the ice at the time of melting, which have undergone little or no disturbance since they were originally deposited. They are distributed generally over the upland regions of the area and in smaller patches, at lower levels, where the land rose above the surface of the waters of the flooded epoch. About one-half of the surface of the Schenectady sheet is covered by till.

The thickness of the till varies from a few inches to upwards of a hundred feet. As far as observed the thickest deposits lie in the hills southeast of the Mohawk gorge below Aqueduct. Borings made for water near the residence of Mr W. T. Hanson, near the station Knolls on the Troy branch of the New York Central Railroad, penetrated 130 feet of earthy materials before striking bedrock. A section of the till at this place is afforded by the grading of a roadway running from the base of the hill, where bedrock is exposed, to the summit. It consists in the lower portion largely of compact dark clay, inclosing large and small boulders and without appearance of stratification. Higher up the mass is of looser texture and the relative amount of sand is greater.

A fine exposure of till may be seen near the point where the macadamized road running east of Round lake crosses the eastern margin of the sheet. The materials here are of the typically heterogeneous character and include pockets of evenly stratified coarse sands and gravels, mostly in cross-bedded arrangement, indicating turbulent and shifting local currents. A thickness of about 80 feet is exposed.

In the Glenville hills region and in the floor of the basin adjacent to these hills the till is generally of slight thickness. To a large extent the streams have worn their channels to bedrock and there are frequent exposures of rock in the roadside gutters. In the fields fragments of detached sandstone rock are widely scattered. A broad area of thinly covered rocks extends southerly from the plain which lies at the foot of the Glenville hills to the Mohawk channel. The materials of the till of this area are chiefly clay and fragments of shale and shaly sandstone, evidently derived from the local rocks. Cobbles and boulders of gneissic and quartz rock occur.

Drumlins. There are a number of hills of a well-defined drumlin type. The most conspicuous of these is that in the town of Glenville crossed by the east-west road north of Alplaus. The hill is of an elongated elliptical shape, about one mile in length and one-quarter of a mile in diameter. There is an exposure of bedrock in the road west of the hill; taking this as the level of the base of the hill its thickness at the summit is about 40 feet. The direction of the long axis corresponds closely with that of the glacial striae observed elsewhere. A partial section of the hill is afforded by the cut made in grading the road and reveals the till nature of the material.

Another drumlin of smaller dimensions but similar features occurs one and a quarter miles to the west.

The hilly region in the town of Niskayuna crossed by the road that runs south from Aqueduct presents hills of till of drumlinlike outlines. The group of hills south of the village of Niskayuna, the highest of which has an elevation of 500 feet, is probably of this type.

Morainic hills. In the vicinity of the village of Burnt Hills the topography is marked by hills of irregularly rounded or moundlike forms separated by basin-shaped depressions or wide intervening hollows. They are most typically developed in the area southeast of the village toward the Ballston channel. Owing to their moderate size they are not indicated by the contour lines of the sheet. Of the materials that enter into the composition of these hills the amount of gravel and sand is conspicuously large. In places, as observed at the surface, little else is visible. The gravel consists of coarse sand, hard, worn pebbles and small cobbles and worn fragments of shaly rock. In the locality here referred to no exposure sufficient to determine whether the materials are stratified in arrangement was found; but farther to the west beyond the road that runs south from Burnt Hills a cutting was found in which the materials showed definite stratification. Also at the side of the road that runs eastward from Burnt Hills there is a sand and gravel pit that shows a layered arrangement. The area in which gravel abounds extends to the west and southwest and is cut by the Alplaus gorge. South of the gorge the fields are strewn with coarse gravel and cobblestones.

It seems warrantable to interpret these features as due to accumulations of glacial debris along the margin of the ice-front and indicating a pause in the recession of the ice sheet. It is certain that a thick mass of materials was thrown down west of High Mills, obstructing drainage and giving rise to a glacial lake (Alplaus lake) described below. This obstructing mass was in continuity in east-west direction with the group of hills possessing the features of kames, just described. The facts seem to warrant the view that a recessional moraine was formed extending from near Ballston Lake station westward beyond High Mills. The surface features of this moraine are still evident in its eastern portion; the western portion is evidenced chiefly by the sand and gravel materials and their arrangement.

To avoid multiplying distinctions in mapping, I have included the Burnt Hills locality within the area designated "glacial till more or less covered and mingled with . . . glacio-fluviatile deposits . . ."

KAMES

A notable group of hills answering to the description of kames occurs in the township of Clifton Park about one mile southeast of Groom Corners. The topographic forms which have been termed mound-and-basin or knob and kettle, are characteristically exhibited. The largest of the kettles is designated by depression contours on the topographic sheet. A relief of 60 feet between the bottom of the kettle and the top of the hill immediately to the south is indicated by the contour lines.

All of the hills have rounded or moundlike outlines but with much irregularity of shapes. Some of them are elongated and with somewhat steep slopes. The longest of the hills trends in a northeast-southwest direction. It may represent a deposit made by a subglacial stream or stream emerging from the edge of the glacier.

The materials of composition of the hills are fairly distinctive in character. There is a predominance of gravel, consisting of small and large pebbles and cobbles together with course sand and fragment of the local bedrock. No exposures were found sufficient to determine the arrangement of the materials.

There is a ridgelike accumulation of gravel just west of the large kettle which suggests heaping effects against an ice-block.

The Lake Albany deposits. A large part of the area of the Schenectady sheet is covered with deposits of clays and sands which are continuous with similar deposits lying to the east and which have been interpreted by Woodworth and others as deposits of delta origin made in the extensive body of glacial waters known as Lake

Plate 2

Morainic hills, southeast of the village of Burnt Hills

Albany. Southward from Schenectady lies the sand plain region, the materials of which are described by Woodworth[1] as "the most extensive deposits of this nature (delta) in the Hudson if not also in the Champlain valleys." A portion of this plain, developed in its characteristic topographic features — a generally flat surface marked by many low hills and ridges of sand — occupies the southwestern portion of the Schenectady sheet. Eastward of this lie the hills of till in the town of Niskayuna which, however, are largely covered by blown sand. Farther to the east and south of the Mohawk an area of sandy clay broken by hills of till and dissected by streams extends to the eastern boundary of the sheet. On the eastern side of the sheet a broad and unbroken area of sands extends from the Mohawk channel northward to the Round lake depression. North of the depression the sands again appear forming a plain lying between the Round lake basin and that in which Saratoga lake lies. The margins of this plain are deeply gullied by the small streams tributary to the lakes.

These areas of sands and clays are continuous, except as broken by the Mohawk channel and the obvious water course across the Round lake region. The inference that they are deposits made in one body of water is scarcely open to question. They constitute, however, deltas built into Lake Albany from different sources and under varying conditions. The deposits near Schenectady were brought down by the Mohawk during the flooded or Iroquois stage of that river. The Mohawk delta thus formed became confluent to the south and east with deposits made from waters moving in the general valley of the Hudson. The deposits in the eastern part of the Schenectady sheet both north and south of the Mohawk, belong largely, if not wholly, to the Hudson valley accumulations. A reservation is made in recognition of the possibility that, after the gorge below the Aqueduct began forming, the Mohawk deposited sediments in the basin below Vischer Ferry.

In addition to the areas above described there are others of less extent composed of similar materials and believed to be deposits made in Lake Albany. Two of these are crossed by the northern border of the sheet. Their surfaces are on the same general level as that of the Malta plain to the east and they are evidently portions of the same mass cut off by water courses. A more isolated area occurs west of the southern part of the Ballston channel in the town of Glenville. This presents the same features as to materials,

[1]Ancient Water Levels, N. Y. State Mus. Bul. 84, 1905, p. 130.

topography and elevation as the Albany deposits elsewhere. The source of the materials is believed to have been from the Alplaus drainage basin to the northwest. It is true that this portion of the lake was in communication with the main body of its waters through the open Ballston channel near where the latter joins the Mohawk channel. Woodworth has expressed the opinion that at the time the Mohawk delta was making south of Schenectady, no deposits were made in Lake Albany north of the Mohawk because that area was then covered with ice. I have found nothing incompatible with this view. As the ice retreated to the north, the Alplaus basin became open earlier than the Ballston channel to the north and the part of Lake Albany in question became silted up by inflows from the Alplaus basin.

RELATION OF THE LAKE ALBANY DEPOSITS TO THE TILL

Till underlies the Lake Albany deposits generally, as they occur on the area of the Schenectady sheet. Where streams have cut through the sands and clays, boulders lie in their beds. In a few instances the stream bottoms are in part boulder clays. For example, the stream that flows into Saratoga lake from the Malta plain region has its bed, in a part of its course, on a compact blue clay. The same stream, where it emerges from the Albany deposits onto the flat swampy area bordering the lake, shows blue clay in its banks and boulders in its bed.

The stream that flows into Round lake from the west has likewise cut through the Lake Albany deposits and exhibits both boulder clay and boulders in its bed.

As already stated the streams that flow northerly from the sand plain near Schenectady have their beds on the Albany clays, not having cut through this deposit. Poentic kill farther to the west has a boulder-strewn bed and on its bank, in a railroad cutting near the new station of South Schenectady (just off the edge of the sheet), till is exposed underlying the lacustrine deposits. In a boring made by the Deep Water Survey[1] on the sand plain, near South Schenectady, cobblestones were found as the surface of the underlying rock was approached.

Similar observations with regard to the stratigraphic relation of the Lake Albany deposits to the till were made in the other localities, where the deposits are distributed, as described above.

Elevation. The elevation of these lacustrine deposits varies some-

[1] Deep Waterways Report, p. 540, House Doc. v.71, 1900.

what in the different localities. The Mohawk river has cut into the materials of the sand plain at Schenectady forming the crescentic line of bluff bordering the Mohawk flats. This bluff consists of evenly stratified clays below grading into stratified sands above. These have been partially disarranged by weathering at the summit but a little south of the top of the bluff horizontally stratified sands and fine gravels were observed in cuttings made in grading a street. According to the contour lines the elevation at this place is not less than 350 feet. The general elevation of the plain farther to the south is slightly lower but it has clearly suffered from wind denudation.

In the southeast portion of the sheet east and south of Watervliet Center the surface of the clay deposits is at a lower elevation than that of the plain south of Schenectady. Crossing the river to the north the deposits, largely of sand at the surface, rise to a gradually higher altitude. North of Round lake on the flat sand tract east of Malta the 380-foot contour lines are shown. In the Ballston Spa area, at the northern edge of the sheet, horizontally stratified sands at 380 feet elevation were seen in an excavation made in the construction of macadamized road.

Regarding the elevation of the Mohawk delta deposited in Lake Albany, Woodworth says:[1] "The average elevation of the surface from Albany southward at the brink of the gorge (Hudson) is now 200 feet. The surfaces rise northwestward to an elevation of about 350 feet near Schenectady." The data above reported show that there is a continuation of this rise as far north as the northern edge of the Schenectady sheet.

COMPOSITION AND ARRANGEMENT OF THE DEPOSITS

1 **Near Schenectady.** As already stated the Lake Albany deposits near Schenectady consist of clays grading into sands. As a general condition the clays predominate up to the level of 300 feet. The grading of streets has afforded opportunity to observe these clays, in their upper levels, through about 100 feet of exposure. They are of dark color, very fine grained, highly plastic when wet and cut with smooth shining surface. When exposed they become slightly indurated so that their edges at a distance appear like shale rock with even horizontal stratification. If the dried layers are cut with a knife fine laminations are shown. They weather from a dark to a gray color.

[1] Ancient Water Levels, N. Y. State Mus. Bul. 84, 1905, p. 130.

At the higher levels the clays become sandy and at the top of the bluff, at a level of 340 feet, the materials are predominantly sand. Transitional stages occur, where thin layers of clay, often yellowish in color, are interstratified with layers of fine sand or sandy clay. The materials of the bluff at the higher levels are well exposed farther to the west, toward South Schenectady. In a cutting made in grading the new line of the Delaware & Hudson railway, in that part of the bluff at the foot of which Poentic kill flows, a thickness of about 50 feet of sand is exposed. There is also a deep and broad sand pit along the old line of the railroad east of South Schenectady. Here the sand is for the most part coarse and at the top of the pit on the south side, approaching the 360 foot level, fine gravels occur. In places there are evidences that the materials were laid down in turbulent waters, as shown by cross-bedding and the occurrence of pockets of dark-colored, angular-grained sands.

In regard to the mineral composition of the sands microscopic examinations of samples collected in several different localities showed that quartz is the predominant constituent and that feldspar and a dark mineral, probably magnetite, rank next in abundance. The grains are generally of irregularly rounded form, though some are angular.

It is evident from these data that, after Lake Albany had formed, for a long time the Mohawk currents brought down and deposited in the lake near where Schenectady is now situated great quantities of clay sediments. The source of these sediments was chiefly the argillaceous rocks (already largely disintegrated by glacial erosion) which prevail in the drainage basin of the river. They were deposited under comparatively tranquil and constant conditions as shown by the even horizontality and the fineness of the laminations of the clays. This was due to the fact that the force of the currents had already been largely spent, the river entering the lake some miles to the west.

At a later time sediments composed chiefly of sand were brought into the lake and deposited upon the clays already laid down. These sands were evidently derived from the gneissic and other crystalline rocks of the Precambric formations. As the southern slopes of the Adirondack region became freed from ice the streams tributary to the Mohawk from the north contributed their load of sediments and these coarser materials were borne to Lake Albany. The powerful currents swept the sands far out into the lake, building a broad delta which eventually merged with similar accumulations formed in the Hudson channel.

With the subsidence of the waters of Lake Albany the sands be-

Plate 3

Lake Albany clays in excavation for new high school on Nott terrace, Schenectady

came the surface materials of the sand plain. At the same time the currents of the Mohawk, now confined to their channel, cut powerfully into the western edge of the mass of deposits. Gradually the basin at Schenectady, bounded by the bluff which still parallels the course of the river, was eroded out.

To what depth below the level of the present surface of the basin the mass of deposits extends is not known. I am informed by Mr J. L. Fitzgerald, City Engineer of Schenectady, that a boring was made under his direction, in connection with locating a site for a gas tank, at a point near Villa road, some 400 feet from the foot of the bluff, and that a depth of 50 or 60 feet of sands and clays was penetrated. The sands are described by him as "quicksands," consisting of rounded grains. He states that the sands occurred in layers, with thin partings of clay. I am also informed by Mr B. B. Steers, manager of the Schenectady Gas Company, that a boring was made near the site of the present gas works on South Center street and 150 feet of sand was penetrated and no rock was struck. The boring was tubed for the purpose of obtaining water but the supply was meager and the well was abandoned.

It would appear from these data that the rock basin near Schenectady is of considerable depth. It seems probable that this depression was already partly filled with deposits when the epoch of delta-building in Lake Albany began.

2 **The Round lake region.** In the Round lake region clays are exposed on the floor of the depression and in places on its slopes. The level to which the clays rise is about the same as in the deposits near Schenectady. In a cutting where the road entering Round Lake village from the west descends the hill, horizontally stratified dark clays are seen at approximately the 300 foot level. They are overlaid by sandy clays grading into sands. The clays appear in several places, on the opposite side of the depression, in cuttings made in grading the macadamized road. West of Maltaville, beyond the creek, where the road ascends the hill, a very interesting section is presented. At the base (at about the 220 foot level) a thickness of about 12 feet of dark evenly stratified clays are shown. Above this are 3 feet of fine-grained, yellowish clayey material, not exhibiting stratification. Overlying this and unconformably with it is a layer about 4 feet thick composed of sand, gravel and small cobbles.

There is another section similar to this on the same road half a mile to the south.

It is evident that in this locality the clays have been subjected to erosion and that the coarse gravel was deposited upon the eroded surface. (The middle layer evidently consists of weathered clays.) Assuming that the upper layers of the clays were originally at the same level here as on the west side of the depression, about 70 feet of clay have been removed by erosion.

Reserving for a moment the further interpretation of the section we may notice other features of the Round lake depression. On ascending the hill above the section just described, going toward Malta, the surface material is till up to about 340 feet elevation. Beyond that are the sands of the Malta plain rising to the level of 380 feet. Thus in ascending the hill from the creek we cross successively stratified clays, a deposit of gravel, till, and a thick surface bed of sands. The floor of the depression is largely composed of till but with a broad area of clays along Anthony kill. There is a ridge of till extending from the site of Round Lake village southeasterly across the floor of the basin. South of Round lake this ridge rises to the height of 100 feet above the level of the clay area, forming a dome-shaped, boulder-strewn hill. To the west of this ridge there is a low-lying swampy tract the surface materials of which are varied — clay, sand, till and vegetable debris entering into their composition. North of the clay flat along Anthony kill, till is the predominant material of the floor. The slopes surrounding the depression at the higher levels are everywhere sand except where the rock valley of the inlet stream of the lake opens into the depression.

All of these features become clearly understood by the following interpretations.

A rock basin occupied the site of the present depression in preglacial times.

With the melting of the ice till was distributed unevenly over the floor and the slopes of this basin.

Water from the melting ice and from the sources which supplied Lake Albany filled the basin and merged it with that lake.

Deposits of clay and afterward of sands, made widely in Lake Albany, filled in the basin and for the time being obliterated it.

When Lake Albany began to subside powerful currents of water entering from the Ballston channel cut into the deposits.

The erosion of the deposits thus initiated continued *pari passu* with the subsidence of Lake Albany and resulted in the present topography and the exposures of materials on the slopes and floor of the depression as above described.

An incident of the last stage was the deposition of eroded and transported materials (sand, gravel and small cobbles) in places on the surface of the previously eroded clays, as seen in the section above described.

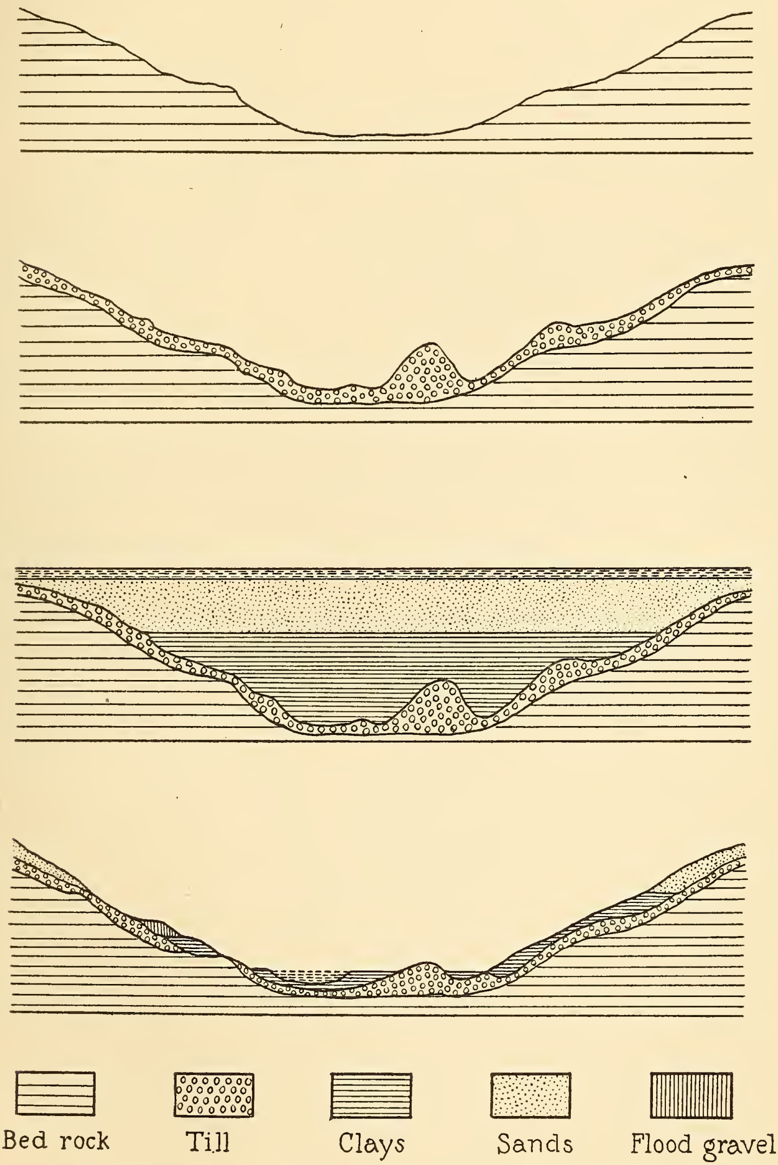

Fig. 3 Diagrams showing successive stages in the formation of Round lake depression. The first diagram shows the depression as formed prior to the glacial epoch; the second diagram shows the conditions after the melting of the ice when glacial till had been deposited on the floor and slopes of the depression; the third diagram shows the conditions when Lake Albany was at its height, clays and sands having been deposited, filling the depression; the fourth diagram shows present conditions as resulting from erosion and the deposition of flood gravel.

ECONOMIC VALUES OF THE LAKE ALBANY DEPOSITS

Molding sands. Sands of the requisite qualities for use as molding sands appear to be a widely distributed constituent of these lake deposits. They are obtained at present in the localities of the following shipping stations: near South Schenectady, Carman (on New York Central & Hudson River Railroad, east of Schenectady), Niskayuna, Dunsbach Ferry, Elnora, Usher, Round Lake.

At the South Schenectady locality about 40 acres of farm land have been here worked over and the company holds rights to about an equal additional area. The molding sand occurs in a layer underneath the surface soil at a depth of about one foot. The thickness of the layer is variable, running from a foot or less to three or four feet. In gathering the sand the surface soil is first removed; the molding sand is then directly loaded into carts and hauled to the car.

The sand is very fine grained, slightly plastic when wet and of yellowish brown color. A microscopic examination of the sand was made and it was found to correspond closely with the molding sand from Albany county described by Dr G. P. Merrill.[1] He states: "the Selkirk molding sand is of a yellow brown color showing under the microscope angular and irregular rounded particles rarely more than .25 mm in diameter, interspersed with finely pulverulent matter which can only be designated as clay. The yellow brown color of the sand is due to the thin film of iron oxid which coats the larger granules. When this film is removed by treatment with dilute hydrochloric acid, the constituent materials are readily recognized as consisting mainly of quartz and feldspar fragments (both orthoclase and plagioclase variety), occasional granules of magnetic iron oxid, and irregularly outlined scales of kaolin together with dustlike material too finely comminuted for accurate determination."

Theory of the secondary origin of molding sands. In their present occurrence the molding sands do not form a stratum but a surface layer of variable but limited thickness. This layer follows the irregularities of the surface, rising and falling with the surface elevations and depressions. In the Schenectady locality there is a marked unevenness of surface, the difference in elevation of different portions of the area being at least 30 feet. It appears to be a necessary inference from this that surface conditions are a determining cause in the origin of the layer of molding sands. In

[1] U. S. Nat. Mus. Report, 1899, p.476, 477.

dry seasons of the year when the surface soil has been largely deprived of water by evaporation, an upward movement of the ground water by capillarity takes place. If the ascending ground water carries iron in solution the iron may be oxidized and precipitated as it approaches the surface. In this way the film of iron oxid coating the particles of sand is formed. The porosity of sand, admitting air to a considerable depth below the surface and at the same time favoring evaporation, facilitates the process. In addition to the iron it is probable that small particles of clay are carried upward by the moving ground waters and are fixed through cementation by the iron oxid. These processes continue from season to season through a long period of years, the layers of molding sand being periodically added to at the bottom until it attains such a thickness that surface influences no longer penetrate it.

Sands for making sand-lime bricks. The Lake Albany deposits furnish sands which are adapted for use in the manufacture of sand-lime bricks. This industry has recently been established in the vicinity of Schenectady. There are two plants for making the bricks on the line of the Delaware & Hudson railroad between Schenectady and South Schenectady. At one of the plants the sand selected for this purpose was a somewhat coarse, sharp-grained sand of gray color. It was evidently a water-sorted sand, as it was evenly stratified and occurred in a pocket, surrounded by sands of different color and texture. At the other plant the sand used was less distinctive, being of the color and texture common to the mass of sands in that locality. At this plant the sand was first sifted to remove gravel.

Sand for making cement blocks. This industry has recently been developed to a considerable extent in the vicinity of Schenectady. There are a large number of small plants and as the apparatus used is simple it is readily moved from place to place. The sands selected for this purpose are the sharp or angular grained sands that occur in pockets as above described.

Brick clays. Though probably belonging to a later geological stage than the Lake Albany deposits described above, mention may here be made of a deposit of Pleistocene clays which is used for making red brick. The bed is located about half a mile from the highway bridge which crosses the Mohawk below Schenectady and near the Delaware & Hudson railroad tracks. The clays are yellowish and bluish in color, the colors showing in the layered arrangement of the materials. They are of firm, compact texture. The bed is overlaid by a thickness of one or two feet of sand or sandy clay which is mixed with the stiff clays in proportions proper for the purpse of making bricks. The areal extent of this deposit of clays is said to be about 25 acres.

LAKE ALPLAUS DEPOSITS

The region of country traversed by Alplaus kill presents striking topographic features. At High Mills the creek enters a rocky gorge from which, after a descent of 40 feet in the course of a mile, it emerges on the floor of the Ballston channel. West of High Mills on either side of the creek are deposits of morainic character continuous with the morainic hills of the Burnt Hills district, already described. Farther to the west the creek lies in a broad valley bounded on either side by an extensive, nearly level area having an elevation of 420 feet. The materials of this area are stratified clays and sands of evident lacustrine origin. To the body of glacial waters in which these deposits were laid down I have given the name of Alplaus lake.

A section of the deposits is shown where the road crosses a branch of the Alplaus kill about one mile west of High Mills as follows: At the base about 10 feet of blue boulder clay with gravel; then 4 feet of dark evenly stratified clays overlaid by about 2 feet of yellowish clays, evenly stratified; then, at the top, 3 feet of sand and gravel. The sand continues as the surface soil in the adjoining fields attaining a level 10 feet higher than the top of the section. Farther to the west the deposits are of somewhat coarser materials. In many places fine gravels occur, as along the road that runs northerly to Charlton village.

The conditions under which Lake Alplaus was formed and the subsequent events resulting in the present topography are clearly deducible from the above data.

With the melting of the ice sheet a mass of debris was heaped up in the Burnt Hills district, forming morainic hills with an elevation of upwards of 420 feet.

The belt of morainic materials lay across the floor of the deepest portion of the Glenville rock basin in the locality west of High Mills.

Glacial waters became ponded back of the moraine dam, forming a lake. In this lake sediments were deposited; at first from streams derived from the melting ice and later from Alplaus creek, draining

Plate 4

Postglacial gorge of Alplaus creek, south of High Mills

an extensive land surface. These deposits filled the lake up to the level of 420 feet.

The overflow waters of the lake followed lines of depression across the belt of moraine forming the dam. Gradually, through difference in rate of erosion a single outlet stream was formed and began to cut out the gorge east of High Mills. At the same time the lake was drained leaving the deposits in the form of a plain, 420 feet in elevation.

Alplaus creek and its tributaries, by downward cutting and meandering, have since formed broad and deep valleys in the deposits; while below High Mills the gorge with vertical walls of rock in places 60 feet high, has been eroded out.

MODIFIED TILL

The surface materials thus far described, namely, the unmodified till and the deposits made in Lakes Albany and Alplaus, cover about five-sixths of the area of the Schenectady quadrangle. Of the remaining area much the larger part is covered by glacial till which has undergone more or less extensive modifications since it was left by the melting of the ice. The modifications were due either (1) to additions of other materials, at first generally covering and afterward becoming more or less intermixed with the till, or (2) to the removal by erosion of a portion of the materials of the till, altering its surface features and to some extent its composition.

Glacial till more or less covered and mingled with marginal lake deposits or with glacio-fluviatile deposits or with wind-blown sands. In the work of mapping it was found that in many localities it was difficult to fix the marginal boundary lines for the lacustrine deposits, since the sands of the latter graded into the materials of the adjoining areas of till. This is interpreted as due to marginal lake deposits having originally overlapped the till and subsequently become mixed with it. Such intermixing would result from the cultivation of the land, the tunneling of the soil by burrowing animals and the roots of trees, and to some extent by the processes of weathering. Accordingly for the sake of accuracy it seemed best in the localities in question to indicate a marginal area or belt separating the undoubted lake deposits from the evidently unmodified till. This expedient did not, however, always render the task of fixing the lines an easy one and in some localities they have been drawn somewhat arbitrarily.

A like difficulty was experienced where areas of till lie on the side of the sand regions toward which the prevailing winds (northwest) blow. Sands blown by the wind have been deposited on the till and subsequently intermixed with it in the ways above described. On the upland slopes east of Schenectady this condition is developed over a considerable area. This has been mapped as modified till.

A third condition is that produced by the spreading of materials (mostly sands) over the till by glacio-fluviatile waters. The glacial streams derived from the melting ice lingering on the uplands of the northern part of the sheet carried the finer materials of the debris derived from the glacier to lower levels. It was from this source that materials deposited as sediments in Lake Alplaus were largely derived. But, apparently, before the Alplaus area had become freed of ice, glacial waters swept across the floor of the Glenville basin, along the foot of the Glenville hills, and southward to the Mohawk channel. These waters deposited sands over an already till-covered area, thus forming the surface materials of mixed composition — sands or clayey sands of loose texture, with cobbles and boulders — of the southeastern portion of the town of Glenville.

Glacial till more or less washed and eroded by powerful currents of water, boulders mostly of large size. The vicinity of East Line in the northern part of the sheet exhibits in its typical development the glacial till as modified by powerful currents of water. The surface of the country is marked by a general evenness or absence of hilly features. It is thickly strewn with boulders and large cobbles. The soil or mantle of materials covering the bedrock, is generally thin, with frequent exposures and outcrops of rock. The soil is generally clayey, evidently consisting partly of till clays and partly of residual clays from local rock detritus.

Features and materials of like description mark the several watercourses that radiate from the East Line vicinity. In the valley of Drummond creek, flowing to the northeast, and in the valley and on the slopes of Mourning kill, flowing north, and of Anthony kill, flowing southeast across the Round lake depression, evidences of the washing and eroding effects of moving flooded waters are definite and unmistakable. In the last named valley, in the section extending from near East Line to Round lake, the floor and lower slopes have been stripped of all the till except large boulders which now lie on the surface of rock. On the floor and slopes of the Round lake depression the till shows eroded and water-swept surface features.

The three glacial watercourses just noticed were branches of a more general watercourse occupying the Ballston channel. The evidences are of the same nature as already described. The region north of Ballston lake to East Line and on either side of the northern end of Ballston lake is strewn with boulders and shows water-swept surface features. The floor of the channel farther to the south, near the head of the lake, is neither eroded till or worn rock surface, partly covered with rock detritus. Similar features characterize the southern end of the channel except that on its western slope erosion took effect in the Lake Albany deposits and not to the extent to expose the underlying till.

The inference to be drawn from these facts is plain. A flood of waters once swept northward through Ballston channel, dividing in the vicinity of East Line into three currents which pursued the several courses described above. The time in glacial history when this took place was subsequent to the general disappearance of the ice and also subsequent to the stage of maximum development of Lake Albany. For these currents eroded out the Lake Albany deposits that filled at least the southern end of the Ballston channel and the deposits that filled the Round lake basin and then cut into the underlying till and, in places, through the till to bedrock.

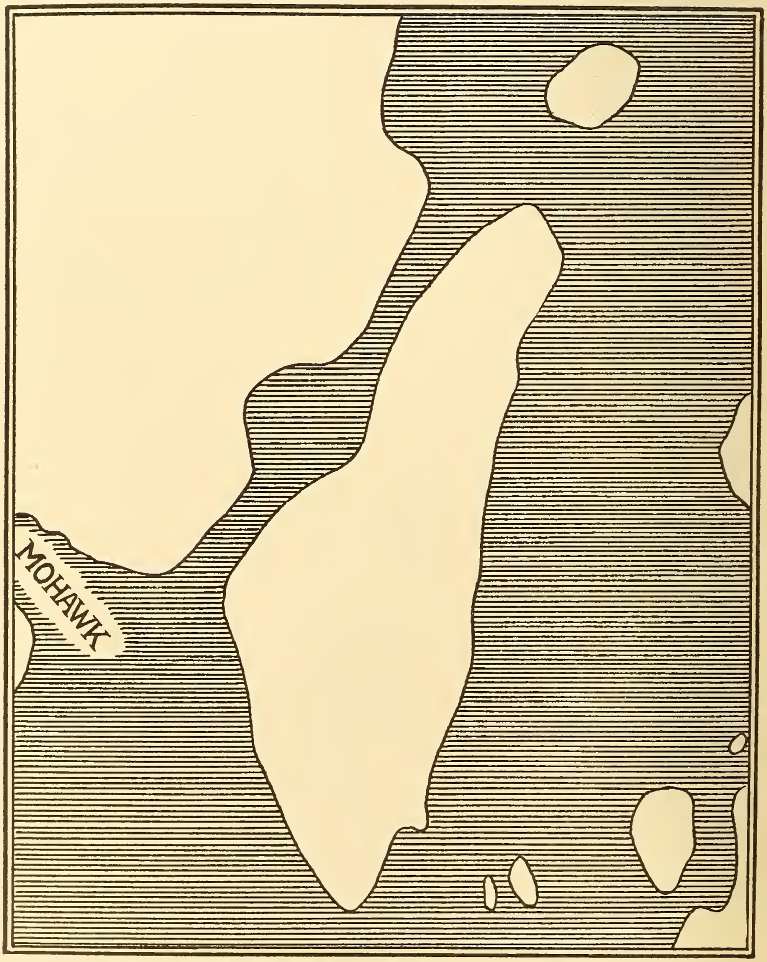

Fig. 4 Sketch map showing the distribution of land and water on the area of the Schenectady quadrangle when Lake Albany was at its height. Shaded part denotes waters of Lake Albany

Plate 5

Glacial till washed and eroded by powerful currents of water. In Ballston channel, east of the northern end of Ballston lake.

The flood which coursed northward through the Ballston channel was a part of the Mohawk flood when the stream was the outlet of Lake Iroquois. There were several conditions which determined this diversion of the Mohawk waters into the channel. (1) The subsidence of the waters of Lake Albany. When Lake Albany was at its fullest development, the Mohawk discharged into the body of the lake near Schenectady, its waters spreading widely into the lake as shown by the delta deposits previously described. Later when the lake began to subside and the delta emerged as land surface the river became gradually confined to the Mohawk channel and flowed in great volume and with high velocity in that portion of the channel which now forms the basin near Schenectady. (2) But the preglacial channel of the Mohawk from near Schenectady eastward had been filled by deposits and the waters now cut off from the old outlet sought the lowest levels of discharge left open to them under the new conditions. (3) At Aqueduct and eastward, where the river now occupies a gorge, a barrier of rock then existed. The present elevation of the rock surface on the north side of the river east of Rexford Flats is the same (according to the contour lines) as the elevation of the bluff bounding the Mohawk basin on the south, near Schenectady. This elevation may be taken at 350 feet. The surface slope of the rocks in that region is toward the south and a thick mass of till overlies the rocks south of the river. These conditions show that when Lake Albany had so subsided that the Mohawk waters flowed within the Schenectady basin, an overflow took place across the Aqueduct barrier and a spillway became established there, the waters entering Lake Albany near Vischer Ferry after flowing over the surface of the rocks and for a distance of some three miles. (4) The Aqueduct barrier acted as a dam against a great rush of waters and while the spillway just described was forming, a second place of discharge from the basin had become established. This was through the Ballston channel.

The southern end of this channel had been filled with sediments deposited in that portion of Lake Albany now indicated by the small sand plain east of East Glenville. The Ballston lake section of the channel had probably remained open. There is no clear evidence that it received Lake Albany deposits at any time. Woodworth,[1] as already quoted, has suggested that during the Mohawk delta stage " the ice sheet lay over this region (Ballston lake) while

[1] Ancient Water Levels. Mus. Bul. 84. 1905. p. 76

these clays were deposited on the east and south." It is true that Lake Albany deposits occur north of Ballston lake (crossed by the northern edge of the sheet). These deposits, however, represent deltas made by currents flowing from the north. They are thickest at the edge of the sheet and thin out toward the south, indicating that the currents dropped their loads not much south of the present boundary lines of these deposits.

There was, therefore, little to obstruct the northward flow of strong currents through the Ballston channel. The Lake Albany deposits in the southern end offered at least no more resistance than

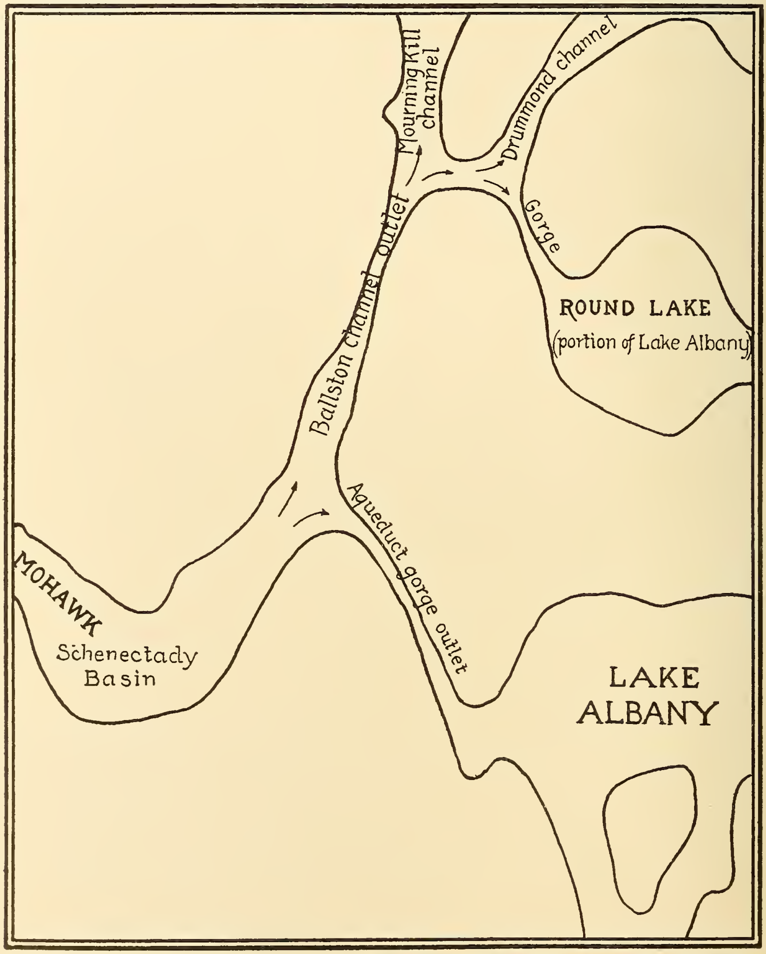

Fig. 5 Sketch map showing the distribution of land and water on the area of the Schenectady quadrangle when Lake Albany had subsided to the level of about 320 feet

the barrier of till, or till and rock, in the Aqueduct region. The dammed up waters, everywhere pressing against the slopes of the basin, gradually cut through these deposits and coursing northward flowed over the area in the vicinity of East Line, discharging into Lake Albany in that quarter.

These two exits of the Mohawk flood waters from the basin near Schenectady to Lake Albany continued for a considerable period. During this period the waters of Lake Albany further subsided. The three watercourses radiating from the East Line locality were established and the erosion of the Lake Albany sediments now represented by their channels, in their broader aspects, including the Round lake depression, took place.

At the same time the spillway in the Aqueduct region had deepened in that portion of its bed which was least resistant to erosion and had thus gradually acquired the character of a gorge. Its capacity, however, had not been increased to the extent that it afforded an exit for the entire volume of waters that the Mohawk poured into the basin, so that the excess of waters, above the capacity of the nascent gorge, continued to be diverted into the Ballston channel.

While the condition just named must have been for a long time a factor in the maintenance of the two contemporaneous outlets, it does not appear that it was a condition necessary to this end. For if we suppose that the rate of subsidence of Lake Albany was not greater than the rate of lowering of the channel of the two streams by erosion then the two outlets must have persisted. Even when the Aqueduct gorge, in the process of its gradual enlargement, acquired a capacity sufficient to contain the entire volume of Mohawk waters, the Ballston channel remained open as long as its bed was maintained at the same level as that of the Aqueduct channel. As long as, due to the subsidence of Lake Albany, an impetus was given to the flow of the waters in the two channels and as long as this flow kept the beds of the two channels eroded to the same level, both outlets must have persisted.

At length the time came when the Ballston channel currents were unable to maintain this equality of erosive effects. The greater length of bed to be deepened as compared with its rival gave the advantage to the latter. As soon as a slight difference in depth of bed was established in favor of the Aqueduct passage, the waters of the Ballston channel began to be drawn off. The divide in the channel emerged as land surface and the present system of drainage was initiated.

MOHAWK FLOOD DEPOSITS OF GLACIAL AGE

The broad basin of the Mohawk, west of Schenectady, is largely filled with deposits of gravel and sand. These deposits appear as the surface materials of the extensive depressed area, north of Scotia, crossed by the trunk-line railways. Farther to the south, along the river, gravels underlie the alluvium, as is shown where, on the shores of the islands, the alluvium has been swept off. The bed of gravel has been cut into by the river near the western edge of the sheet exposing a thickness of about 50 feet. The materials as here exhibited consist of cobbles of considerable size, generally smoothly worn, mixed with coarse sand and clay. The clay, or clay and lime, constituent to some extent acts as a cementing substance and masses of considerable thickness, appearing somewhat stratumlike in arrangement, are of conglomerate composition. Huge fragments of conglomerate have become detached and fallen to the base of the bluff.

The wells from which the public water supply of the city of Schenectady is obtained are excavations in this bed of gravel. They are located just south of the river at a point about one mile west of the western extremity of Van Slyck island. There are three wells, varying in depth from 42 to 44 feet. The deepest one is farthest to the east and is excavated entirely in gravel. The other two penetrate the bed of gravel and have their bottoms on a compact clay of dark bluish color.

There is an evident gradation from the coarser gravels in the western portion of the area referred to above to finer gravels and coarse sands farther to the east, passing to sands in the immediate vicinity of Scotia. Northwest of Scotia and extending as far as Alplaus the surface materials are mainly coarse sands and gravels.

North of the tracks of the New York Central & Hudson River Railroad there is a depression which was evidently at one time a watercourse. The soil here is clayey in composition and is believed to represent a deposit of alluvial origin. Another narrow area of clay of similar composition occurs farther to the east, extending toward Alplaus and bordering the modern river alluvium. In mapping it was thought best to distinguish between these, although the line of demarkation could be drawn only somewhat arbitrarily.

The bed of coarse gravels above described lying northwest of Scotia and extending to the edge of the sheet and beyond is interpreted as a deposit made by the Mohawk in the flooded or Iroquois stage of that river. It represents the heavy materials which were

Plate 6

Glacial flood gravels northwest of Scotia, cut by the Mohawk river

Plate 7

Looking across the Mohawk basin west of Schenectady

carried or pushed along by swift currents of water and which were deposited where the currents entered the static waters of Lake Albany. The less coarse materials were carried farther on and deposited in the order of their fineness. The fine clay and sand sediments were borne far out into the lake, building a great delta, as already described.

When Lake Albany had subsided to the extent that the Mohawk currents were held within the present boundaries of the basin the deposits were powerfully affected by the increased erosive force of the currents. The surface of the mass of coarse gravels heaped up in the western portion of the basin was swept by the swift currents and the finer constituents were picked up and carried on toward the Aqueduct spillway and (as soon as opened) the Ballston channel outlet. These sediments, however, owing to the damming effect of the Aqueduct barrier, were to a large extent redeposited, especially along the northern slope of the valley, thus giving rise to the coarse sands and fine gravels which constitute the surface materials of a somewhat broad area extending from north of Scotia to Alplaus. At a later date when the gorge at Aqueduct had been cut to the 300 foot level, the surface of the coarse gravel bed emerged, forming an island where the highest part of the gravel area northwest of Scotia now appears. This island increased in extent with the further lowering of the waters and the river thus became divided into two streams, one between the island and the slope of the hills to the north, the other approximately where the present river channel is located. As the northern stream gradually shallowed it began to deposit fine sediments and when finally the river abandoned this channel, the sediments remained as the soil of alluvial character described above.

DEPOSITS FROM FLOATING ICE

At the time of its flooded condition, especially in the early stages, the Mohawk waters doubtless transported numerous masses of floating ice. As these blocks melted, and where they became stranded and subsequently melted, the debris inclosed in them was dropped and added to the deposits already made from the waters. In this way the occasional boulders found buried in sands or mingled with gravels may be accounted for. Interesting examples of these are found in several localities. There is evidence that an ice block was stranded a short distance north of Scotia. A kettle hole (shown by a depression contour line on the topographic sheet) has a number of boulders of considerable size lying on its bottom. They are the more noticeable as occurring in the midst of an area of sand and fine gravel.

Boulders inclosed in sand, and dissociated from the underlying till, occur in the fields where molding sand is obtained southeast of South Schenectady. Also in the deep cut made in grading the new railway line to South Schenectady a large boulder imbedded in sand is exposed.

RECENT DEPOSITS

The deposits belonging to the recent epoch or period that has elapsed since the final subsidence and disappearance of glacial waters are (1) the alluvium laid down on the flood plains of the Mohawk river and the larger creeks and (2) the wind-blown sands of the sand plain areas. Mention may also be made of the peaty accumulations of swamps, or partially drained areas formerly lakes.

STREAM ALLUVIUMS

The alluvial deposit in the basin west of Schenectady is somewhat notable both for areal extent and for thickness. Some four or five square miles of valley lands, including the several large islands in the river, are composed of soils of alluvial origin. It is said that it was the fertility of these soils of the "great flats" that determined the original settlement of Schenectady.

The lower portion of the basin is still an area of sedimentation. This is shown not only by the overflow of the river on the flood plain at times (high water), but also by the steady growth of the islands west of the Schenectady-Scotia bridge at their lower (downstream) ends, and the silting up of the channels between them. It is also interesting to note that two new islands have been formed in recent years farther down the river, about half a mile west of the mouth of Alplaus kill. On the other hand, at the western end of the basin the alluvium is to some extent being swept away by the river currents, as is shown by the fact that the underlying gravel has in places been laid bare.

Another extensive alluvial deposit made by the Mohawk occurs farther to the east below Vischer Ferry. Here the river, abandoning the rock-bottomed channel which begins at Aqueduct, enters the territory of Lake Albany deposits. The stream has cut through the sands and clays and swept out a broad basin the floor of which consists mainly of till, overlaid, in the flood-plain area, with alluvium.

WIND-BLOWN SANDS

The regions of Lake Albany deposits where the surface materials consist mainly of sand show the effects of the drifting and heaping of sands by the winds. Some portions of these areas present a highly distinctive sand-dune topography. This is conspicuously the case in the Schenectady-Albany sand plain. The dunes are for the most part in the form of ridges with axes parallel to the direction of the prevailing wind that is, northwest-southeast. These dune features are brought out strikingly by the contour lines of the sheet in the portion of the plain crossed by the New York Central & Hudson River Railroad tracks, southeast of Schenectady.

The extent to which sands have been shifted by wind agency is clearly indicated on this plain. The western portion is nearly level and its soil has some clay mixed with the sand. It bears the appearance of a wind-denuded plain, from which the surface sands have been partially stripped leaving the underlying clays. To the east of this level area lies the highly irregular surface, marked by ridges and hillocks of sand. The highest dunes attain an elevation of 400 feet or 60 feet above the level of the denuded portion of the plain. This does not represent, however, the full extent to which the sands have been lifted, as farther to the east where the hills of till rise to the height of 500 feet, the country is more or less overspread with wind-laid sands.

In the sand region of the eastern portion of the sheet lying between the Mohawk valley and the Round lake depression there are extensive areas marked by the effects of wind agency. The country around Clifton Park is especially characterized by hills and hollows of sand. There is no evident regularity to the forms of the dunes, indicating that winds blowing from different directions have had part in their formation. Recent effects of the wind in modifying existing surface features are noticeable.

Plate 8

Showing the topography of the sand plain region southeast of Schenectady where the sands have been blown by the winds, forming dunes

Plate 9

A portion of the sand plain region which has undergone denudation by the winds; located east of South Schenectady

REVIEW AND SUMMARY

The Pleistocene history of the area of the Schenectady quadrangle begins with that condition of glaciation which produced the striae now observable on the surface of the bedrock. We start, then, with the conception of a sheet of ice overspreading the country and moving in a general direction of some 30 degrees west of south. The number of localities where striae were observed is insufficient to determine differential movements due to the adjustment of the flow of the ice to local irregularities of surface. A comparison with similar observations for adjoining territory would also be necessary to determine whether the direction of movement was influenced by the regional topography which, as suggested by Chamberlain,[1] caused a westward movement of ice in the eastern portion of the Mohawk valley. It may be noted, however, that at the western edge of the sheet striae showing a direction of 57 degrees west of south were observed in one locality.

With the change to climatic conditions that resulted in the general retreat of the ice sheet to the north, we conceive that the southern portion of the area was first freed of ice. Its lower altitude as compared with the northern portion of the sheet strengthens the probability of this inference. The withdrawing ice sheet left in its wake the materials of the ground moraine together with the debris dropped by the melting ice, forming the sheet of till that now overlies the bedrock.

As the channel of the Mohawk became uncovered it seems probable that glacial waters filled the rock depression underlying the present basin west of Schenectady. Rocks lie at a considerable, though unknown, depth below the present surface of the basin; we also lack knowledge of the present extent of this rock basin toward the south. We may, however, with considerable confidence assume the accumulation of glacial waters in this locality before the Mohawk valley to the west was opened. It is likewise probable that the rock basin below Vischer Ferry filled in with waters derived from the melting ice.

How soon after the withdrawal of the ice from the southern portion of the sheet the Lake Albany waters spread over the bared area could be determined only by a study of the general conditions involved in the origin and development of Lake Albany. It is even

[1] U. S. Geol. Survey, 3d An. Report, p.361–65.

possible that the two local accumulations of glacial waters just referred to were parts of that general body of water.

If, however, the lower Mohawk valley became open prior to the time when Lake Albany had developed to the extent that it covered the general region from the Mohawk valley near Schenectady to the Hudson, then the Mohawk waters found an outlet to the Hudson channel at the lowest level left open by a topography modified by glacial drift. It is possible that at this time the preglacial channel of the Mohawk still afforded this passage.

As the ice sheet receded farther to the north, uncovering the region of the Glenville basin, glacio-fluviatile waters swept in considerable volume across the floor of that depression, bearing sands to the area southward.

In the region of Burnt Hills there was a temporary halt in the recession of the ice sheet, giving rise to morainic accumulations. Behind these accumulations glacial waters became ponded, thus originating Lake Alplaüs.

We pass then to the stage when Lake Albany had reached the development evinced by the clays and sands of the plain region between Schenectady and Albany. These deposits are likewise the witness of a flooded condition of the Mohawk which we correlate with the Iroquois stage of that river. Where the flooded river issued into the lake, somewhat west of the western edge of the Schenectady sheet, it dropped the coarser materials of its load, building a bed of gravel into the lake; the finer sediments were carried farther out into Lake Albany, building a delta. For a long time these finer sediments consisted mainly of clays derived from the shale rocks which predominate in the drainage basin of the river. Later, when the southern slopes of the Adirondack region became freed of ice, the Mohawk received from its tributaries from the north the sands derived from the Precambric rocks and these were deposited in Lake Albany overlying the clays.

It was perhaps during this time that the preglacial channel of the Mohawk from near Schenectady eastward was filled up by sediments. The alternative view is that it had been filled at an earlier time by glacial debris, or drift.

At some time after the ice in its retreat to the north had passed beyond the northern edge of the area of the Schenectady sheet, the waters of Lake Albany covered all parts of the area, the present elevation of which is from about 350 feet in the southern part to 380 feet in the northern part. Besides the Mohawk delta, above described, sediments borne by currents from the north were deposited in the lake, forming the clays and sands of the eastern and northern portions of the sheet. There is evidence that a tongue of ice lingered in the depression of the Ballston channel, thus preventing the accumulation of sediments in the northern portion of this depression.

The time came when Lake Albany waters began to subside The delta southeast of Schenectady emerged as land surface and the Mohawk currents became confined within a channel conforming with the basin near Schenectady. For a time the flooded waters may have found a passage to the east near South Schenectady in the course marked by the present valley of the Poentic kill. But as the divide between Poentic kill and Normans kill is now about 350 feet elevation and allowance must be made for postglacial erosion, it is evident that a spillway was found across the rocks below Aqueduct and the flow of the currents was established in this direction. The rush of waters, impeded by the Aqueduct barrier, forced an entrance into Ballston channel, eroding the sands deposited in that portion of Lake Albany which occupied the southern end of the channel. The northward moving currents emerged from the Ballston channel near East Line, there discharging into Lake Albany. As the lake further subsided the currents established three watercourses: two northerly, initiating the present valleys of Mourning kill and Drummond creek and one southeasterly, initiating the valley of Anthony kill. The current pursuing the last named course eventually swept away the sands and clays in the Round lake locality resulting at length in the present depression in that region.

The two outlet streams from the Mohawk basin to Lake Albany were maintained as long as through erosion their beds were kept at the same level. This equality of erosive effects was probably determined by the circumstance that the rate of subsidence of Lake Albany was no greater than the rate of lowering of the beds of the two streams by erosion. At length, however, owing to the greater extent of bed of the Ballston stream, it failed to deepen its channel as rapidly as its rival and its waters were drawn off in favor of the Aqueduct course of the Mohawk.

The present conditions of drainage having thus been initiated, the Mohawk gorge below Aqueduct, the Alplaus gorge below High Mills and the gorge of Anthony kill from near East Line to Round Lake have since been developed. Probably the greater part of the erosion resulting in these gorges was the work of the flooded waters of the late glacial and early postglacial times; but the process has continued during the present epoch and is still in progress.

With the gradual deepening of the Aqueduct gorge the Mohawk waters, sweeping in a great half circle, cut into the western edge of the Lake Albany deposits forming the basin near Schenectady. At the same time the waters, as they issued from the gorge, spreading in their course, swept away the sands and clays in their path, forming the basin east of Vischer Ferry. In the recent epoch the surfaces of these basins have been overlaid with alluvium.

The plains left by the subsiding Lake Albany waters were early swept by strong winds which, over extensive areas, lifted the surface sands, transporting them mainly eastward. Thus were formed, on the one hand, wind-denuded and leveled tracts and, on the other, the regions marked by hills and ridges of wind-blown sands.

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Appendix 2

Economic geology

Museum Bulletin 151

151 Mining and Quarry Industry of New York 1910

Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 496 ALBANY, N. Y. June 1, 1911

New York State Museum

John M. Clarke, Director

Museum Bulletin 151

THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1910

BY

D. H. NEWLAND

New York State Education Department
Science Division, June 16, 1911

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

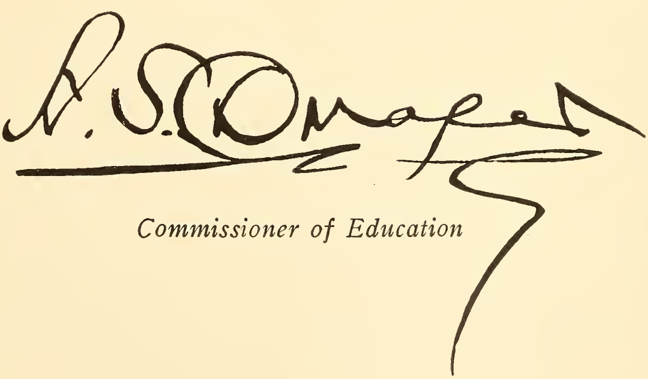
MY DEAR SIR:

I transmit to you herewith the manuscript of our annual report on *The Mining and Quarry Industry of New York State,* for the year 1910, and I recommend its publication as a bulletin of the State Museum.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 17th day of June 1911



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THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1910

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D. H. NEWLAND

INTRODUCTION

The year 1910 did not witness any notable extension of mining and quarry operations in the State. The outlook at the opening seemed propitious for a very busy season for these industries and a substantial advance in most branches, but the activity of the first few months was not maintained. Toward the middle of the year a reaction set in which soon caused general curtailment of production and put a definite end to further progress. In this respect the industrial record was exactly the reverse of that for 1909 when the depression which lasted during the first few months gave way to a period of marked expansion and prosperity.

A summary of the reports rendered by the mining and quarry enterprises shows that the value of the mineral production of the State amounted to $35,400,257. The total represents a slight gain as compared with the value of $34,742,287 for the output in the preceding year, but it falls considerably short of the high mark reached in 1907 when a production of over $37,000,000 was reported.

The figures as given are based on some thirty different materials in their crude or first marketable forms, but can not be considered as representing the full importance which the mineral industries share in the activities of the State. They are serviceable, however, as standards for comparing the conditions in these fundamental branches so closely allied with many other businesses of chemical, metallurgical or engineering nature. The manufacture of pig iron by local furnaces is alone nearly equal to the totals given for the entire output of the mines and quarries.

One of the few mineral products that showed a decided gain during the year was iron ore, of which the gross output amounted to 1,517,880 long tons. This is probably the largest quantity that has ever been hoisted from the New York mines. After allowance for concentration there remained suitable for furnace use a total of 1,159,067 tons of ore which had a value of $3,906,478. The corresponding figures for 1909 were 991,008 tons valued at $3,179,358. The Adirondack region furnished, as usual, the greater part of the product, but the mines in the Clinton belt of central and western New York were more active than for some time. Altogether there were thirteen companies who reported a production, as compared with twelve in 1909 and ten in 1908.

The clay-working industries contributed an important share of the total value with an aggregate of $11,518,982 for the various materials which were manufactured. In comparison with the record for 1909 this showed a slight decrease, for which the dull season in the building trades was mainly responsible. The output of clay structural materials, such as brick, terra cotta, tile and fire proofing, was valued at $8,067,098 against $9,342,015 in 1909, a decline of nearly 15 per cent. The number of brick for building purposes made last year was 1,404,345 thousands against 1,518,023 thousands in 1909, of which the plants in the Hudson river region contributed about three-fourths. On the other hand the value of the pottery manufacturers showed a good gain with a total of $2,136,518 against $1,827,193 in the preceding year. The number of plants engaged in the different branches of clay manufacturing was 223, or nine less than 1909.

The value of the quarry materials last year was $6,193,252, also a loss as compared with the record for 1909 when the sum of $7,061,580 was reported. The total was divided according to various uses into: building stone, $780,333; monumental stone, $101,673; curb and flagstone, $484,020; crushed stone, $3,042,136; other uses, $1,785,090. The output of slate, millstones, and limestone used in making hydraulic cement is not included in these totals. All kinds of stone were quarried less extensively last year, though the falling off was particularly noticeable in granite and sandstone which are used largely for structural purposes. The production of limestone, marble and trap was but little smaller than in the preceding year.

Conditions in the hydraulic cement trade were rather unfavorable last year, yet there was a notable gain in production from the local mills. The total quantity of cement manufactured was 3,657,015 barrels valued at $3,087,020, against 2,610,383 barrels valued at $2,122,902 in 1909. The gain came from the portland cement plants which contributed a total of 3,364,255 barrels as compared with 2,061,019 barrels in the preceding year; the production of natural cement continued to decline, as for a number of years past, and amounted only to 292,760 barrels, or about one-half the quantity reported for 1909. The latter industry, once so important in the State, has thus been reduced to small proportions, but there is every prospect of a continued growth of the portland branch in which some large developments have recently been in progress.

The production of salt from the mines and wells of the State amounted to 10,270,273 barrels, exceeding that of any previous year. The value of the output was $2,258,292. As compared with the totals reported for 1909 there was a gain of about 4 per cent in quantity, but a slight reduction in the value of the product. The two rock salt mines were very active and served to keep Livingston county, in which they are situated, in the leading place as a salt producer. Onondaga county had the second largest industry, though it contributed very little for actual sale, most of its output being consumed locally for alkali manufacture.

The mining of gypsum has assumed large proportions of late years due to the increased manufacture of gypsum plasters for building purposes. The output from the mines last year reached a total of 465,591 short tons as compared with 378,232 short tons for 1909. The value of the different gypsum materials, including wall plaster, plaster of paris, and gypsum sold in unburned condition, was $1,122,952, against $907,601 in the preceding year. The gain which exceeded 20 per cent came mostly from the mines in the western section where a number of new enterprises recently entered the field.

The combined value of the petroleum and natural gas produced in the State last year was $2,869,893 against $3,059,308 in 1909. The quantity of petroleum, all from the wells in Allegany, Cattaraugus and Steuben counties, amounted to 1,073,650 barrels with a value of $1,458,194. This was a reduction from the previous year's total of 1,160,128 barrels attributable to the recent drop in prices which discouraged exploration work. The gas wells, however, made a larger output than ever before, the total flow amounting approximately to 4,815,643,000 cubic feet with a value of $1,411,699 against 3,825,215,000 cubic feet and a value of $1,045,693 in 1909. The Erie county wells contributed the largest increase of output for the year.

The talc industry is one of the smaller mining activities represented in New York and the output came mostly from a single district in St Lawrence county. The amount obtained last year was about 65,000 short tons, valued at $552,500, a gain of 15,000 tons over the total for 1909. The St Lawrence county mines have practically a monoply of the fibrous talc consumed in paper manufacture.

Garnet for abrasive uses was produced to the amount of 5297 short tons, valued at $151,700, a large gain over the figures reported for the preceding year which were 3802 tons, valued at $119,190.

The production of crystalline graphite from the Adirondack mines amounted to 2,619,000 pounds with a value of $160,700. The corresponding total for 1909 was 2,342,000 pounds with a value of $140,140.

The mineral springs that were used for commercial purposes reported sales of 8,432,672 gallons valued at $675,034 as compared with 9,019,490 gallons valued at $857,342 in 1909.

Among the other mineral materials which had a place in the list of products reported last year were apatite, carbon dioxid, clay, diatomaceous earth, emery, feldspar, lead ore, marl, millstones, metallic paint, slate pigment, pyrite, quartz, slate, sand and sand-lime brick. The collected value of these materials was $2,904,454 as compared with $2,170,881 in 1909.

Mineral production of New York in 1906

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 423 374	$2 766 488
Natural rock cement	Barrels	1 691 565	1 184 211
Building brick	Thousands	1 600 059	9 688 289
Pottery			1 795 008
Other clay products			2 472 003
Crude clay	Short tons	5 477	9 125
Emery	Short tons	1 307	13 870
Feldspar and quartz	Long tons	13 660	44 350
Garnet	Short tons	4 729	159 298
Glass sand	Short tons	9 000	8 600
Graphite	Pounds	2 811 582	96 084
Gypsum	Short tons	262 486	699 455
Iron ore	Long tons	905 367	3 393 609
Millstones			22 442
Metallic paint	Short tons	2 714	29 140
Slate pigment	Short tons	2 045	15 960
Mineral waters	Gallons	8 000 000	1 000 000
Natural gas	1000 cubic feet	3 007 086	766 579
Petroleum	Barrels	1 043 088	1 721 095
Pyrite	Long tons	11 798	35 550
Salt	Barrels	9 013 993	2 131 650
Roofing slate	Squares	16 248	57 771
Slate manufactures			4 150
Sand-lime brick	Thousands	17 080	122 340
Granite			255 189
Limestone			2 963 829
Marble			460 915
Sandstone			1 976 829
Trap			847 403
Talc	Short tons	64 200	541 600
Other materials [1]			1 850 000
Total value			$37 132 832

[1] Includes apatite, arsenical ore, carbon dioxid, diatomaceous earth, fullers earth, marl and sand and gravel exclusive of glass sand.

Mineral production of New York in 1907

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 108 450	$2 214 090
Natural rock cement	Barrels	1 137 279	757 730
Building brick	Thousands	1 366 842	7 424 294
Pottery			2 240 895
Other clay products			3 023 679
Crude clay	Short tons	3 927	6 163
Emery	Short tons	1 223	13 057
Feldspar and quartz	Long tons	8 723	36 230
Garnet	Short tons	5 709	174 800
Glass sand	Short tons	1 200	1 380
Graphite	Pounds	2 950 000	106 951
Gypsum	Short tons	323 323	751 556
Iron ore	Long tons	1 018 013	3 750 493
Millstones			21 806
Metallic paint	Short tons	5 269	59 521
Slate pigment	Short tons	620	3 700
Mineral waters	Gallons	8 000 000	1 000 000
Natural gas	1000 cubic feet	3 052 145	800 014
Petroleum	Barrels	1 052 324	1 736 335
Pyrite	Long tons	49 978	162 430
Salt	Barrels	9 657 543	2 449 178
Roofing slate	Squares	11 686	53 625
Slate manufactures			1 175
Sand-lime brick	Thousands	16 610	109 677
Granite			195 900
Limestone			3 182 447
Marble			1 571 936
Sandstone			1 998 417
Trap			941 627
Talc	Short tons	59 000	501 500
Other materials[1]			1 850 000
Total value			$37 141 006

[1] Includes apatite, arsenical ore, carbon dioxid, diatomaceous earth, fullers earth, marl and sand and gravel exclusive of glass sand.

Mineral production of New York in 1908

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	1 988 874	$1 813 622
Natural rock cement	Barrels	623 588	441 136
Building brick	Thousands	1 066 533	5 200 951
Pottery	....	....	1 653 241
Other clay products	....	....	2 064 671
Crude clay	Short tons	4 697	11 605
Emery	Short tons	690	8 860
Feldspar and quartz	Short tons	16 413	68 148
Garnet	Short tons	2 480	79 890
Graphite	Pounds	1 932 000	116 100
Gypsum	Short tons	318 046	760 759
Iron ore	Long tons	697 473	2 098 247
Millstones	....	....	18 341
Metallic paint	Short tons	5 750	54 500
Slate pigment	Short tons	922	7 376
Mineral waters	Gallons	8 007 092	877 648
Natural gas	1000 cubic feet	3 860 000	987 775
Petroleum	Barrels	1 160 128	2 071 533
Pyrite	Long tons	23 775	104 798
Salt	Barrels	9 005 311	2 136 736
Sand and gravel	....	....	1 130 291
Sand-lime brick	Thousands	8 239	55 688
Slate	....	....	111 217
Granite	....	....	367 564
Limestone	....	....	3 119 835
Marble	....	....	692 857
Sandstone	....	....	1 711 585
Trap	....	....	723 773
Talc	Short tons	70 739	697 390
Other materials [1]	....	....	333 648
Total value	....	....	$29 519 785

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

Mineral production of New York in 1909

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 061 019	$1 761 297
Natural rock cement	Barrels	549 364	361 605
Building brick	Thousands	1 518 023	8 159 096
Pottery	....	....	1 827 193
Other clay products	....	....	2 365 193
Crude clay	Short tons	12 174	11 585
Emery	Short tons	892	10 780
Feldspar and quartz	Short tons	16 111	52 444
Garnet	Short tons	3 802	119 190
Graphite	Pounds	2 342 000	140 140
Gypsum	Short tons	378 232	907 601
Iron ore	Long tons	991 008	3 179 358
Millstones	....	....	15 000
Metallic paint	Short tons	6 560	65 600
Slate pigment	Short tons	1 155	9 130
Mineral waters	Gallons	9 019 490	857 342
Natural gas	1000 cubic feet	3 825 215	1 045 693
Petroleum	Barrels	1 160 402	1 914 663
Salt	Barrels	9 880 618	2 298 652
Molding sand	Short tons	468 609	437 402
Sand-lime brick	Thousands	12 683	81 693
Roofing slate	Squares	21 187	126 170
Slate manufactures	....	....	880
Granite	....	....	479 955
Limestone	....	....	3 300 383
Marble	....	....	380 016
Sandstone	....	....	1 839 798
Trap	....	....	1 061 428
Talc	Short tons	50 000	450 000
Other materials [1]	....	....	1 483 000
Total value	....	....	$34 742 287

[1] Includes apatite, carbon dioxid, diatomaceous earth, marl, pyrite, and sand and gravel exclusive of molding sand.

Mineral production of New York in 1910

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	3 364 255	$2 938 818
Natural rock cement	Barrels	292 760	147 202
Building brick	Thousands	1 404 345	6 683 071
Pottery	....	....	2 136 518
Other clay products	....	....	2 699 393
Crude clay	Short tons	6 005	9 667
Emery	Short tons	978	11 736
Feldspar and quartz	Short tons	18 012	64 503
Garnet	Short tons	5 297	151 700
Graphite	Pounds	2 619 000	160 700
Gypsum	Short tons	465 591	1 122 952
Iron ore	Long tons	1 159 067	3 906 478
Millstones	....	....	6 613
Metallic paint	Short tons	8 063	70 841
Slate pigment	Short tons	1 400	10 900
Mineral waters	Gallons	8 432 672	675 034
Natural gas	1000 cubic feet	4 815 643	1 411 699
Petroleum	Barrels	1 073 650	1 458 194
Pyrite	Long tons	37 270	175 791
Salt	Barrels	10 270 273	2 258 292
Sand and gravel	....	....	2 129 708
Sand-lime brick	Thousands	14 053	82 619
Roofing slate	Squares	14 107	79 857
Slate manufactures	....	....	3 233
Granite	....	....	244 763
Limestone	....	....	3 245 807
Marble	....	....	341 880
Sandstone	....	....	1 451 796
Trap	....	....	909 006
Talc	Short tons	65 000	552 500
Other materials [1]	....	....	258 986
Total value	....	....	$35 400 257

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

CEMENT

The portland cement mills of the State generally reported a larger business during 1910 than for some time past. The year as a whole, however, could hardly be called very favorable for the industry. The improved demand which began late in 1909 enabled manufacturers to extend operations, in some plants to nearly full capacity, but prices were still on an unremunerative basis. A radical improvement in this respect was especially needed to bring any real prosperity to the industry. A slight advance that was made early in the summer appeared to mark the beginning of a stronger market, but before the year closed prices were again on the former level. That the consumption of cement has been increasing should strengthen the hope for a definite relief of the market situation before long. With the large amount of engineering work in progress in the State, the local producers have fared perhaps better than the average.

The unfavorable conditions were still more accentuated in the natural cement trade, in which both prices and demand showed a marked decline. For the last decade the natural cement companies have been gradually withdrawing from business and the production has fallen to small proportions. The closing of the plants has caused heavy losses not only of capital but of industrial activity to many communities, since only in one or two instances has it been possible to replace the enterprises with portland cement mills. As a measure of the former importance of the natural cement industry in New York, the statistics in the accompanying table will be of interest.

The aggregate production of cement in 1910 amounted to 3,657,015 barrels. The total for the preceding year was 2,610,383 barrels and for 1908 it was 2,612,462 barrels. The production last year has not been exceeded since 1906. The returns showed that twelve companies were active, or one less than in 1909, and about one-half the number active five years ago.

Of the total production, the portland cement mills contributed 3,364,255 barrels, with a value of $2,939,818, much the largest that has ever been reported. In the preceding year the output was 2,061,019 barrels valued at $1,761,297. One new plant was placed in operation and eight in all were active during the whole or part of the year.

The output of natural cement was returned as 292,760 barrels, valued at $147,202, against 549,364 barrels valued at $361,605 in 1909. There were only four companies which reported a production, a loss of three as compared with the preceding year. The Rosendale district was represented by a single company and Onondaga county by three firms. All of the plants in Erie county were closed throughout the year.

Production of cement in New York

YEAR	PORTLAND CEMENT		NATURAL CEMENT	
	Barrels	Value	Barrels	Value
1890	65 000	$140 000	3 776 756	$2 985 513
1891	87 000	190 250	3 931 306	3 046 279
1892	124 000	279 000	3 780 687	3 074 781
1893	137 096	287 725	3 597 758	2 805 387
1894	117 275	205 231	3 446 330	1 974 463
1895	159 320	278 810	3 939 727	2 285 094
1896	260 787	443 175	4 181 918	2 423 891
1897	394 398	690 179	4 259 186	2 123 771
1898	554 358	970 126	4 157 917	2 065 658
1899	472 386	708 579	4 689 167	2 813 500
1900	465 832	582 290	3 409 085	2 045 451
1901	617 228	617 228	2 234 131	1 117 066
1902	1 156 807	1 521 553	3 577 340	2 135 036
1903	1 602 946	2 031 310	2 417 137	1 510 529
1904	1 377 302	1 245 778	1 881 630	1 207 883
1905	2 117 822	2 046 864	2 257 698	1 590 689
1906	2 423 374	2 766 488	1 691 565	1 184 211
1907	2 108 450	2 214 090	1 137 279	757 730
1908	1 988 874	1 813 622	623 588	441 136
1909	2 061 019	1 761 297	549 364	361 605
1910	3 364 255	2 939 818	292 760	147 202

The New York-New England Cement and Lime Co. started its new portland cement mill during the summer. The quarries and kilns are situated at Greenport near Hudson. The company also uses the old plant of the Hudson Cement Co. at the river side as a supplementary mill, the two plants being connected by a private railroad. The capacity of the works is the largest of any in the State.

The Knickerbocker Portland Cement Co. is expected to begin operations this summer. The limestone quarries which are already opened are situated on Becraft mountain in the same vicinity as those of the former company, in the Coeymans and Manlius formations. The plant is designed for a capacity of 3000 barrels a day and will include three rotary kilns, each 10 by 175 feet. Shipping facilities into New England states are provided by the Boston & Albany Railroad, and the company has a private road connecting with the main line of the New York Central and with the Hudson river.

The Marengo Portland Cement Co., the successor to the Iroquois Co., completed the work of remodeling the mill at Caledonia, Livingston county, which was again placed in operation. The mill of the Wayland Portland Cement Co., at Wayland, Steuben county, also resumed work.

The mill of the Empire Portland Cement Co., at Warners, Onondaga county, was dismantled and sold. The company will not continue in the business.

A second new producer during the current year will probably be the mill now under construction at Jamesville, Onondaga county, by Thomas Millen & Co. It is expected to be ready for operation in July.

CLAY

The prominence of the clay-working industries in New York State is due chiefly to the widely distributed deposits of common clays suited for building brick, drain tile and materials of that class. As the whole State lies within the zone of Pleistocene glaciation, residual clays are of rare occurrence and of little commercial importance.

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

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

In addition to the soft clays there is an abundance of shales among the stratified rock formations; some of the shales are adapted for making paving and building brick, tile and other materials, though they have not been exploited to any extent.

PRODUCTION OF CLAY MATERIALS

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

The returns received for the year 1910 show that trade conditions as a whole were rather unsatisfactory, though the outlook at the opening seemed propitious for a busy and prosperous season. As a matter of fact business fell off steadily from month to month, its course being exactly opposite to the trend of the preceding year. In the building trades, which had shown marked activity in the later months of 1909, the decline was most pronounced and the demand for all classes of clay structural materials was very restricted. The Hudson river brick industry experienced the full effects of the depression, production having largely exceeded the demand, with poor prospects for any material improvement in the situation during the current season.

Production of clay materials

MATERIAL	1908	1909	1910
Common brick	$5 064 194	$8 009 766	$6 563 212
Front brick	136 757	149 330	119 859
Vitrified paving brick	211 289	207 970	333 511
Fire brick and stove lining	545 951	486 894	464 693
Drain tile	273 134	268 589	254 679
Sewer pipe	133 716	117 324	127 731
Terra cotta	709 360	962 497	1 062 017
Fireproofing	91 377	166 025	256 820
Building tile	70 162	54 397	65 190
Miscellaneous	29 680	101 497	134 752
Pottery	1 653 241	1 827 193	2 136 518
Total	$8 918 861	$12 351 482	$11 518 982

The output of clay materials of all kinds in 1910 was valued at $11,518,982. The total thus fell only a little short of that for the preceding year when the value was $12,351,482, but for many branches the showing was really much less favorable than this comparison would indicate. The number of firms or individuals engaged in the clay-working industry was 223 against 232 in 1909 and the product was distributed among 39 of the 61 counties in the State.

Examination of the different items entering into the production brings out the fact that the main decrease was in building brick, the output of which was valued at $6,683,071 against $8,159,096 in 1909, a decrease of $1,476,025. Common brick accounted for $6,563,212 in the total, against $8,009,766 in the preceding year, and front brick for $119,859 against $149,330. Fire brick and stove lining showed a small decrease, with a total value of $464,693 against $486,894 in 1909. The vitrified paving brick industry, on the other hand, reported a good advance, the product reaching a value of $333,511 as compared with $207,970 for the preceding year. The manufacture of drain tile was valued at $254,679 against $268,-589; and of sewer pipe at $127,731 against $117,324. The production of terra cotta was valued at $1,062,017 as compared with $962,-497 in 1909; fireproofing at $256,820, as compared with $166,025; and building tile at $65,190 as compared with $54,397. The miscellaneous clay manufactures, including such items as flue lining, fire tile and shapes, conduit pipes and acid-proof brick, had a collected value of $134,752 against $101,497 in 1909. The potteries of the State reported an output valued at $2,136,518 as compared with a value of $1,827,193 in the preceding year.

A distribution of the production in 1910 according to the counties represented places Ulster county in the lead as having the largest clay-working industry. The value of its output was $1,121,460, nearly $500,000 less than the total for 1909. Rockland county held second place, with a value of $1,080,117, also showing a large reduction from the amount reported in the preceding year. In both counties the manufacture of common building brick is the main industry. Erie county advanced from sixth place in 1909 to third place last year with an aggregate value of $841,726. It has a diversified industry, including important potteries. Onondaga county maintained its place as the fourth largest producer and contributed a value of $833,892, practically the same as in 1909. The other counties which reported a value exceeding $500,000 were, in order: Orange ($761,500); Dutchess ($649,862); Albany ($641,227); Richmond ($633,010); Kings ($569,720); Queens ($551,375); and Schenectady ($505,966).

Production of clay materials by counties

COUNTY	1908	1909	1910
Albany	$538 213	$750 754	$641 227
Allegany	44 627	22 601	a..........
Cattaraugus	a.........	a.........	63 887
Cayuga	13 280	15 400	20 675
Chautauqua	128 866	118 897	129 331
Chemung	89 000	61 000	a..........
Clinton	3 920	a.........	a..........
Columbia	283 720	472 280	454 550
Dutchess	605 371	880 707	649 862
Erie	632 048	753 362	841 726
Greene	113 373	346 982	266 452
Jefferson	17 897	11 175	7 997
Kings	416 474	490 946	569 720
Livingston	53 555	6 900	a..........
Madison	12 550	a.........	nil
Monroe	240 087	278 991	264 421
Nassau	71 390	136 375	111 650
Niagara	10 892	22 923	22 882
Oneida	88 606	83 500	126 907
Onondaga	734 880	834 111	833 892
Ontario	214 246	196 345	269 549
Orange	747 637	814 440	761 500
Queens	a.........	435 182	551 375
Rensselaer	233 995	317 559	348 172
Richmond	587 919	698 991	633 010
Rockland	800 603	1 488 457	1 080 117
Saratoga	245 878	335 670	388 428
Schenectady	238 750	322 549	505 966
Steuben	166 544	205 036	219 615
Suffolk	125 430	68 370	101 560
Ulster	819 947	1 620 468	1 121 460
Washington	11 295	10 950	3 685
Westchester	226 062	438 243	371 328
Other counties *b*	401 808	112 318	158 038
Total	$8 918 863	$12 351 482	$11 518 982

a Included under "Other counties."
b In 1908, aside from counties marked *a* are included Broome, Fulton, Genesee, Herkimer, Montgomery, New York, St Lawrence, Tioga, Tompkins, Warren, and Wayne counties. In 1909, aside from counties marked *a* are included Fulton, Genesee, Montgomery, New York, St Lawrence, Tioga, Tompkins, Warren, and Wayne counties. In 1910, aside from counties marked *a* are included Genesee, Montgomery, New York, St Lawrence, Tompkins, and Warren counties.

MANUFACTURE OF BUILDING BRICK

The product of common building brick in 1910 amounted to 1,396,606,000, against 1,507,126,000 in the preceding year, showing a decrease of 110,520,000. The value of the product was $6,563,-212 against $8,009,766, or a decrease of $1,446,554. In addition there were made last year 7,739,000 front brick valued at $119,859, as compared with 10,897,000 valued at $149,330 in the preceding year. The aggregate output of brick for building purposes was, therefore, 1,404,345,000 valued at $6,683,071, against 1,518,-023,000 valued at $8,159,096 in 1909. The manufacture of building brick was carried on in 32 counties by a total of 172 companies or individuals. In 1909 there were 36 counties represented with a total of 180 producers. The largest number of producers for any one year was in 1906 when 213 reported as active, distributed over 37 counties.

The average price received for common brick throughout the State was $4.70 a thousand, the price being based on the sales at the yard. This was the lowest average reported in a number of years. In 1909 the corresponding figure was $5.31 a thousand and in 1908 when the effects of the panic were still strongly felt the average was $4.79 a thousand. The maximum average of late years was $6.53 in 1905. The price of front brick averaged $15.49 a thousand last year against $13.70 in 1909 and $14 in 1908.

Production of common building brick

COUNTY	1909		1910	
	NUMBER	VALUE	NUMBER	VALUE
Albany	80 343 000	$429 554	74 496 000	$390 894
Cattaraugus	....	....	612 000	5 984
Cayuga	1 612 000	10 200	2 403 000	16 075
Chautauqua	7 815 000	52 047	5 058 000	32 588
Chemung	10 500 000	61 000	*b*..........	*b*.......
Clinton	250 000	1 500	*b*..........	*b*.......
Columbia	88 026 000	472 280	92 700 000	454 550
Dutchess	170 615 000	876 207	147 696 000	649 862
Erie	43 379 000	243 786	51 244 000	283 207
Greene	42 794 000	246 982	30 374 000	137 452
Jefferson	1 450 000	11 175	1 068 000	7 997
Livingston	1 100 000	6 700	312 000	2 184
Monroe	23 493 000	126 950	19 531 000	111 758
Nassau	20 000 000	118 560	17 000 000	107 500
Niagara	3 368 000	22 923	3 434 000	22 882
Oneida	16 000 000	83 500	19 126 000	119 082
Onondaga	22 800 000	154 250	19 569 000	104 534
Ontario	2 350 000	14 200	*b*..........	*b*.......
Orange	164 680 000	814 440	160 500 000	761 500
Rensselaer	19 895 000	102 225	14 600 000	72 800
Richmond	37 500 000	170 475	32 355 000	134 049
Rockland	275 262 000	1 488 457	251 190 000	1 080 117
Saratoga	70 539 000	333 728	84 639 000	387 268
Steuben	3 480 000	30 132	*b*..........	*b*.......
Suffolk	11 870 000	68 370	16 360 000	98 560
Ulster	304 904 000	1 620 468	263 873 000	1 121 460
Westchester	72 265 000	392 577	66 836 000	332 027
Other counties *a*	10 836 000	57 080	21 630 000	128 882
Total	1 507 126 000	$8 009 766	1 396 606 000	$6 563 212

a Includes in 1909, Allegany, Cattaraugus, Fulton, Montgomery, St Lawrence, Tioga, Tompkins, Warren, and Washington counties. In 1910 the following counties are included: Chemung, Clinton, Montgomery, Ontario, St Lawrence, Steuben, Tompkins, Warren, and Washington.

b Included under "Other counties."

Hudson river region. The Hudson river region from Albany and Rensselaer counties south to New York city enjoys special advantages in the manufacture and marketing of building brick and has long held a leading position in that branch of the industry. The nine counties included in the region contribute about four-fifths of the entire output of common brick in the State. A small share of the product, mainly from the yards in Albany and Rensselaer counties, is marketed locally; the rest is all shipped to New York, mostly by river during the eight or nine months of open navigation.

The occurrence and character of the clays are very similar throughout the region. They form banks or terraces, with occasional layers of sand or gravel, and are normally blue in color, weathering to yellow near the surface. They are worked by open pit excavation. In one or two places the clay is obtained by dredging from the river. They usually contain rather high percentages of fluxing constituents, chiefly calcium carbonate, and sufficient iron to burn to a red color. The brick are molded by the soft-mud process and burned in scove kilns. The run of the kilns is classed as "Hudson common hard."

With a single grade of product, practically all shipped to one market, it is natural that the industry should be subject to sudden and extensive fluctuations. The normal productive capacity of the region may be placed at about 1,200,000,000 a year, which is above the average annual consumption. During the years 1905 and 1906, a period of exceptional prosperity, the demand equaled or slightly exceeded that figure and prices were on a very remunerative basis. This brought about an expansion of operations so that in 1907 the market became overstocked: as a result the production fell the following year to about 800,000,000 and prices ruled very low. The improved conditions during 1909 brought the production up to the earlier level and restored prices to a fairly profitable basis, but the activity was only temporary. The course of the market during the past season was steadily downward, reaching in the later months a stage below that of any recent year.

The status of the industry in 1909 and 1910 is shown by the accompanying tables which give the production, value, average price, and number of active plants separately for each county. The total number of brick manufactured last year was 1,102,265,000, valued at $5,000,662, reported by 114 plants. In the preceding year the number was 1,218,784,000, valued at $6,443,190, with 117 active plants. Though the decline of output thus amounted to less than

10 per cent, there is no doubt that a much larger proportion of the product remained unsold at the close of 1910 than at the end of 1909. It is estimated that the stocks in the yards at the close of the past season amounted to fully 350,000,000 or nearly one-third of the year's output. About 200,000,000 are estimated as having been carried over from 1909. The actual consumption for the year can be placed accordingly at about 950,000,000.

The average price realized for the brick at the yard last year was $4.54 a thousand. This was the lowest average in any recent year and represented a decrease of $.74 from the average for 1909. The prices ranged from about $5 in the early months of 1910 to below $4 during the late fall and winter. As a whole the season was an unprofitable one for the manufacturer. Operations, no doubt, will be curtailed during the current year.

New York prices on the average are about $1.25 a thousand above the prices at the yard. The difference represents the cost of river shipment and commission exacted on the sale of the brick by the New York dealers.

The leading county in the industry is Ulster, which contributed a production last year of 263,873,000, valued at $1,121,460 against 304,904,000 valued at $1,620,468 in 1909. Rockland county is second and Orange third, the latter displacing Dutchess county which ranked third in the list in 1909.

Output of common brick in the Hudson river region in 1909

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	80 343 000	$429 554	$5 34
Columbia	5	88 026 000	472 280	5 36
Dutchess	19	170 615 000	876 207	5 13
Greene	5	42 794 000	246 982	5 77
Orange	8	164 680 000	814 440	4 93
Rensselaer	6	19 895 000	102 225	5 64
Rockland	28	275 262 000	1 488 457	5 40
Ulster	26	304 904 000	1 620 468	5 31
Westchester	8	72 265 000	392 577	5 43
Total	117	1 218 784 000	$6 443 190	$5 28

Output of common brick in the Hudson river region in 1910

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

OTHER CLAY MATERIALS

The manufacture of vitrified paving brick was carried on by four companies in Cattaraugus, Chautauqua, Greene and Steuben counties, as against three companies in 1909. The number of paving brick made was 19,762,000 valued at $333,511 against 12,778,000 valued at $207,970 in 1909. The price received for paving brick averaged $16.88 a thousand, as compared with $16.27 in the preceding year.

The production of fire brick and stove lining showed a small decrease for the year, the total value for both products having been $464,693 against $486,894 in 1909. Fire brick numbered 9,596,000 valued at $380,980. The stove lining was valued at $83,713. The respective values reported in 1909 were $411,796 and $75,098. There were eleven companies operative, the same as in the preceding year. One company in Richmond county uses local clay, while the others obtain their crude material from outside the State, chiefly from New Jersey.

The output of drain tile and sewer pipe has varied little from year to year. In 1909 the manufacture of drain tile was carried on by eighteen firms who reported a production valued at $254,679. The same number of firms returned a value of $268,589 in the preceding year. Albany county outranked all others in this branch. The production of sewer pipe was valued at $127,731, as against $117,324 in 1909. Monroe county contributed the larger part.

Fireproofing, including terra cotta lumber, hollow brick, and various other kinds of hollow fireproofing, was made last year by eight firms, one each in Albany, Erie, Kings, Monroe, New York, Oneida, Onondaga, and Rensselaer counties. The value of the output was $256,820 as compared with $166,025 in the preceding year when six firms reported as active. The use of clay fireproofing is growing very rapidly, and with the extensive markets to be found in the State and bordering territory, the local industry should develop to large proportions. Clays suitable for fireproofing are found in various sections.

Building tile, inclusive of roofing tile, vitrified floor tile and terra cotta tile, was reported from Allegany, Erie, Kings, Monroe and Oneida counties, by a total of six firms. The output was valued at $65,190 against $54,397 in 1909. This is another department of clay-working which deserves greater attention than it has received in the past.

Architectural or ornamental terra cotta showed a good gain, with a reported value of $1,062,017 against $962,497 in 1909. Its manufacture is carried on by three firms in Queens, Richmond and Steuben counties. The Staten island Cretaceous clays are used in part for this product.

The miscellaneous clay materials accounted for a value of $134,-752 against $101,497 in 1909.

POTTERY

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

Notwithstanding the limitations of resources, the pottery industry has shown a fairly steady growth. The output last year was valued at $2,136,518 and was the largest that has ever been recorded. The gain over the preceding year exceeded $300,000. The number of potteries that contributed to the total was twenty-two, of which all but one reported their production. Porcelain and semiporcelain wares constituted the largest items in the total, with a value of $1,027,249. Electric and sanitary wares, which are classed together so as to conceal the individual figures, contributed $991,131 to the total. The value of the electric supplies does not include the metal trimmings. The other pottery products of the State potteries embraced stoneware, earthenware, clay tobacco pipes and art pottery.

The following counties were represented in the production: Albany, Erie, Kings, Nassau, New York, Onondaga, Ontario, Queens, Schenectady, Suffolk, and Washington. Onondaga county ranked first in value of its output, with a total of $721,451, followed by Schenectady, Erie and Kings counties. Most of the china tableware was made in Syracuse and Buffalo; the electrical supplies were made in Victor, Lima, Syracuse, Schenectady and Brooklyn; and the sanitary wares in Brooklyn.

Value of production of pottery

WARE	1908	1909	1910
Stoneware	$44 712	$41 298	$41 925
Red earthenware	31 645	32 800	25 713
Porcelain and semiporcelain [1]	900 548	999 663	1 027 249
Electric and sanitary supplies	595 247	697 573	991 131
Miscellaneous	81 089	55 859	50 500
Total	$1 653 241	$1 827 193	$2 136 518

Includes china tableware and cream-colored ware.

CRUDE CLAY

The clay obtained in a few localities is not utilized by the original producer, but is shipped to others for manufacture, some of it going to points without the State. This production, therefore, is listed separately from that of clay materials. The clay most extensively exploited for shipment is the Albany slip clay which is found in layers within the ordinary brick clays of the Hudson valley. It resembles the latter in appearance but has a finer grain and a larger percentage of the alkaline constituents than the usual run of the deposits. It has consequently a low fusibility and when applied to clay wares as a " slip " gives a rich brown glaze.

The light-colored refractory clays of Long island and Staten island and various pottery clays are also shipped to some extent.

Returns were received from five producers in 1910 and their total shipments of crude clay amounted to 6005 short tons, valued at $9667. In the preceding year the reported shipments amounted to 12,174 short tons valued at $11,585. The relatively higher value assigned to the product last year is explained by the larger proportion of slip clay in the total.

EMERY

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

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

Reports from the industry for the last year showed a product amounting to 978 short tons with a value of $11,736. The output was a little larger than in 1909 when a total of 892 short tons valued at $10,780 was reported and considerably more than in 1908, but still did not reach the level of some of the earlier years.

The figures of production are based upon shipments, and the value upon the crude rock without any treatment other than sorting or cobbing which it receives at the mines. None of the product is sold locally, but is shipped for grinding and preparation to abrasive manufacturers outside of the State. The producers in 1910 were as follows: Blue Corundum Mining Co., Easton, Pa.; Keystone Emery Mills, Frankford, Pa.; and the Tanite Co., Stroudsburg, Pa. The Hampden Corundum Wheel Co. of Springfield, Mass. and R. Lancaster of Peekskill who were engaged in the industry at one time did not make any shipments last year.

FELDSPAR

New York is a small producer of feldspar for uses in the manufacture of pottery, roofing material, and for other purposes. The industry, though long established in the State, has not developed to any extent, specially with regard to the production of the higher grades of feldspar suitable for pottery uses, which is insufficient to meet the local demand. Most of that material required by the New York potteries is brought in from Maine and other states or from Canada. Many quarries that have been opened in the Adirondacks and in the southeastern section have succumbed to competition owing to poor facilities for shipment or to unfavorable natural conditions.

The greater part of the present output consists of roofing feldspar, which is simply a crushed pegmatite made up usually of quartz, mica and other minerals in addition to the feldspar. This is produced in the Adirondack region by the Barrett Manufacturing Co. and the Crown Point Spar Co. which have quarries and crushing plants near Ticonderoga and Crown Point respectively. Pottery feldspar is produced by P. H. Kinkel's Sons who operate quarries near Bedford, Westchester county, and by the Adirondack Spar Co. with quarries near Batchellerville, Saratoga county. The Bedford quarries have yielded the greater quantity of pottery material that has been produced in the State. In addition to feldspar from the latter quarries there is also a considerable production of quartz which is utilized for wood filler.

No new discoveries or developments in connection with the feldspar industry were reported last year. The production was somewhat under the total for the preceding year and amounted to 12,132 short tons valued at $46,863. In 1909 it was 13,871 short tons with a value of $46,444, and in 1908 it was reported as 14,613 short tons with a value of $53,148. The market prices have remained about the same; crushed feldspar for roofing purposes averaged about $3 a ton last year and the ground spar about $6 a ton.

GARNET

The production of abrasive garnet during 1910 was 5297 short tons valued at $151,700. This represented a large gain over the output in the preceding year which was reported at 3802 tons valued at $119,190. It can not be said, however, that the increase reflected any real expansion of the mining industry through new developments or the entrance of new companies into the field; on the other hand the enlarged operations were but a response to an improved market situation after a period of severe depression. In 1907 the production of the mines amounted to 5709 tons or over 400 tons in excess of the total last year. In 1908 when the depression was severest, it fell to 2480 tons, less than one-half the output of an average year.

The year was unmarked by any notable changes in the industry. Most of the output as heretofore, came from the vicinity of North River in the upper Hudson valley. The North River Garnet Co., with mines on Thirteenth lake, Warren county, and H. H. Barton & Son Co., owning mines on Gore mountain a few miles southeast of the former locality, were the principal producers. The American Glue Co. has worked a property near North River in previous years, but did not make any output in 1910. Aside from the above the only mines recently operated were those of the Warren County Garnet Mills at Riparius, Warren county, and the American Garnet Co. on Mt Bigelow, near Keeseville, Essex county.

The market for abrasive garnet is limited and it has shown little tendency to grow, at least of late years. The Adirondack region furnishes almost the entire product that is mined in this country; attempts have been made to develop the industry in other states but do not appear to have been permanently successful. The present position of the local mines has been secured solely through advantages of economic production and marketing, as there is no monopoly of the natural resources. It would appear, however, that garnet of the requisite character for abrasive purposes occurs in but few regions in sufficient abundance to be worked on a commercial basis.

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

In the last few years Spanish garnet has been sold in the American market in competition with the domestic product. The garnet is said to be obtained from alluvial sands. It is produced at a lower cost than the Adirondack garnet and pays no import duty. It comes only in the finer sizes so that its use is somewhat limited. The imports in 1910 amounted to about 775 short tons with an invoiced value of $14,830. The imports in 1909 were 536 tons valued at $10,315. The principal ports of entry are New York, Boston and Chicago and the shipments are generally made through English ports.

GRAPHITE

An output of 2,619,000 pounds of crystalline graphite was reported last year from the Adirondack region. This was a substantial gain over the total of 2,342,000 pounds reported for 1909, but represented only an average output for the industry which has been subject to rather extensive fluctuations. The maximum product for any one year was in 1905 when it amounted to 3,897,616 pounds; a sharp decline during the next few years brought the total down to 1,932,000 pounds in 1908, since which time the industry has partly recovered its place.

The Adirondack graphite continues to find a good market. The returns from the mining companies show for last year's product a value of $160,700, or slightly more than 6 cents a pound. This does not represent the actual selling price, but rather a base or average for the mine output which is marketed under many different grades of widely varying value.

There have been few new features in the industry during the last year or two. In fact less interest has been manifest in exploration for graphite and development of new properties than for some time, no doubt a natural reaction from the widespread attention which the industry shared in the few preceding years and which led to many ill-founded ventures. The technical and commercial aspects of the graphite business are peculiar, and it is only by persistent effort and experiment that success has been achieved in the utilization of the low-grade Adirondack deposits.

The main producer of graphite of late years has been the Joseph Dixon Crucible Co. operating the mine at Graphite, Warren county. The company also owns mines at Hague on Lake George and on Lead hill near Ticonderoga, but these are not now worked. The graphite is first separated at the mine and shipped to Ticonderoga for refining.

The Crown Point Graphite Co. has worked a deposit near Chilson lake, Essex county, which differs from the usual Adirondack type in that the graphite is associated with limestone. It is said to use a dry process for the recovery of the graphite. The product is refined in a finishing mill at Crown Point Center. The company expects to increase its output during the current season.

The Glens Falls Graphite Co. reported a small production from the mine at Conklingville.

The Empire Graphite Co., with a mine at Greenfield Center, Saratoga county, also contributed to the output in 1910.

The exploration of the Faxon property, situated near the Dixon or American mine at Graphite, which was mentioned in the review of the industry for 1909, has not as yet led to active mining operations. The recent work has demonstrated the existence of very extensive deposits of graphite rock, fairly rich and uniform in grade.

GYPSUM

The gypsum industry was very active during 1910, specially in western New York where the manufacture of calcined plasters has become an important branch. The returns from the mines and quarries showed a gain exceeding 20 per cent in the output of rock, or about the same ratio of increase as was indicated for the preceding year's output which outstripped all records up to that time.

The recent growth of the industry in view of the rather dull conditions in the buliding trades seems remarkable. No new mines became productive during the past year and the increase came from enlarged operations on the part of enterprises already well established.

The output of rock or crude gypsum in 1910 was 465,591 short tons and the value of the marketed products as reported by the producing companies amounted to $1,122,952. The product in the preceding year was 378,232 short tons valued at $907,601. The actual gain for the year was thus 87,359 short tons in production and $215,351 in value. In the period since 1904 for which statistics have been collected by this office the production has expanded by more than 200 per cent.

The accompanying table gives the statistics for gypsum for the last two years. The figures are those returned by the mining companies. It may be noted that the items for calcined and ground plasters as given in the table probably fall a little below the actual amounts made from local materials, since some of the crude gypsum is sold to plaster mills outside of the mining district. The output of calcined plasters, including plaster of paris and wall plaster, on the above basis amounted in 1910 to 250,228 short tons with a value of $838,340. In 1909 the output was 209,223 short tons valued at $699,110. The amount ground for land plaster was 12,597 short tons valued at $28,100 against 9468 short tons valued at $19,283 in the preceding year. The sales of crude or lump gypsum, chiefly to portland cement works, amounting to 178,518 short tons valued at $256,512 as compared with 126,606 short tons valued at $189,208 in 1909.

Production of gypsum

MATERIAL	1909		1910	
	SHORT TONS	VALUE	SHORT TONS	VALUE
Total output, crude....	378 232	....	465 591	....
Sold crude............	126 606	$189 208	178 518	$256 512
Ground for land plaster.	9 468	19 283	12 597	28 100
Wall plaster, etc., made.	209 223	699 110	250 228	838 340
Total value.......	....	$907 601	....	$1 122 952

The gypsum resources of the State have been described at length in a special report, issued as bulletin 143 of the New York State Museum. The information in the report is brought down to the year 1909; the interval that has since elapsed has been without any notable changes in the industry.

The growing demand for gypsum plasters in the building trade is the basis of the recent expansion of the industry. It was not until 1892 that the local gypsum found use in making calcined plaster and several years passed before the product assumed any importance. The entrance of the U. S. Gypsum Co. in the Oakland district about 1903 gave a strong impetus to the industry and may be regarded perhaps as marking the real beginning of the successful manufacture of calcined wall plaster which the resources of the company and its experience gained in other fields enabled it to establish on a permanent footing. With the rapid growth of the market for these materials other enterprises have naturally followed. The present capacity of the mines and mills is probably equal, however, to the demands that are likely to be made upon them for some time to come, and the opportunity for new developments seems somewhat limited so far as the immediate future is concerned.

The natural resources of the State are capable of supporting the industrial requirements for an indefinite period. The total production of gypsum from the start of mining about the year 1808 to the present has amounted probably to a little more than 5,000,000 tons. With the increasing rate of production now in progress an equal quantity will be taken out before the end of the present decade. But the mining operations of the past, or those likely to be undertaken in the future, appear insignificant as compared with the known extent of the deposits. The actual output in the past represents the equivalent of less than 500 acres of a 4 foot seam which is about the minimum thickness of a workable bed. The gypsum is found in a belt that extends from Madison county to Lake Erie, occurring as a regularly stratified member of the Salina formation of which the chief constituent is shale. The deposits of course have the elongated lenticular form characteristic of sedimentary strata and doubtless many gaps exist in the belt when they can not be exploited economically on account of insufficient size or unfavorable conditions as to surroundings. There is also considerable variation in the quality of gypsum; some seams, specially in the eastern section, are too impure to be used for calcined plaster manufacture. These features call for careful investigation before mining developments are undertaken in any new locality, but they need scarcely be taken into account as fixing a limit upon the available supply in general.

IRON ORE

Iron mining was quite active last year, in fact the industry made a better showing on the whole than could have been anticipated from the trend of the iron trade. A total of about 1,500,000 tons of ore was hoisted from the mines, and the tonnage of furnace ore produced was well above the quantity reported in any previous year for a long time. The larger part of the shipments to furnaces consisted of magnetic concentrates, averaging about 65 per cent iron.

At the opening of the year the iron market showed a good deal of activity and seemed to foreshadow a prosperous season for mining. It began to weaken, however, after the first month or two and then as the season advanced fell off rapidly until prices were on a very low basis. The year closed without any immediate improvement in prospect. The effect of the slump was to discourage new enterprises and in some degree to curtail operations on the part of the active mines. A few companies ceased work altogether before the year ended. That the output held up so well in spite of the unfavorable market situation may be attributed probably to the sales of ore under contracts which served to keep most of the mines busy during the dull months.

In the Adirondacks exploratory work was carried on much as usual and the record of results compared well with that of any recent year. Promising developments were reported from the vicinity of Arnold hill, of which an account is given on a subsequent page. The Mineville-Port Henry district also received attention.

The accompanying table gives the statistics of production of the different classes of ores for the last two decades. The figures are based on the shipments of lump ore and concentrates to furnaces rather than the mine output. The volumes of the *Mineral Resources* published by the United States Geological Survey have supplied the data for the years previous to 1904.

Production of iron ore in New York State

YEAR	MAGNETITE	HEMATITE	LIMONITE	CARBONATE	TOTAL	Total value	Value per ton
	Long tons	Long tons	Long tons	Long tons	Long tons		
1890	945 071	196 035	30 968	81 319	1 253 393	....	.....
1891	782 729	153 723	53 152	27 612	1 017 216	....	.....
1892	648 564	124 800	53 694	64 041	891 099	$2 379 267	$2 67
1893	440 693	15 890	35 592	41 947	534 122	1 222 934	2 29
1894	....	....	....	....	242 759	....	.....
1895	260 139	6 769	26 462	13 886	307 256	598 313	1 95
1896	346 015	10 789	12 288	16 385	385 477	780 932	2 03
1897	296 722	7 664	20 059	11 280	335 725	642 838	1 91
1898	155 551	6 400	14 000	4 000	179 951	350 999	1 95
1899	344 159	45 503	31 975	22 153	443 790	1 241 985	2 80
1900	345 714	44 467	44 891	6 413	441 485	1 103 817	2 50
1901	329 467	66 389	23 362	1 000	420 218	1 006 231	2 39
1902	451 570	91 075	12 676	Nil	555 321	1 362 987	2 45
1903	451 481	83 820	5 159	Nil	540 460	1 209 899	2 24
1904	559 575	54 128	5 000	Nil	619 103	1 328 894	2 15
1905	739 736	79 313	8 000	Nil	827 049	2 576 123	3 11
1906	717 365	187 002	1 000	Nil	905 367	3 393 609	3 75
1907	853 579	164 434	Nil	Nil	1 018 013	3 750 493	3 68
1908	663 648	33 825	Nil	Nil	697 473	2 098 247	3 01
1909	934 274	56 734	Nil	Nil	991 008	3 179 358	3 21
1910	1 075 026	79 206	4 835	Nil	1 159 067	3 906 478	3 37

The production in 1910 as reported by all the active mines was 1,159,067 long tons, valued at $3,906,478. This represented an increase of 168,059 tons over the total reported for the preceding year, which was 991,008 tons. It was the largest output contributed in any year since 1891; and the value was the highest ever reported without exception, though the average fell below the average values for 1906 and 1907.

The principal ore represented in the production was magnetite, the mines of which returned a total of 1,075,026 long tons valued at $3,721,383. The output of hematite, mainly from the Clinton belt, amounted to 79,206 tons valued at $175,425. A few thousand tons of limonite were mined in southeastern New York. There has been no production of carbonate ore in recent years.

Of the magnetite ore an aggregate of 653,963 tons was reported as consisting of concentrates and 421,063 tons of lump ore. The concentrates represented the product of 1,012,776 tons of crude material, so that the actual quantity hoisted from the magnetite mines in the year was 1,433,839 tons and from all the mines throughout the State 1,517,880 tons.

The list of active producers in 1910 included for the Adirondack region: Witherbee, Sherman & Co. and the Port Henry Iron Ore Co., at Mineville; the Cheever Iron Ore Co., Port Henry; the Chateaugay Ore & Iron Co., Lyon Mountain; the Benson Mines Co., Benson Mines; and the Salisbury Steel & Iron Co., Salisbury Center. The producers in southeastern New York were the Sterling Iron & Railway Co., Lakeville, and the Hudson Iron Co., Fort Montgomery. The single producer in the limonite region east of the Hudson river was the Amenia mine. The output of hematite was made by the Old Sterling Iron Co., with mines near Antwerp, Jefferson county; Furnaceville Iron Co.; the Ontario Iron Ore Co., Ontario Center; and C. A. Borst, Clinton.

Arnold. An important transaction in iron ore lands, which may lead eventually to a renewal of mining in southern Clinton county, is the recent purchase by Witherbee, Sherman & Co. of an extensive tract in the townships of Black Brook and Ausable, including the holdings of J. N. Stower and the Peru Steel & Iron Co. A large number of magnetite deposits occur within the area and altogether it may be considered one of the most promising properties in the Adirondack region. It embraces several old mines such as the Arnold, Cook, Mace, and Battie which at one time supported a very active industry in connection with the local forges. The Arnold mines have been intermittently active for the last century and were worked as late as 1906, since which time, however, no ore has been mined in this district.

Exploration of the property by the new owners has been under way since the latter part of 1909 and has already resulted in some encouraging developments. The Battie and Cook ore bodies, which so far have received most attention, have been demonstrated by surface excavations and diamond drill tests to be of much greater thickness and continuity than had been revealed in the earlier work. The two appear to form a practically connected deposit extending for a mile and a half or more on the strike. The ore pinches to small size and shows slight offsets in places, but as a whole exhibits a degree of regularity unusual to most Adirondack occurrences. It is entirely of concentrating grade, the magnetite being intermixed with quartz and dark silicates, or else interleaved with bands of rock so as to require mill treatment. The thicker portions of the deposit measure as much as 75 or 80 feet between the walls. Tests in the concentration of the magnetite have been conducted by an experimental plant set up in the Arnold mill nearby.

Benson Mines. The mines of this place were active during only a few months of the past year, having been closed in the late summer after a brief run. The general plan of operations proved unsatisfactory for economical production and it is unlikely that they will be reopened until a complete reorganization can be effected. The main difficulty was reported to have been met in the mill treatment. On the recent resumption of mining it was thought that the old plant after alterations and additions of equipment could be utilized, but its operation involved heavy charges for handling the ore and disposal of the tailings, as well as other disadvantages incident to its situation. A number of novel features, as far as Adirondack practice is concerned, had been adopted so that the recent work was something of an experiment. The use of churn drills and steam shovels for breaking down and handling the ore is said to have proved satisfactory. Giant Edison rolls were employed for the first reduction in place of the usual jaw or gyratory crushers. Owing to the necessity of fine crushing in order to effect a good recovery of the magnetite, a considerable part of the concentrates was below the limit of size desirable for blast furnace use and had to be agglomerated before shipment. The fines were separated by an air blast and nodulized in rotary kilns heated by producer gas, a form of apparatus first adopted for the nodulizing of pyrites cinder. This process also effected a reduction of the sulfur content and was so successful that it will probably be used on all of the concentrates in case a new mill is erected.

Mineville. This is the most important iron mining center in the State, and for several years the ore shipments from Mineville have exceeded that of any other locality in the East. The mines are operated by Witherbee, Sherman & Co. and the Port Henry Iron Ore Co.

The combined output of the two companies last year was the largest on record. A total of 953,553 tons was hoisted from the mines and the product of lump ore and concentrates for shipment amounted to 842,279 tons as compared with 705,000 tons in 1909. The best previous year was 1907 when the shipments amounted to 751,155 tons.

The new Clonan shaft, put down by the Port Henry Co., was completed early in the year. The shaft has greatly facilitated mining in the lower or southern workings of the "21" ore body which were formerly reached only by a long incline. The shaft has three compartments, with a steel head frame equipped with grizzlies, crushers and storage bins. An independent steam-generating plant near the shaft furnishes the power for hoisting and underground work. The Welch mine north of "21" has continued to yield a fair output.

Another important addition to the surface equipment at Mineville completed during the year, is the Harmony mill of Witherbee, Sherman & Co. This is a large concrete and steel structure situated between "A" and "B" shafts on the Harmony mines, just south of the Old Bed group. While the mechanical methods of ore treatment follow in a general way those adopted in the earlier mills, there are many features that make for increased efficiency and economy. The full running capacity of 200 tons an hour will probably be attained, considerably larger than the capacity of any other mill in this country for magnetic concentration of iron ores. The mill is designed to provide for the increasing output of the Harmony mines which are second in importance only to the Old Bed group.

According to present plans mining will soon be resumed in the Barton hill section. These deposits will be worked through a tunnel which has been driven into the south end of the hill so as to intersect the ore at some distance below the outcrop. Some ore was shipped from the mines last year in connection with experimental work in concentration. The ore differs from both the Harmony and Old Bed magnetite and the resumption of mining may necessitate the construction of another mill specially designed for its treatment.

With the progress of mining and exploration at Mineville new features of the ore occurrences are being uncovered each year. A deep test hole drilled during 1909 and 1910 from the tunnel of Barton hill encountered crystalline limestone and much dark hornblendic gneiss in association with the lighter ore-bearing gneiss. This is probably the first discovery of limestone in close proximity to the magnetite bodies and is of considerable interest, though its presence in the syenitic gneisses elsewhere is not altogether rare.

Cheever mine. The property of the Cheever Iron Ore Co., just north of Port Henry, has now reached a stage of development that assures a steady output of ore for some time to come. The mine had been dismantled and abandoned for twenty years or more. The work of draining and reopening has required time and has been attended to with some difficulty owing to the lack of information as to the situation and extent of the ore left in the old workings. Up to the middle of last year operations were mainly directed toward exploration and to the assembling of the necessary underground and surface plants.

Mining has been limited thus far to the southern part of the ore zone, which was tapped by the Weldon and Tunnel shafts of the former operative company. These shafts have been retimbered and a third shaft opened in the ground farther north. Some high grade ore has been found in the old workings, mainly on the north side of the Weldon shaft. Large quantities of concentrating ore, sufficient to maintain operations for many years, also occur in that section. There is still much ground awaiting exploration which should add materially to the resources. The ore of concentrating grade has a stoping thickness up to 20 or 25 feet, considerably greater than that of the rich seams which alone were mined in the early operations.

Under steady production the mine should nearly double its shipment during the current year. Additions and improvements to the plant, recently made or now being supplied, will give an increased capacity as well as effect important economies. One of the new additions is a 400-horsepower, two-cylinder compressor which will allow the use of more than twice the number of drills now operated. Power for the compressor as well as for the hoists and mill is supplied by the Port Henry electric generating station of Witherbee, Sherman & Co.; no steam power is used. The equipment for handling the ore includes some labor-saving devices not usually found in mines of this character. An electric locomotive is employed underground for tramming the ore to the shaft, where the cars dump automatically into a receiving bin. A gravity tram transports the ore from the shaft to the mill and another lowers the concentrates to the railroad for shipment.

The entire output of the mine is sent to the mill. After the first crushing the product passes over a magnetic cobber which takes out about one-half of the magnetite in coarse form; it is then recrushed and goes to drum separators, and after a third crushing to belt machines. The concentrates carry above 58 per cent iron and about .35 per cent phosphorus. The mill is unpretentious, but it has treated 800 tons a day and has a good record for costs.

Salisbury. The Salisbury Steel & Iron Co. was active during a part of the year and made shipments of high-grade concentrates and cobbed ore to furnaces in New York and Pennsylvania. The company has one of the most complete surface equipments for handling and treating magnetite ores to be found in the State. An interesting feature is the use of producer gas for power purposes. The gas is made in the company's plant and supplies gas engines of 750-horsepower which are connected with electric generators that furnish current for driving all machinery in the mining and milling operations. An aerial tramway, 800 feet long, assembles the ore from the different workings and delivers it to the mill. The process of milling and concentration is similar to that used elsewhere in the Adirondacks. The lump ore goes to Blake crushers, of which there are three of graduated size, and after screening passes to a series of magnetic cobbing machines. These take out the rich magnetite in coarse form which goes to storage bins for shipment. The rest of the material is subjected to further reduction in Cornish and finishing rolls and is then conveyed to magnetic separators of the belt type. The concentrates from these are delivered to separate storage bins. The shipping products are loaded on cars by a gravity system. The company has its own railroad which connects at Dolgeville with a branch of the New York Central.

Clinton hematites. The production of ore in the Clinton belt showed a good gain in 1910. The larger part of the output came from the western district in Wayne county, where the Furnaceville Iron Co. and the Ontario Iron Ore Co. were active and shipped regularly to Pennsylvania furnaces. The mines at Clinton were operated by C. A. Borst who supplied ore mainly for paint manufacture.

Dutchess county limonites. Though a renewed interest in the limonite deposits of this section has been manifest during the last year or two productive activity has been limited to the Amenia mine which resumed work in April, 1910. This is one of the more important properties which is credited with shipments of 200,000 tons of ore in the interval from 1870–90 when the mining industry was at its height. The present operations are limited to open-cut excavation near the surface, the old workings having been rendered inaccessible by fire. The output is about 25 tons of crushed ore a day. It is shipped to the furnace at New Canaan, Conn. The pig iron made from the ore finds special application for the manufacture of car wheels.

MILLSTONES

The quarrying and preparation of millstones, once a quite important industry in Ulster county, has shown a marked decline of late years. The industry in Ulster county dates back more than a century and for a long time has supplied a large share of the millstones and disks or chasers used in the country. The market for millstones, however, has been curtailed greatly by the increasing favor shown for rolls, ball mills and other improved forms of grinding machinery. The roller process has displaced almost entirely the old type of cereal mills, particularly in grinding wheat flour. The small corn mills in the southern states are practically the only survivals of the old type and constitute one of the important markets for the New York millstones.

The millstones are quarried from the Shawangunk conglomerate, a light gray quartz-cemented rock that in places shows a marked gritty structure. Most of the quarries have been opened along the western edge of the Shawangunk mountain, near the valley of Rondout creek, and between Kerhonkson and High Falls. Kyserike, St Josen, Granite and Kerhonkson are the principal centers of the industry, but the stones are also shipped partly from New Paltz and Kingston. The quarries are worked intermittently, often as a subordinate business to farming or other occupations.

The work of quarrying requires only a small equipment, the stone being pried or broken out by hand bars and wedges, sometimes with the aid of powder. The spacing of the natural joint planes determines the size of the block. The latter is dressed by hand at the quarry into a disc through the center of which a circular hole is then drilled. The millstones vary in diameter from 15 inches to 54 inches or even larger. They are sold to grinders of cement, gypsum, paint etc. as well as to cereal mills. The chasers are disks dressed to run on edge in pans which are paved with blocks of the same material. The latter are also prepared at the quarries in roughly cubical shapes about a foot long. They are used in grinding hard materials like quartz and feldspar, and are usually made in the larger sizes from 54 to 72 inches in diameter, so as to give the weight necessary for crushing such minerals.

The value of the production of millstones, chasers and blocks amounted last year to about $7000. The sales were smaller than in any previous year for a long time. In 1909 the output was valued at about $15,000. The selling prices for millstones usually varied from $3 to $4 for a 16-inch stone up to $60 for a 72-inch stone. Chasers in size from 54 to 72 inches sold at prices ranging from $30 to $70 each.

MINERAL WATERS

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

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

Character of mineral waters. Among the spring waters that contain mineral ingredients in appreciable quantity those characterized by the presence of alkalis and alkaline earths 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 sulfuric acid, as illustrated by the Sharon and Clifton springs.

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

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

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

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

Ordinary spring waters. The greater quantity of spring waters consumed in the State belongs to the nonmedicinal, noncarbonated class, represented by such springs as the Great Bear, Deep Rock, Mount View, Sun Ray, Chemung etc. The waters are obtained either from 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. Besides the sale of mineral waters an extensive industry has been developed in connection with carbon dioxid which is given off as gas by some of the springs. The collection, storage and shipment of the gas for use in making carbonated beverages and for other uses has received attention at Saratoga Springs, where the industry for some time attained even greater importance than the trade in the mineral waters themselves. Over thirty wells have been driven in that vicinity for gas alone. The carbon dioxid, together with the water, is pumped to the surface, separated from the water at the well and then is conveyed to gas holders where it is stored preparatory to charging into cylinders. The cylinders in which it is shipped to consumers are made to withstand the heavy pressure necessary to liquify the gas and are of two sizes, the smaller holding about 25 pounds and the larger from 40 to 50 pounds. The principal producers have been the New York Carbonic Acid Gas Co., the Lincoln Spring Co., and the National Carbonic Gas Co. The gas is said to be superior to that produced by the calcination of magnesite or other artificial methods.

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

Name	Locality
Baldwin Mineral Spring	Cayuga, Cayuga co.
Coyle & Caywood	Weedsport, Cayuga co.
Diamond Rock Spring	Cherry Creek, Chautauqua co.
Mrs D. N. Palmer	West Portland, Chautauqua co.
Breesport Oxygenated Mineral Spring	Breesport, Chemung co.
Chemung Valley Spring	Elmira, Chemung co.
Chemung Spring	Chemung, Chemung co.
Lebanon Mineral Spring	Lebanon, Columbia co.
Monarch Spring	Matteawan, Dutchess co.
Mt Beacon Spring	Matteawan, Dutchess co.
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Elk Spring Water Co	Lancaster, Erie co.
Beauty Spring Water Co	Lyons Falls, Lewis co.
Cold Spring	New York Mills, Oneida co.
Glacier Spring	Franklin Springs, Oneida co.
Lithia Polaris Spring	Booneville, Oneida co.
G. Wells Smith	Franklin Springs, Oneida co.
W. W. Warner	Franklin Springs, Oneida co.
Geneva Lithia Spring	Geneva, Ontario co.
Red Cross Spring	Geneva, Ontario co.
Crystal Spring	Oswego, Oswego co.
Deep Rock Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
J. Hagerty	Oswego, Oswego co.
Os-we-go Spring	Oswego, Oswego co.
Redstone Spring	Oswego, Oswego co.
Mammoth Spring	North Greenbush, Rensselaer co.
Shell Rock Spring	East Greenbush, Rensselaer co.
Massena Mineral Spring	Massena Springs, St Lawrence co.
Arondack Spring	Saratoga Springs, Saratoga co.
Artesian Lithia Spring	Ballston Springs, Saratoga co.
Chief Spring	Saratoga Springs, Saratoga co.
Congress Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Hathorn Spring	Saratoga Springs, Saratoga co.
Hides Franklin Spring	Ballston Springs, Saratoga co.
High Rock Spring	Saratoga Springs, Saratoga co.
C. N. Mead	Ballston Springs, Saratoga co.

Name	Locality
Patterson Mineral Spring......	Saratoga Springs, Saratoga co.
Royal Spring..................	Saratoga Springs, Saratoga co.
Saratoga Seltzer Spring.......	Saratoga Springs, Saratoga co.
Saratoga Carlsbad Spring.....	Saratoga Springs, Saratoga co.
Saratoga Emperor Spring......	Saratoga Springs, Saratoga co.
Star Spring..................	Saratoga Springs, Saratoga co.
Washington Lithia Spring.....	Saratoga Springs, Saratoga co.
Chalybeate Spring............	Sharon Springs, Schoharie co.
Eye Water Spring............	Sharon Springs, Schoharie co.
Gardner White Sulphur Spring.	Sharon Springs, Schoharie co.
Magnesia Spring..............	Sharon Springs, Schoharie co.
Red Jacket Spring............	Seneca Falls, Seneca co.
H. W. Knight................	Seneca Falls, Seneca co.
Pleasant Valley Mineral Spring..	Rheims, Steuben co.
Setauket Spring..............	Setauket, Suffolk co.
Sparko Crystal Spring.........	Huntington, Suffolk co.
Elixir Spring.................	Clintondale, Ulster co.
Sun Ray Spring..............	Ellenville, Ulster co.
Vita Spring..................	Fort Edward, Washington co.
Briarcliff Table Water........	Briarcliff Manor, Westchester co.
Gramatan Spring Water Co....	Bronxville, Westchester co.
Putnam Spring Water Co......	Peekskill, Westchester co.

Production. The reports received from the mineral water trade for the year 1910 showed sales of 8,432,672 gallons valued at $675,-039. The number of springs contributing to the production was 46. In the preceding year the sales amounted to 9,019,490 gallons valued at $857,342 from 48 springs. The value of the water is estimated at the spring localities and does not include the cost of bottling. No account is made of the waters used in hotels, sanitariums etc. run in connection with the springs, though this is an important branch of the business in some places.

The falling off in the sales as shown by the above figures may be attributed mainly to the decreased use of the higher priced carbonated waters which contain considerable amounts of mineral matter. The trade in the ordinary spring waters of the nonmedicinal class seems to have gained a permanent foothold and to be of growing importance.

NATURAL GAS

Natural gas is produced in fifteen counties of the State, all of which are situated in the western half in the section between Lake Ontario and the Pennsylvania boundary. The principal fields are in Erie, Chautauqua, Allegany, and Cattaraugus counties, but scattered pools occur as far east as Oswego county. The eastern part of the State seems to be barren of productive pools at least nothing of importance has been found there after persistent and rather thorough exploration; the disturbed condition of the strata perhaps has prevented the accumulation of gas in quantity.

The range of the gas pools geologically may be said to extend from the base of the Paleozoic sedimentary formations, the Potsdam sandstone, to the Chemung and Portage formations of the Devonic, which are near the top of the Paleozoic series as represented in New York. Certain formations, however, are more prolific than others, and the wells in each field, as a rule, derive their main supply from a definite horizon. In Erie county the more important pools have been found in the Medina sandstone, which is also the source of the supply of the new Pavilion field in Genesee county and of the recent fields opened in northern Chautauqua county. The Portage and Chemung formations of the Devonic yield perhaps most of the gas obtained from the fields of southern Allegany and Cattaraugus counties. Another important horizon is the Trenton which contributes most of the supply in Onondaga and Oswego counties.

The production of natural gas has increased markedly of late years, despite the fact that many of the fields have been exploited for a long time. The wide demand for this cheap and convenient source of heat and light has been an incentive to active exploration that has extended into every promising section. The recent additions to the supply have come principally from the drilling in old territory of deep wells which tap the lower productive strata like the Medina sandstone rather than from any extensions of the geographic limits of the fields.

The reports received from the producers for the year 1910 showed a total of about 1340 productive wells of which the output was used for fuel and lighting purposes. This does not include the wells in the oil region which supply gas for pumping operations. The number of individual producers was about two hundred, most of whom, however, made only a small output from one or two wells for their own supply. Aside from these minor enterprises, there were some forty companies who produced and distributed gas in quantity for the supply of cities and communities in the western part of the State.

The surplus gas from the oil region of Cattaraugus, Allegany and Steuben counties is collected by the Empire Gas Co. of Wellsville; the Producers Gas Co. of Olean; and the United Natural Gas Co. of Oil City, Pa. The product is distributed in pipe lines to different places as far distant as Buffalo. This city is also supplied from the important fields in the eastern and southern townships of Erie county and also in part from Pennsylvania. The gas from the other fields is mainly consumed by the towns and villages within short distances of the wells.

The value of the natural gas production during the last four years is given in the accompanying table which is arranged to show also, so far as practicable, the contributions from the principal counties. The returns for the year 1910 indicated a production valued at $1,411,699, much the largest that has been reported. The output in 1909 was valued at $1,045,693, so that the actual gain from the year was $366,006 or about 35 per cent. In quantity the output also reached record figures with a total of 4,815,643,000 cubic feet against 3,825,215,000 cubic feet for the preceding year. These quantities include estimates for some of the smaller producers who have no meters attached to their mains, but they are believed to be close approximations of the actual production. On the basis of the above totals the average value of the gas was 29 cents a thousand in 1910 and 27 cents a thousand in 1909. The actual selling prices of the different companies who supplied gas to consumers ranged from a minimum of about 20 cents to a maximum of 50 cents a thousand.

Production of natural gas

COUNTY	1907	1908	1909	1910
Allegany–Cattaraugus	$250 159	$264 736	$282 964	$337 427
Chautauqua	106 411	153 019	174 597	202 754
Erie [1]	320 199	451 869	461 531	717 038
Livingston [2]	55 780	54 083	59 888	60 997
Onondaga	17 030	13 837	12 310	12 733
Oswego	10 585	12 800	14 402	14 783
Wyoming [3]	39 850	37 431	40 001	65 967
Total	$800 014	$987 775	$1 045 693	$1 411 699

[1] Includes a part of the production of Genesee county.
[2] Includes also Seneca, Schuyler, Steuben, Ontario and Yates.
[3] Includes also Niagara and Genesee.

A comparison of the statistics shows that Erie county leads all others in the quantity and value of production. Its contribution last year amounted to 2,241,660,000 cubic feet valued at $717,038, from a total of 293 wells. The greater part of the output came from the eastern townships where the principal producers were as follows: Akron Natural Gas Co., Alden-Batavia Natural Gas Co., Lancaster-Depew Natural Gas Co., Niagara Light, Heat & Power Co., and the United Natural Gas Co. The company last named also operated in the Allegany-Cattaraugus field and in southern Erie county. The Springville Natural Gas Co. and the Angola Gas Co. were large producers in southern Erie county.

The production listed under Allegany and Cattaraugus counties included mainly the gas collected from oil wells, but there was also a small output from fields in the northern parts of the two counties where no oil is found. It has been impossible to separate the figures of the two counties. The combined output taken from the reports of the pipe-line companies and the individual producers amounted in 1910 to 1,361,426,000 cubic feet, valued at $337,427, from a total of 768 wells. The output of this district was mainly handled by the Empire Gas & Fuel Co., the Potter Gas Co., the Producers Gas Co., and the United Natural Gas Co.

Chautauqua, which held third place in the industry, contributed an output of 751,588,000 cubic feet valued at $202,754. The principal supply came from the deep wells which have been put down during the last few years in the belt along Lake Erie. The leading producers were the Frost Gas Co., Silver Creek Gas & Improvement Co., South Shore Gas Co., and the Welch Gas Co. Aside from these companies who operated pipe lines for the supply of gas to the public, there were many individual producers owning one or two wells for private use.

Genesee county has recently taken an important place in the natural gas industry through the development of a very productive field near Pavilion. The output last year showed the largest relative increase of any county in the State. The Pavilion Natural Gas Co. and the Alden-Batavia Natural Gas Co. have been the chief operators in the district.

The record for 1910 showed considerable activity in exploration and new drilling, and to this may be attributed the large gain of production. Genesee and eastern Erie counties continued to yield good results, though the discovery of no new pools was reported. The exploration of the abandoned Zoar oil field of northern Cattaraugus county attracted much attention, but the results as yet have not been made public. In this work the United Natural Gas Co. has been chiefly engaged. The first well drilled in 1909 found gas at 3300 feet. The second well put down last year was said to have encountered oil sand with gas at 2500 feet. The same company has been active in acquiring other properties in northern Cattaraugus and southern Erie counties and will construct a pipe from that region to Buffalo. In Chautauqua county the Welch Gas Co. drilled a well just west of the village of Westfield which showed an estimated flow of 300,000 cubic feet a day. The Frost Gas Co. and the South Shore Gas Co. put down several wells in the same region.

PETROLEUM

An output of 1,073,650 barrels was reported last year from the oil field in the southwestern part of the State. This represented a slight reduction from the total returned in 1909 which amounted to 1,160,402 barrels, but was about an average yield for the wells in this field. Owing to the marked decline in the prices paid for crude oil by the refining companies, the value of the output was lower than it has been in a long time and at the average market quotations amounted to $1,458,194 or $1.36 a barrel, as compared with $1,914,663, an average of $1.65 a barrel for the preceding year.

As a result of the fall in prices, exploratory operations were conducted on a much reduced scale, which no doubt will have a very apparent effect on the production of the current season.

The oil field of New York is a part of the Appalachian district which reaches its main development in Pennsylvania, Ohio and West Virgina. The pools occur in fine-grained sandstones of dark color belonging to the Chemung formation of the Upper Devonic system and are scattered through the southern parts of Cattaraugus and Allegany counties near the Pennsylvania border. The productive area in Cattaraugus county includes Olean, Allegany and Carrolton townships with an area of about 40 square miles. Some of the larger pools in this county are the Ricebrook, Chipmunk, Allegany and Flatstone. The wells average from 600 to 1800 feet deep. In Allegany county are the Bolivar, Richburg, Andover and Wirt pools which extend across the southern townships and are tapped by wells averaging from 1400 to 1800 feet deep. The Andover field lies partly in the town of West Union, Steuben county. A recent estimate places the number of productive wells in Allegany county at 6000, and the total number in the entire field probably exceeds 10,000.

In view of the long career of the productive industry in New York, it seems surprising that the field should continue to show so good results. There have been no important pools discovered in many years, but by continual exploration of old territory and by the use of the gas found in the wells for pumping, the yield has been maintained at a fairly constant level. The average product now is less than a barrel a day from each well. The quality of the oil is such that it commands the highest prices in the eastern markets, and this feature is the main incentive to the small-scale operations.

The production of oil during the last two decades is shown in the accompanying table. The figures for the years 1891–1903 inclusive have been compiled from the annual volumes of the *Mineral Resources,* while those for subsequent years are based on reports received from the pipe-line companies who transport the oil to the refineries. The following companies operate pipe lines in the New York field: The Allegany Pipe Line Co., Columbia Pipe Line Co., Union Pipe Line Co., and Fords Brook Pipe Line Co., of Wellsville; Vacuum Oil Co. of Rochester; New York Transit Co. of Olean; Emery Pipe Line Co., Kendall Refining Co., and Tide Water Pipe Co., Limited, of Bradford, Pa.

Production of petroleum in New York[1]

YEAR	BARRELS	VALUE
1891	1 585 030	$1 061 970
1892	1 273 343	708 297
1893	1 031 391	660 000
1894	942 431	790 464
1895	912 948	1 240 468
1896	1 205 220	1 420 653
1897	1 279 155	1 005 736
1898	1 205 250	1 098 284
1899	1 320 909	1 708 926
1900	1 300 925	1 759 501
1901	1 206 618	1 460 008
1902	1 119 730	1 530 852
1903	1 162 978	1 849 135
1904	1 036 179	1 709 770
1905	949 511	1 566 931
1906	1 043 088	1 721 095
1907	1 052 324	1 736 335
1908	1 160 128	2 071 533
1909	1 160 402	1 914 663
1910	1 073 650	1 458 194

[1] The statistics for the years 1891–1903 inclusive are taken from the annual volumes of the *Mineral Resources.*

The most notable feature in the industry recently has been the violent break in the market prices of crude oil from the Appalachian field. The quotations for Pennsylvania crude, which are taken as the basis for rating the New York output, fell off from $1.78 a barrel, the average price paid in the early months of 1909, to $1.43 a barrel at the close of that year. A further decline took place during the past season which brought the quotations down to $1.40 a barrel at the opening and finally to $1.30 a barrel, the ruling price for the last few months.

In response to the market decline there was a notable decrease of activity in new drilling. The records for the past year showed that a total of 283 wells were completed in New York as compared with 457 wells in 1909. The increment of production from the new wells amounted to 368 barrels a day, while in 1909 it was 715 barrels. Of the number drilled 61 were dry holes as compared with 32 in the preceding year.

PYRITE

The production of pyrite, confined to St Lawrence county, showed a large increase last year and reached the highest total that has been recorded for the State. Most of the ore came from the mines at Stellaville, near Hermon, owned by the St Lawrence Pyrite Co. which for several years previous had supplied the entire output. During the last season the Cole mine, near Gouverneur, which had been closed since 1907, resumed operations and contributed to the product.

The pyrite deposits of this section are associated with belts of gneisses, schists and crystalline limestones — the same series of rocks that inclose the hematite ores which have been mined at various places in St Lawrence and Jefferson counties. The principal belt of these metamorphosed strata extends from near Antwerp, Jefferson county, across Gouverneur, De Kalb and Clinton townships, St Lawrence county, a distance of some 40 miles. Pyrite zones are found at intervals along the belt, following the general northeast-southwest strike and extending for variable distances. The pyrite is generally intermixed with quartz, hornblende and feldspar and other minerals of the wall rocks so as to form a lean ore. In places, however, bands and lenticular bodies of fairly rich pyrite occur and it is these which constitute the workable deposits.

Up to the present time mines have been opened only at three localities; near High Falls on the northeastern end of the belt, at Stellaville in the town of De Kalb and near Gouverneur. The

High Falls deposits have not been actively worked in the last five years, though they were recently explored by diamond drilling.

The mines at Stellaville operated by the St Lawrence Pyrite Co. are opened on a parallel series of pyrite bodies, of which the largest is known as the Stella. A second important deposit, the Anna, is found in the footwall 1600 feet to the southeast and others occur in the interval. The ore carries from 15 to 40 per cent of sulfur, with an average probably between 25 and 30 per cent. The mine output is crushed and concentrated so as to bring the sulfur up to 40 per cent or more. The concentrates are shipped to acid burners in the East. Though of lower sulfur content than the imported ores they are desirable material for acid making on account of their freedom from arsenic and other injurious impurities.

The Cole mine, just north of Gouverneur, is based on a large outcropping deposit that was first worked as an open cut. Under the early operations by the Adirondack Pyrite Co. extensive shipments of lump ore were made, as much of the output was sufficiently rich to be used without concentration. The property was equipped with a mill, however, for treating the leaner material. Recently work has been renewed by the Hinckley Fibre Co., which used the output last year in connection with sulfur pulp manufacture at Hinckley.

Besides these mines there are many prospects and exposures of pyrite in the metamorphic belt of Jefferson and St Lawrence counties. As has been noted by C. H. Smyth, the hematite ores of that section are often accompanied by bodies of pyrite in the adjoining wall rocks. The iron ores in fact have probably been derived from the decomposition of the pyrite and their distribution affords a useful clew to exploration for the latter mineral. Some of the better known localities are on the Alexander Farr farm, two and a half miles northeast of Bigelow; on the George Styles farm one and a half miles west of Bigelow; S. Hendricks one mile south of Bigelow; and L. Hockens seven miles west of Rensselaer Falls. Near Antwerp pyrite is found in vicinity of the Dixon and Old Sterling mines; it is also found farther north in the vicinity of Ox Bow.

The pyrite industry in this section has not evidenced, hitherto, the activity that might have been expected from its favorable situation in regard to markets. The fact that the ores are low grade for the most part has restricted their exploitation, as they could not be shipped any distance without concentration. This has involved the erection of expensive milling plants and a heavy outlay for other development.

Recent experiments in the use of low-grade pyrite for sulfite manufacture are said to have been successful and to have demonstrated that ores carrying but 25 or 30 per cent sulfur can be economically employed if obtainable at low cost. Under such conditions there should be opportunity for enlarging the output from the deposits which are within easy shipping distance of the Adirondack sulfite mills. According to a leading manufacturer in that section, the output of sulfite fiber by the local plants amounts to about 900 tons a day, for which 135 tons of commercial sulfur, at an average cost of $3300, are consumed. An output of from 400 to 600 tons of pyrite of the grade found in northern New York would be required to supply the equivalent of that amount of sulfur.

SALT

The salt industry of the State is very important; the annual output amounts to about one-third of the total for the entire country. The local product thus finds an extensixe market, and it is in fact the excellent situation with respect to trade facilities that are supplied by the railroads and canals of the State, more than any other factor apparently, that has been responsible for the continued progress of the industry. Of late years competition has been very keen, owing to the growth of the production in Michigan and the states of the Middle West, which has curtailed the outlet for the local product in that direction. Michigan is also a competitor for the eastern trade in evaporated salt, as a lower cost of manufacture counterbalances to some extent at least the shipping advantages which the local producers enjoy. The latter supply, of course, the greater part of the New York and New England requirements and will doubtless continue to hold a preponderant share of this trade in the future. The rock salt from New York is marketed over a wide territory; until recently it has had no near competitors, though the cheaper grades of evaporated salt are used as a substitute when they can be obtained at sufficiently low prices. Since 1909 Michigan has been a producer of rock salt, a mine having been opened in that year near Detroit.

Returns received from the companies engaged in the salt industry for the year 1910 showed a slight gain of production which brought the total up to a new record, but in other respects the conditions appear to have been rather unsatisfactory. Prices were lower than at any time for a number of years. The increased output was due to the activity in rock salt and in the manufacture of alkali products. The salt used for alkali manufacture is consumed in the form of brine without evaporation. The actual product of evaporated salt for the market was less than in 1909.

The total quantity reported by the mines and wells for last year was 10,270,273 barrels of 280 pounds, as compared with 9,880,618 barrels in 1909, showing an increase of 389,655 barrels or about 4 per cent. The production in 1909 was the largest up to that time and represented a gain of 875,307 barrels for that year. Converted to a tonnage basis the output in 1910 amounted to 1,437,838 short tons against 1,383,386.5 short tons in the preceding year.

Notwithstanding the gain in quantity, as shown in the above figures, the value of the output last year was less than that reported in 1909, the amount being $2,258,292 as compared with $2,298,652. The value averaged 22 cents a barrel, against 23.3 cents a barrel in 1909; 23.7 cents in 1908 and 25 cents in 1907. Prices have thus diminished steadily for a number of years. It is to be noted, however, that the average values are reduced to some extent by the inclusion of the salt used in the form of brine for alkali manufacture. Since this salt is not marketed as such and is not even evaporated it is given only a nominal valuation, representing practically the cost of pumping. The production of this brine is confined to a single company, the Solvay Process Co., which has a number of wells in the town of Tully, Onondaga county, whence the brine is carried through a pipe line to the alkali works near Syracuse.

The year was unmarked by any notable developments or changes in the industry. The list of producers included about thirty works and mines or the same number as in 1909. Under the conditions which have obtained during the last few years, there has been no incentive to the establishment of new enterprises. On the other hand the low prices for evaporated salt have caused the closing of some of the smaller plants and those less favorably situated with respect to manufacturing and marketing facilities. Another effect has been to introduce more economical methods by the use of the grainer and vacuum pan which have generally superseded the old kettle or direct-fire process of evaporation.

A small part of the evaporated salt is made by the solar process. Its manufacture is limited to Syracuse and vicinity where it has survived from the early days of the industry, though it has lost its former importance. The product is mainly coarse salt and is used for practically the same purposes as rock salt. It is marketed through the Onondaga Coarse Salt Association. The wells are situated on lands once included within the Onondaga reservation;

until recently the State supplied the brine to the individual plants, exacting a small tax on the product to cover the cost of pumping and supervision. The lands and wells were sold in 1908 to private companies and the historic connection of the State with the salt business has been definitely terminated. Solar salt is made from a natural brine, the only instance of its use in New York.

The accompanying tables give the statistics of salt production for recent years. The output for 1909 and 1910 is distributed according to grades, so far as the classification could be made without revealing the individual figures. The grades depend upon methods of manufacture and the purposes for which the salt is used. Rock salt and salt in brine consumed by the alkali industry appear in the last item of the tables which also includes small quantities of evaporated salt not specially classified in the returns. The evaporated salt is chiefly marketed under the grades of common fine and table and dairy salt. Common coarse, coarse solar, and packers are the other grades of evaporated salt. The prices range all the way from about 50 cents a barrel for the table and dairy grade down to a few cents for the salt used for chemical manufacture.

Production of salt by grades in 1909

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine [1]	1 436 233	$494 464	$ .35
Common coarse	130 200	45 569	.35
Table and dairy	1 281 207	633 195	.50
Coarse solar	540 614	162 253	.30
Packers	99 123	38 344	.40
Other grades [2]	6 393 241	924 877	.14
Total	9 880 618	$2 298 652	$ .233

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

Production of salt by grades in 1910

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

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

Six counties of the State are represented in the industry. Livingston county leads in quantity and value of output, its importance being due chiefly to the mines of rock salt, of which there are two in active operation, situated at Retsof and Cuylerville and owned respectively by the Retsof Mining Co. and the Sterling Salt Co. The mines are worked through vertical shafts from 1000 to 1100 feet deep. They are capable of a much larger output than is made at present. The Genesee Salt Co. is the only producer of evaporated salt in Livingston county.

Onondaga county ranks second in output though it actually produces little marketable salt. Its prominence is due to the operations of the Solvay Process Co., whose alkali works at Solvay are the largest of the kind in this country.

The other counties in order of production are Tompkins, with three evaporating plants, two of which are owned by the International Salt Co., and the other by the Remington Salt Co.; Wyoming county with two plants, owned by the Worcester Salt Co., and the Rock Glen Salt Co.; Schuyler county with two works, owned by the International Salt Co., and the Watkins Salt Co.; and Genesee county with the single plant of the Le Roy Salt Co.

The salt production during the last 25 years is summarized in the accompanying table which has been prepared from the preceding issues of this report and from the statistics published in the volumes of the *Mineral Resources*, issued by the United States Geological Survey.

Production of salt in New York since 1886

YEAR	BARRELS	VALUE
1886	2 431 563	$1 243 721
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

SAND AND GRAVEL

Surficial deposits of sand and gravel are widely distributed in the State and supply most of the needs for such materials in local building, engineering and metallurgical operations. The molding sands of the Hudson river region also have an extensive sale outside of the State.

The sand and gravel deposits 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 on its retreat a mantle of transported boulders, gravels, sands and clays. In places these have the character of unmodified drift, or morainal accumulations in which the materials are more or less intermixed, and are then of little industrial value. But more generally the deposits show a sorted stratiform arrangement due to their having been worked over by the glacial streams and lakes. Such is the condition in many of the larger valleys like those of the

Hudson, Genesee and Champlain, where the sands, gravels and clays occur separately in terraced beds extending far above the present water level. Later water action may have effected a beneficial resorting of the materials as in the case of the beach sands on Long island and some of the lakes in the interior of the State.

The industry based on the extraction of sand and gravel for industrial uses is a very large one, but the conditions under which it is carried on make it very difficult to obtain complete or reliable information of current production. The operations are widely scattered and in most sections of the State have little permanency. For the year 1910 the reports received from the industry show a production of sand and gravel of all kinds amounting in value to $2,129,708. This total should be considered as an approximation only and is based on the reports of about one hundred producers and dealers in the business. It undoubtedly represents the larger part of the output, but may fall short of the actual total by as much as 25 per cent, due to incomplete returns from the building sand trade.

Production of sand and gravel

MATERIAL	1908	1909	1910
Molding sand	$277 290	$437 402	$424 015
Core sand	22 371	30 230	[c] 33 709
Building sand	666 809	[b]	1 016 598
Other sand [a]	43 368	[b]	65 835
Gravel	120 453	[b]	589 551
Total	$1 130 291	....	$2 129 708

[a] Includes glass sand, furnace sand, filter sand, engine and polishing sand.
[b] Statistics not collected.
[c] Includes also fire sand.

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

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

The production of molding sand in 1910 amounted to 471,351 short tons valued at $424,015, or almost the same as in the preceding year when the total was 468,609 tons valued at $437,402. These figures are probably close to the actual amounts, as the molding sand trade is on a fairly stable basis and can be canvassed with some degree of accuracy.

Of the total production last year the Hudson river region furnished 448,805 tons valued at $406,542. The remaining 22,546 tons valued at $17,473 came mainly from Erie county, though small quantities were reported from Cayuga, Chautauqua, Essex, Livingston, and Oneida counties. In 1909 the Hudson river region contributed an output of 450,989 tons valued at $422,144.

Core sand used in connection with molding sand for the cores of castings is obtained from Oneida lake and from Erie county. Its production in 1909 amounted to 30,230 tons valued at $25,472. For 1910 the figures were included with those of fire sand, the combined total of the two materials amounting to 76,589 tons valued at $33,709.

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

An incomplete census of the industry for the past year showed a production of sand and gravel valued at $1,606,149. Of this value sand constituted $1,016,598 and gravel $589,551. The quantity of sand reported was 3,838,976 cubic yards and of gravel 1,037,026 cubic yards, a total of 4,876,002 cubic yards. Reports were received from 56 producers distributed among 32 counties. The largest business was on Long island, principally in Nassau county, where the supply for New York is obtained. Nassau county alone contributed a total of 2,903,600 cubic yards valued at $1,020,247.

SLATE

The quarrying of slate in New York is restricted at present to a small district in eastern Washington county. The district extends north from Salem through the towns of Hebron, Granville, Hampton and Whitehall and is practically continuous with the Vermont slate district which has much greater economic importance. The slate occurs at several horizons among the metamorphosed Paleozoic strata of the region, but belongs mostly to the Cambric and Ordovicic systems. The associated rocks include limestone, shale, sandstone and quartzite. Extensive slate beds are found also in the southern continuation of the metamorphic region along the east side of the Hudson river, in Rensselaer, Columbia and Dutchess counties. Attempts to work the slate in this section, however, have not been permanently successful, though it is recorded that quarries were operated for a time at Hoosick, New Lebanon and Hamburg.

The slate from Washington county is remarkable for its variety of colors. Red slate is the characteristic product, and has the greatest value owing to its rarity elsewhere. It is quarried chiefly near Granville and in the Hatch Hill and North Granville sections. Purple, mottled and different shades of green slate including the unfading green are also quarried. Nearly all of the product is sold for roofing purposes, as the manufacture of other materials has not been developed to any extent in this State.

A paper by Henry Leighton, descriptive of the general occurrence of slate in Washington county, and of the practice of quarrying and preparing the material for the market is included in the issue of this report for the year 1909.

The production of slate increases and decreases irregularly from year to year, though no very great change has taken place in the industry for some time. During the past year the demand for roofing material was rather poor owing to the dull conditions in the building trades. The total value of the output as reported by the quarry companies amounted to $83,090 as compared with $127,050 in 1909 and $111,217 in 1908. This shows a falling off in the value of nearly 35 per cent. The product of roofing slate amounted to 14,107 squares with a value of $79,857, an average value per square of $5.66. In 1909 the roofing slate amounted to 21,187 squares valued at $126,170, an average of $6.99 a square. These averages are above those obtained for the slate in other districts, due to the fact that the red slate commands a very high price, usually from $8 to $10 a square. The balance of the slate output last year consisted of mill stock with a total value of $3,233, against a value of $880 in 1909.

STONE

Quarry materials are among the leading items in the mineral production of the State. In the aggregate their value ranks second only to that of clay manufactures and the quarry industry is even more widely represented throughout the various sections. They include all the principal varieties of stone used for building purposes, some of which are worked on a fairly extensive scale. The production of building stone, however, has never approximated the requirements of the local markets, and very large quantities of that material are brought in from other states. The main developments in quarrying, hitherto, have taken place in the branches that supply stone for engineering work, road improvements and such purposes which entail a minimum amount of labor for extraction and preparation.

The production of stone in 1910 was valued at $6,193,252 as compared with $7,061,580 in the preceding year. A decrease of $868,338, or about 12 per cent, thus occurred in the industry and was distributed among all the different branches. It should be noted that these figures do not include slate, millstones or limestone used for cement manufacture, which are reported separately.

The output of granite fell to nearly one-half the amount reported in 1909. The value of the product was $244,763 as compared with $479,955 in the preceding year. Both the Adirondack quarries and those in southeastern New York reported a reduced business. New developments that may bring about an expansion of the industry in the near future have been under way in the Adirondack region.

Limestone showed a relatively small decrease; the output was valued at $3,245,807 against $3,300,383 in the preceding year. The wide use of limestone for road work was largely responsible for maintenance of the output.

The value of the marble that was quarried last year amounted to $341,880 against $380,016 in 1909. The Gouverneur and Columbia county quarries both shared in the decline.

Sandstone accounted for a value of $1,451,796 in the total as compared with $1,839,798 for the preceding year. A slight gain in the sandstone for building uses was more than counterbalanced by the falling off in the other kinds like curb and flagstone.

The Hudson river trap quarries were worked on about the usual scale. The value of the product was $909,006 against $1,051,428 in

1909; the quantity of stone quarried was actually larger than in the preceding year, the lower selling price accounting for the decrease in value.

Production of stone in 1908

VARIETY	BUILDING STONE	MONU-MENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$71 122	$27 585	*a*	$152 783	$116 074	$367 564
Limestone	245 655	....	$15 668	1 647 629	1 210 883	3 119 835
Marble	567 444	111 492	....	....	13 921	692 857
Sandstone	380 182	....	912 843	135 741	282 819	1 711 585
Trap	....	....	....	722 863	910	723 773
Total	$1 264 403	$139 077	$928 511	$2 659 016	$1 624 607	$6 615 614

a Included under "All other."

Production of stone in 1909

VARIETY	BUILDING STONE	MONU-MENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$35 019	$33 818	$1 352	$182 029	$227 737	$479 955
Limestone	217 109	....	15 363	1 744 314	1 323 597	3 300 383
Marble	262 934	104 495	25	6 403	6 159	380 016
Sandstone	358 589	....	783 880	220 200	477 129	1 839 798
Trap	....	....	....	1 061 428	....	1 061 428
Total	$873 651	$138 313	$800 620	$3 214 374	$2 034 622	$7 061 580

Production of stone in 1910

VARIETY	BUILDING STONE	MONU-MENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$40 911	$12 989	*a*	$91 988	$98 875	$244 763
Limestone	99 049	....	$3 888	1 815 809	1 327 061	3 245 807
Marble	252 965	88 684	....	....	231	341 880
Sandstone	387 408	....	408 132	225 408	358 848	1 451 796
Trap	....	....	....	908 931	75	909 006
Total	$780 333	$101 673	$484 020	$3 042 136	$1 785 090	$6 193 252

a Included under "All other."

GRANITE

In the strict sense granite is an entirely crystalline igneous rock made up of potash, feldspar and quartz, usually with subordinate amounts of mica, hornblende or pyroxene. Among quarrymen and builders, however, the name granite is given to various other types of rocks, such as the heavier and darker colored diorites, norites, gabbros, syenite which resembles granite but lacks quartz, and the bedded or banded rocks known as gneisses and schists.

Two main areas of extensive outcrops of granites and gneissic rocks are found in the State: the Adirondacks and bordering region and the Highlands of southeastern New York. In both areas a wide variety of these rocks exists from which material suitable for almost any purpose can be obtained. Up to the present time, however, the local granites have not been utilized to any great extent for cut and polished work, of which trade the New England quarries have long held control.

In the Adirondack region the prevailing rock formations are granite, syenite, anorthosite and norite of both massive and gneissoid types. Quarries have been opened only in the more accessible places on the borders.

One of the best known products from this region is the red granite which is obtained on Picton and Wellesley islands in the St Lawrence river. This is a true granite, of attractive red and pink shades, ranging from fine to course texture, and takes a handsome polish. It ought to command a wide market for monumental and building purposes.

Green syenite is quarried at West Chazy and Ausable Forks. The Adirondack Granite Co. has recently undertaken the development of large quarries at the latter locality and intends to erect a dressing and polishing plant for turning out all classes of work. The company has secured the quarries formerly worked by the Ausable Forks Granite Co., as well as additional properties. The products of the quarries are green and dark green granite (syenite) and light gray granite (anorthosite). The syenite is particularly adapted for polished material. The anorthosite has the qualities of an attractive building stone.

An outlying mass of Adirondack crystalline rocks occurs at Little Falls, Herkimer county, where quarries have been opened principally for supplying crushed stone. The crushing plant of the Syenite-Trap Rock Co., which was destroyed by fire in 1909, is in course of reconstruction.

The granite quarries of southeastern New York are mainly situated in Westchester county. The Fordham gneiss, a well-foliated, grayish biotite gneiss, supplies stone for foundations and rough masonry. The Yonkers gneiss, more massive than the former and containing hornblende, affords a good building material. Dikes and bosses of massive granite are also common in this region and have been quarried quite extensively for building purposes at New Rochelle, Mount Vernon and Lake Mohegan, Westchester county;

Round Island, Rockland county; and Pine Island, Orange county. The Storm King granite, below Cornwall, is used for crushed stone.

The granite trade last year showed a marked recession, the production falling below that of any recent year excepting 1907. The decrease was mainly in the crushed stone and paving block industries, though the output of granite for building and monumental work did not attain the usual proportions. The total production was valued at $244,763 against $479,955 in 1909 and $367,564 in 1908. Building stone, rough and dressed, contributed $40,911 to the total as compared with $35,019 in the preceding year and $71,122 in 1908. The output of crushed stone amounted in value to $91,988 against $182,029; monumental stone to $12,989 against $33,818; rubble and riprap to $20,272 against $12,737; and paving blocks and other kinds to $78,603 against $216,352 in 1909.

Production of granite

	1908	1909	1910
Building stone	$71 122	$35 019	$40 911
Monumental	27 585	33 818	12 989
Crushed stone	152 783	182 029	91 988
Rubble, riprap	15 351	12 737	20 272
Other kinds [a]	100 723	216 352	78 603
Total	$367 564	$479 955	$244 763

a Includes curbing, paving blocks and minor uses.

LIMESTONE

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

A smaller part is represented by crystalline limestone and by the waste product 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 duplication of the statistics.

Limestones are widely distributed in the State; the only region which is not well supplied with this stone being the southern part where the prevailing formations are sandstones of Devonic age. In the western and central parts the Onondaga and Cobleskill limestones and the Lockport dolomite furnish material for most requirements, though they are as a rule rather impure. In the northern section the Trenton and Chazy limestones and the Precambric crystalline limestone are well represented and in some localities are of very high quality. The Hudson river region has an important quarrying industry which is based on limestones of various ages, ranging from the Precambric crystalline series in the Highands of southeastern New York to the Salina and Helderberg limestones of the eastern counties. Besides the hard limestones as noted, there are unconsolidated calcareous deposits or marls which are found in swamps and old lake beds, particularly in the central and western parts of the State. They are utilized to some extent for cement manufacture and for fertilizer.

The limestone quarries rank first in importance among the stone industries. The product for 1910 was valued at $3,245,807, and was distributed among 32 counties. The returns showed a slight decrease as compared with the output in 1909 which was valued at $3,300,383.

Erie county has the largest product of any county, with a value of $866,335 for last year. Onondaga county ranks second, its importance being chiefly due to the operations of the Solvay Process Co., a large consumer of limestone in alkali manufacture. Then follow in order Dutchess, Jefferson, Genesee, Warren, and Albany counties, each reporting a product of more than $100,000.

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

Production of limestone

MATERIAL	1908	1909	1910
Crushed stone	$1 647 629	$1 744 314	$1 815 809
Lime made	401 728	452 874	365 839
Building stone	245 655	217 109	99 049
Furnace flux	230 117	434 311	538 491
Rubble, riprap	a	82 748	30 819
Flagging, curbing	15 668	15 363	3 888
Miscellaneous	b 579 038	b 353 664	b 391 912
Total	$3 119 835	$3 300 383	$3 245 807

a Included in "Miscellaneous."
b Includes lime made by Solvay Process Co. and Union Carbide Co., also rubble and riprap.

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

The value of the crushed limestone for 1910 was reported as $1,815,809 as compared with $1,744,314 for the preceding year. The amount of the product was about 2,800,000 cubic yards. Erie county led with a production valued at $476,490 against $447,605 in 1909. The other counties reporting values over $100,000 were Dutchess, Rockland, Onondaga, Albany, and Genesee.

Lime. The total value of lime made in 1910 was $365,839. This branch of the industry experienced a poor season owing to the dull conditions in the building trades. In the preceding year the value was reported as $452,874. The lime made by the Solvay Process Co. and the Union Carbide Co. has not been included in the totals, but classed under " Other uses." The leading counties in the manufacture of lime for the trade were Warren with a total value of $140,576; Jefferson with $55,837; and Clinton with $48,823.

Building stone. The limestones found in the State have only a limited sale for building purposes, and few quarries supply more than a local demand, so that their output fluctuates greatly from year to year. The restricted market is probably due largely to the fact that the limestones are prevailingly of dark or somber colors, whereas the present demand is for the lighter colors like those of the Bedford limestone and Ohio sandstone. The extending use of concrete has also been a factor in the recent decline of the cut stone trade, though it has increased the sale of crushed stone.

The returns for 1910 indicated a total product of building stone valued at $99,049 as compared with a value of $217,109 for the preceding year and $245,655 for 1908. The loss was distributed among various counties, but it was most apparent in Erie where the output showed a falling off from a value of $119,134 in 1909 to $53,881 last year. The quarries in Schoharie and Herkimer counties which have been notable producers in earlier years were either inactive or were operated on a small scale.

Furnace flux. The value of the limestone used in blast furnaces for flux is second only to that of crushed stone. The principal quarries of this material are in the Onondaga limestone of Erie and Genesee counties, from which the Buffalo iron furnaces derive much of their supply. The Lockport dolomite is also quarried in Niagara county and shipped to furnaces in that section. The furnaces of northern New York derive their supply of flux from the Chazy limestone of Clinton county and the crystalline limestone in Essex county. One quarry in the Gouverneur marble district ships its product to furnaces in western New York.

The production of flux in 1910 reached a value of $538,491 which was the largest ever recorded. The output for the preceding year was valued at $434,311, so that the gain was nearly 25 per cent. Erie county contributed a value of $322,067, or about 60 per cent of the total. Genesee county made an output valued at $90,132.

Production of limestone by counties in 1909

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$105 440	$4 600	....	$200	....	$110 240
Cayuga	36 734	400	$610	6 835	$2 500	47 079
Clinton	21 735	47 488	14 200	13 325	532	97 280
Columbia	9 883	....	3 460	200	....	13 543
Dutchess	365 661	4 000	....	....	....	369 661
Erie	447 605	375	257 966	119 134	28 684	853 764
Fulton	....	18 900	....	....	....	18 900
Genesee	123 784	5 400	99 814	1 225	....	230 223
Greene	4 177	....	....	500	30	4 707
Herkimer	6 611	3 350	....	....	....	9 961
Jefferson	1 000	[a] 57 368	....	562	153 420	212 350
Lewis	940	8 000	....	887	2 359	12 186
Madison	24 176	....	....	840	12 000	37 016
Monroe	20 218	23 593	....	3 917	2 454	50 182
Montgomery	42 832	....	....	10 440	1 503	54 775
Niagara	2 060	3 000	27 920	5 587	612	39 179
Onondaga	110 886	[a] 600	....	17 380	231 842	360 708
Rensselaer	15 700	....	75	3 550	6 750	26 075
St Lawrence	6 630	5 350	23 994	2 993	1 103	40 070
Saratoga	11 316	....	....	100	....	11 416
Schoharie	18 913	400	....	25 885	....	45 198
Seneca	1 050	360	40	865	210	2 525
Ulster	48 022	11 360	....	1 200	....	60 582
Warren	22 938	175 830	....	1 156	1 750	201 674
Washington	47 660	43 200	....	....	2 000	92 860
Westchester	8 252	30 000	....	....	3 465	41 717
Other counties [b]	240 091	9 300	6 232	328	561	256 512
Total	$1 744 314	$452 874	$434 311	$217 109	$451 775	$3 300 383

[a] Lime used by Solvay Process Co. and Union Carbide Co. included in "Other uses."
[b] Includes Essex, Ontario, Oneida, Orange, Rockland and Schenectady counties.

Production of limestone by counties in 1910

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

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

MARBLE

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

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

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

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

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

The production of marble in the State last year was valued at $341,880. The output was a little below that recorded for 1909 which amounted to $380,016, and much less than the total for 1908 which reached $692,857. The slackened demand for building stone seems to have been mainly responsible for the decline of output, though the monumental trade at Gouverneur has also been less active than formerly.

Production of marble

VARIETY	1908	1909	1910
Building marble	$567 444	$262 934	$252 965
Monumental	111 492	104 495	88 684
Other kinds	13 921	12 587	231
Total	$692 857	$380 016	$341 880

SANDSTONE

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

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

In western New York the principal quarries are situated within the belt of Medina sandstone which outcrops just south of Lake Ontario from Oswego to Niagara county. This is a medium-grained pink or red stone of attractive appearance and good wearing qualities. It is extensively employed for building stone, as well as for paving blocks, curbing and such purposes. The largest quarry industry is in Orleans county in the vicinity of Albion, Holley and Medina, but there are also quarries at Lockport and Lewiston in Niagara county and at Brockport and Rochester, Monroe county. The product of the Niagara county quarries has a white color differing in this respect from the usual grade which is obtained from the reddish layers higher up in the series.

Along the northern and southwestern borders of the Adirondacks is the Potsdam sandstone which has been extensively worked for structural material and flagstone. It is red or gray and ranges from hard flinty quartzite to a somewhat loosely cemented sandstone. The principal quarry openings are near Potsdam and Redwood, St Lawrence county, and Malone and Burke, Franklin county. The Potsdam is also exposed in places along the Champlain valley and has been worked to some extent at Port Henry, Whitehall and Fort Ann. The quarries at Burke produce flagstone chiefly for shipment to Montreal and other Canadian cities.

The Hudson River sandstones are mainly quarried along the Hudson and Mohawk rivers for local requirements in building and engineering work. There are quarries in Albany, Rensselaer, Greene, Dutchess, and Herkimer counties, but few have been operative in recent years.

The Devonic sandstones which extend over much of the area in southern New York are commonly grouped under the class of bluestone, a name first applied to them in Ulster county where they are distinguished by a bluish gray color. They are typically 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 flagging and curbing 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, with Catskill, Saugerties, and Kingston as the chief shipping points. In the Delaware River district are Sullivan, Delaware, and Broome counties with a great number of shipping stations along the Erie and Ontario & Western railroads. The Devonic sandstones are also quarried in many of the counties to the west of these districts, but principally around Norwich, Chenango county, and Warsaw, Wyoming county, which produce large quantities of building stone.

The total production of sandstone in 1910 was valued at $1,451,796. Compared with the value for the preceding year which amounted to $1,839,798, this showed a decrease of $388,002 or a little over 20 per cent. In 1908 the value of the output was $1,711,585.

The large decrease reported for the past year may be ascribed to the lessened activity in the Hudson River and Delaware River districts which shipped a much smaller quantity of curbing and flagging than usual. The value of the bluestone quarried was $1,037,637 against $1,301,959 in 1909. Of the total, curbing and flagging constituted $385,825 as compared with $608,116 in the preceding year, a decline of about 35 per cent. The value of the bluestone used for building purposes, on the other hand, showed a slight advance from $298,631 in 1909 to $351,603 last year.

Sandstone, other than bluestone, constituted a value of $414,159 against $537,839 in the preceding year. The decrease was distributed practically among all the quarry districts. The Orleans county quarries reported an output valued at $332,382 as compared with $385,281 in 1909.

Production of sandstone in 1909

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river........	$7 552	$256 193	....	$175 000	....	$116 268
Delaware river.......	23 165	324 906	....	....	$3 905	88 839
Chenango co.........	66 141	21 340	....	....	368	1 059
Wyoming co.........	191 276	480	....	....	443	850
Other districts........	10 497	5 197	....	7 662	....	818
Total bluestone.....	$298 631	$608 116	....	$182 662	$4 716	$207 834
Sandstone						
Orleans co...........	$16 017	$116 816	$246 091	$874	$4 283	$1 200
Other districts........	43 941	58 948	2 660	36 664	8 245	2 100
Total sandstone....	$59 958	$175 764	$248 751	$37 538	$12 528	$3 300
Combined total.....	$358 589	$783 880	$248 751	$220 200	$17 244	$211 134

Production of sandstone in 1910

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

TRAP

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

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

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

The production of trap in 1910 amounted to 1,185,780 cubic yards valued at $909,006, an increase of quantity but a decrease in value as compared with the totals reported in the previous year. Of the production a little less than 90 per cent was sold for road metal and the remainder for concrete work and ballast. Eight firms were represented in the industry, seven of which operated quarries in Rockland county, and one the quarry at Greenfield, Saratoga county. The Ramapo Trap Rock Co. of Suffern, Rockland county, was a new producer.

During the past year plans were formulated for the establishment of a State park which will include the Palisades from the New Jersey state line north into Rockland county. By a legislative enactment it is proposed to acquire by purchase or condemnation the lands lying between the base and top of the Palisades and also such unimproved lands on the top from the New Jersey state line to Piermont creek in Rockland county, as are necessary to preserve the scenic features from further injury. The execution of this plan was placed in charge of the commissioners of the Palisades Interstate Park. The quarries of the Manhattan Trap Rock Co. have already been acquired and it is reported that the others will be taken over in the near future. In that event the trap industry which for many years has supplied a large part of the crushed stone to the lower Hudson region will be reduced to small proportions if not definitely ended.

Production of trap

MATERIAL	1909		1910	
	CUBIC YARDS	VALUE	CUBIC YARDS	VALUE
Crushed stone for roads	868 650	$823 696	1 000 187	$786 733
Crushed stone for other purposes	226 681	237 732	185 493	122 198
Other kinds	....	....	100	75
Total	1 095 331	$1 061 428	1 185 780	$909 006

TALC

The talc mines in the Gouverneur district last year continued to supply a large output for the demands of the paper trade and for other purposes. The list of producers remained unchanged, with the Ontario Talc Co. and the International Pulp Co. as the only active representatives. The latter company carried on the largest operations and for some time has been the leading factor in the production and sale of ground talc in this country; its position was materially strengthened a few years ago by securing control of the mines and mills formerly owned by the Union Talc Co. and the United States Talc Co.

The general features of the Gouverneur talc district and of the mining developments were described in the issue of this report for 1908.

An important recent development is connected with the preparations of the Uniform Fibrous Talc Co. for engaging in the industry. This company was formed in 1908 since which time it has opened a mine just west of Talcville and erected a mill in the same locality. The mill, a steel frame structure on concrete foundations, was designed for about 50 tons daily capacity. Power for both mines and mill will be supplied by an independent hydroelectric plant on the Oswegatchie river, above Dodgeville. Productive operations were begun in January of this year.

The Ontario Talc Co. has concentrated its mining operations on the Potter property, below Fullerville, which the company began to develop a few years ago. The workings are now down about 175 feet on the bed which dips 45° and ranges from twelve to eighteen feet in thickness. There is little water in the mine, and the walls are sufficiently strong to require no timbering, though not infrequently they give trouble in the mines of this district. The product is hauled in wagons about a mile to the grinding plant where it is prepared in the usual manner by reduction in crushers and pebble mills. The ground talc is mainly of one grade, of finely fibrous texture, and finds sale among paper, wall plaster and paint manufacturers.

The International Pulp Co. has obtained most of its supply of rock from the mines in the northeastern section of the belt. The mine once owned by the United States Talc Co. has been one of its chief producers since the consolidation. The Arnold and Balmat mines of the old Union Talc Co. have been worked intermittently according to needs. The company is opening a new mine in the vicinity of the old Wight mine.

The finished talc from this district is shipped in bags of 50 and 200 pound sizes. Gouverneur, the shipping point on the main railroad lines, is about ten miles from the center of the district which is served by a branch railroad that runs between Gouverneur and Edwards. The mills of the International Pulp Co. are connected by spurs with this railroad and the talc loaded directly on cars.

The first important production of talc outside of the Gouverneur district was made last year by the St Lawrence Talc and Asbestos Co., which operated a deposit near Natural Bridge, Lewis county. As mentioned in the review of the talc industry for 1909, the occurrence at that place may be comparable to the deposits in St Lawrence county so far as geological relations are concerned, though the talc itself has a somewhat different appearance and structure. The product obtained last year was shipped in lump form for manufacture elsewhere into various materials such as powder, disks and pencils. Productive operations were suspended in November in order to make necessary improvements preliminary to the construction of a crushing plant and mill. An electric power station has already been erected. The mill as designed will probably turn out 60 tons of ground talc a day.

Production of talc in New York

YEAR	SHORT TONS	VALUE	VALUE PER TON
1896	46 089	$399 443	$8 67
1897	57 009	396 936	6 96
1898	54 356	411 430	7 57
1899	54 655	438 150	8 02
1900	63 500	499 500	7 87
1901	62 200	483 600	6 99
1902	71 100	615 350	8 65
1903	60 230	421 600	7 ..
1904	65 000	455 000	7 ..
1905	67 000	519 250	7 75
1906	64 200	541 600	8 43
1907	59 000	501 500	8 50
1908	70 739	697 390	9 86
1909	50 000	450 000	9 ..
1910	65 000	552 500	8 50

The production of talc in New York for the period 1896-1910 is shown in the accompanying table. The figures for the years previous to 1904 are from the volumes of the *Mineral Resources.*

The average output of the Gouverneur district has been about 65,000 tons a year, with variations of 5000 tons or a little more from year to year. During some of the last few years the production has been below normal, owing to the slight rainfall in the summer months and consequent want of power for grinding the talc. The quantity turned out last year may be placed at about 65,000 short tons as compared with 50,000 tons in 1909. The value of the production was $552,500 against $450,000 in 1909.

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Appendix 3

Entomology

Museum Bulletin 147

Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 490 ALBANY, N. Y. March 1, 1911

New York State Museum

John M. Clarke, Director
Ephraim Porter Felt, State Entomologist

Museum Bulletin 147

26th REPORT OF THE STATE ENTOMOLOGIST

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1910

New York State Education Department
Science Division, December 21, 1910

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

DEAR SIR: I have the honor to communicate herewith for publication as a bulletin of the State Museum the Annual Report of the State Entomologist, for the fiscal year ending September 30, 1910.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 22d day of December 1910

Commissioner of Education

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JOHN M. CLARKE, Director

EPHRAIM PORTER FELT, State Entomologist

Museum Bulletin 147

26th REPORT OF THE STATE ENTOMOLOGIST, 1910

To John M. Clarke, Director of Science Division

I have the honor of presenting herewith my report on the injurious and other insects of the State of New York for the year ending October 15, 1910.

The past season has been remarkably quiet so far as unusual outbreaks of injurious insects are concerned. The entomologist was exceptionally fortunate in discovering a colony of pedogenetic larvae, presumably those of Miastor americana. These extremely peculiar forms were previously unknown in this country and have been studied by only a few Europeans. A summarized account of these interesting larvae is given in an appendix.

Fruit tree pests. The experimental work with the codling moth was continued the present season under more diverse conditions, and data which will be of great value in the practical control of this species, was secured. The experiments were conducted in the orchards of W. H. Hart, Poughkeepsie; C. R. Shons, Washingtonville and William Hotaling, Kinderhook. Great pains were taken to secure an ample number of trees likely to produce a nearly uniform amount of fruit. Each plot, as last year, except in the case of Mr Hotaling's orchard, consisted of 42 trees, the fruit from the central six alone being counted. Comparisons were made to ascertain the relative efficacy of one spray given just after the blossoms dropped, with this treatment supplemented by a second application about three weeks later. The unusual abundance of the codling moth the past season renders the data secured of exceptional value because they show the possibilities under very adverse conditions. Assistant State Entomologist Young aided in the field work and was responsible in large measure for the computation of the tabulated data. These experiments and their application are discussed on subsequent pages.

The San José scale is still very destructive, especially to peach trees, though our progressive orchardists have comparatively little difficulty in controlling it. A lime-sulfur wash, particularly that known as the concentrated wash, either homemade or commercial, has proved very satisfactory, as a rule, in checking this pest. There was complaint of injury by the cherry maggot in the Hudson valley and an investigation of the pest and methods of controlling it was inaugurated. The cherry and pear slug was exceptionally abundant in this region and also in the western part of the State. The pear psylla was somewhat numerous in the lower Hudson valley and reports of serious injuries were received from certain sections in the western part of the State.

The work of a new apple pest which may be known as the lined red bug (Lygidea mendax Reut.) was observed in the Hudson valley. This insect occurs in early spring, lives upon the more tender terminal leaves and, under favorable conditions, may inflict considerable injury.

Shade tree pests. The injurious work of various species has been brought to our notice. The more important of the shade tree pests is the elm leaf beetle, a well known form which has been exceedingly abundant on Long Island, throughout the Hudson valley and in certain cities in the western part of the State. The sugar maple borer has been unusually numerous on the trees of Fulton, Oswego county, destroying or practically ruining a number of magnificent trees. The cottony maple scale has been somewhat abundant in the lower Hudson valley, while the injurious work of the false maple scale was observed in several localities in the vicinity of New York city.

Forest insects. The snow-white linden moth, a pest which has been very destructive in the Catskills for the past three years, was abundant in limited localities last season and its flight in small numbers was observed in various places. A series of outbreaks by another leaf feeder was reported from several localities. They were due to the operations of a green, white-striped caterpillar

(*Xylina antennata*) frequently designated as the green fruit worm. The destructive work of the hickory bark beetle, noted in a preceding report, has been continued. An unusual outbreak was that of Abbott's sawfly, a false caterpillar which stripped or nearly defoliated many white pines in the foothills of the Adirondacks. The spruce gall aphid has continued to be abundant and injurious on Norway spruce, in particular. It is interesting to record the discovery of another species of gall aphid, new to the State, occurring upon the Colorado blue spruce. The above noted insects have been the subject of correspondence and, in some instances, of field investigations during the past season.

Gipsy and brown tail moths. Much interest was aroused early in 1909 by the finding of thousands of winter nests of the brown tail moth on many shipments of French seedlings. A number of such nests occurred on shipments received in 1910, though the pests were not so abundant as during the preceding year. The careful inspection of the stock appears to have prevented this insect from becoming established in the State. There is much more danger of this moth being brought into New York State on shipments of full grown nursery stock originating in infested American territory than there is of its being introduced with imported seedlings. It has been found necessary to give considerable time to the determination of remains of caterpillars, cocoons and egg masses in order to be certain that none of these fragments on nursery stock indicated the presence of either the gipsy or brown tail moth. The mounting of such fragments has devolved upon Miss Hartman.

A personal investigation of conditions in eastern Massachusetts shows that no pains are being spared to prevent the dissemination of either the gipsy or the brown tail moth. Particular attention has been given to keeping the property abutting on the principal highways free from the pests so as to eliminate in large measure the danger of their being carried by vehicles of any kind. There has been, however, some extension of the territory occupied by these two pests. The gradual spread of these insects appears to be inevitable, though the utmost care is taken in the treatment of the outlying colonies. It is gratifying to state that the serious infestation recently discovered at Wallingford, Conn. has been handled in such a satisfactory manner that only a very few specimens rewarded a week's careful search by a gang of fifteen men. An examination of the work with parasites showed that no stone was being left unturned in an effort to find, rear and liberate a large number of efficient enemies of these pests. The entomologist would emphasize once more the grave danger of bringing either one or both of these pests into the State on nursery stock originating in the infested area, and would call attention to the great desirability of promptly exterminating any isolated colonies which might be found in the near future.

House fly. The popular interest in the control of this pest has continued and bids fair to result in important and far-reaching sanitary changes. The demand for information along these lines speedily exhausted the edition of Museum Bulletin 129 on the *Control of Household Insects* and necessitated its republication in an extended and revised form as Museum Bulletin 136 entitled: *The Control of Flies and Other Household Insects.* The entomologist has been called upon to give a number of popular lectures upon this insect and has made personal examinations of conditions in several localities, giving special attention to situations favorable for the production of flies in cities and villages.

Gall midges. Our studies of this extensive and interesting group have been continued and the results are now in manuscript. This publication will describe fully some 800 species, 441 having been reared. The tabulation of midge galls, made with the assistance of Miss Hartman, shows that we know some 538 species representing 44 genera and living at the expense of some 177 plant genera referable to 66 plant families. In addition to the above, there are some 5 species reared from unknown plants and 11 species belonging to 3 genera known to be zoophagous.

A number of new species have been reared during the year. Miss Cora H. Clarke of Boston, Mass. has continued collecting and forwarding to us excellent series of galls from which we were able to rear several previously unknown species. The care of this material has devolved largely upon assistant D. B. Young and Miss Hartman. The latter has also made a large number of microscopic mounts of these fragile forms.

Miscellaneous. The entomologist spent nearly six weeks in Europe, giving special attention to museum methods, shade and forest tree insects and the gall midges. Collections were studied in the following institutions: British Museum of Natural History, London; the Universities of Oxford and Cambridge; the Tropical School of Medicine, Liverpool; the zoological gardens at Antwerp; the Royal Museum of Natural History at Brussels; the botanical gardens of Ghent; Museum of Natural History and also the entomological station, both of Paris; the University at Zurich; the exceptionally valuable collection of forest insects in the forestry school at Munich; the natural history collections in the Senckenberg Museum at Frankfurt; the Winnertz collections in the University of Bonn; the Museum of Natural History, Berlin, and the Museum of Natural History at Hamburg. In addition, the entomologist spent several days with Prof. J. J. Kieffer of Bitsch, Germany, studying his exceptionally valuable collection of Cecidomyiidae, and a day with Prof. E. H. Rübsaamen at Remagen, Germany, which was devoted largely to examining his numerous excellent drawings and a discussion of the classification of this group. A portion of a day was spent with Oberforster H. Strohmeyer of Münster, Germany, studying his excellent collection of Scolytidae, while another day was passed with Oberforster Karl Philip at Sulzberg obtaining first-hand information of forestry methods as practised in Germany.

Publications. Numerous brief, popular accounts dealing with injurious insects have been prepared by the entomologist for the agricultural and local press, besides a few more technical papers for scientific publications. A revision of Museum Bulletin 129, as noted above, was issued during the year, while the report for 1909 appeared July last. A tabulation of the midge galls known to occur upon several plants was published in August under the title of *Gall Midges of Aster, Carya, Quercus and Salix.*

Collections. A most valuable addition to the collections was secured through the generosity of Prof. J. J. Kieffer, of Bitsch, Germany, who kindly donated to the museum a number of his generic types of European gall midges. These have been carefully mounted and are now accessible to students in the group. A fine series of Italian midge galls was secured by exchange with Dr Mario Bezzi. These were carefully arranged and labeled by Miss Hartman. Miss Cora H. Clarke, as in preceding years, has contributed some valuable biological material, mostly insect galls.

The arrangement and classification of the collection has been pushed as rapidly as possible, though it should be remembered that, with the limited office staff, it is practically impossible to keep the collections properly classified, while the securing of extremely desirable additional material must of necessity proceed slowly. The restrictions due to a small staff will become more apparent with the occupancy of quarters in the new building, accompanied by the obligation of maintaining a larger exhibit. The school teachers of

Albany, Troy and presumably other near-by localities are making extensive use of our exhibit collections in connection with the regular school work. It is the aim of the Department to have a representative collection of the species occurring in the State, though the assembling of such means the work of years.

The nearly completed monograph on the gall midges shows that the State collections in this family will far exceed anything that can be assembled elsewhere for some years to come. It will always be exceptionally valuable because of the very large series of generic types or cotypes. Assistant State Entomologist Young has identified and arranged the Conopidae, besides doing much miscellaneous work in classifying insects collected during the year and identifying species sent in for name. A number of Hemiptera have been very kindly determined by our well known authority in this group, Mr E. P. Van Duzee of Buffalo. Miss Hartman has also assisted in the arrangement of the collection and has reared and spread a number of specimens.

The value of the exhibit collections will be greatly enhanced when the fine series of plant groups, designed for the exhibition of insects in their natural environment in the new Educational Building, has been completed. The wax work for four of these groups has been delivered and it is planned to complete the remainder next year. Several excellent models representing injurious insects are now on exhibition and more should be secured, preferably made to order, since only a few can be purchased in the market, while no one has attempted to prepare models of many forms which could be exhibited in this manner to very great advantage.

Nursery inspection. There has been close cooperation with this phase of the work conducted by the State Department of Agriculture. Numerous specimens of both native and foreign insects have been submitted to this office for name, and the entomologist frequently consulted in regard to various problems. This work, while consuming much time and often necessitating identifications of minute forms, like scale insects or the recognition of species by fragments or the comparatively unknown early stages, is very important, since the treatment of large shipments must depend in great measure upon our findings.

Office matters. The general work of the office has progressed in a satisfactory manner, the assistant State entomologist being in charge of the office and responsible for the correspondence and other matters during the absence of the entomologist in Europe and while away on vacation. Miss Hartman, in addition to matters noted above, has rendered material assistance in bibliographic work and in translating from German, French and Italian works. Numerous specimens have been received during the year for identification and many inquiries made concerning injurious forms. 1445 letters, 37 postals, 417 circulars, 1475 packages were sent through the mails and 44 packages were shipped by express.

General. The work of this office has been greatly facilitated, as in past years, by the identification of certain species through the courtesy of Dr L. O. Howard, chief of the Bureau of Entomology, U. S. Department of Agriculture, and his associates. Several correspondents have aided materially in securing valuable specimens of one kind or another, and, as heretofore, there has been a most helpful cooperation on the part of all interested in the work of this office.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

Office of the State Entomologist, October 15, 1910

INJURIOUS INSECTS

CODLING MOTH

Carpocapsa pomonella Linn.

The apple worm, or larva of the codling moth, is such a common pest that comparatively few appreciate the losses caused by its operations, and altogether too many regard it as a pest which it is almost useless to combat. This latter notion is a very erroneous one. There is abundant data to prove not only the possibility, but the practicability, of controlling this insect in a very satisfactory manner. This is shown in a very striking way by the experiments conducted last year. Even one thorough application resulted in the production of nearly 99 per cent of worm-free fruit, while check trees did not produce quite 73 per cent of sound fruit. These experiments were continued the present season for the purpose of testing more thoroughly and under varying conditions the relative value of one or more sprays for the control of this serious pest.

General observations. The season of 1910 has been remarkable for the development of a large second brood and a consequent prevalence of wormy apples. The work of this pest was very evident in Genesee county as well as in the Hudson valley, and in some unsprayed orchards over 50 per cent of the fruit had been injured by the apple worm. May 30th there was a severe hail storm in sections of the Hudson valley, and an examination of the wormy fruit showed that from 50 to 60 per cent of the apple worms had entered at points injured by the hail. Cacoecia larvae were rather prevalent in one orchard and their operations were very frequently followed by codling moth larvae entering at such places. Moreover, badly rusted, rough spots on the fruit were also favorite points of attack. Comparative freedom from codling moth injury was observable in orchards where pigs or sheep had been allowed to run, this being especially true if the animals had been pastured in the orchards for several years, even in those where there was no spraying. One codling moth larva was found spun up in a slight depression on the under side of an apple resting on loose soil, and another had prepared a similar retreat for the winter on an apple before it had dropped from the tree.

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

Experimental work. It was planned the present season to test, under varying conditions, the relative efficacy of but one spray given just after the blossoms fall, compared with other plots where the application just described was followed by a second about three weeks later, designed to destroy the codling moth larvae just as they are hatching, and a third plot where but one spraying was given about three weeks after the blossoms fell. This plot was designed to show the relative efficacy between the treatment at this time, which is markedly out of season, and the time applications are usually made, namely just after the bloom falls.

Series I. This series of experiments were conducted in a young orchard belonging to Mr W. H. Hart of Arlington, near Poughkeepsie and close to Briggs Station on the Hopewell branch of the Central New England Railroad. The orchard is on a moderately high hill, the trees being thrifty, about 16 years old, 16 to 19 feet

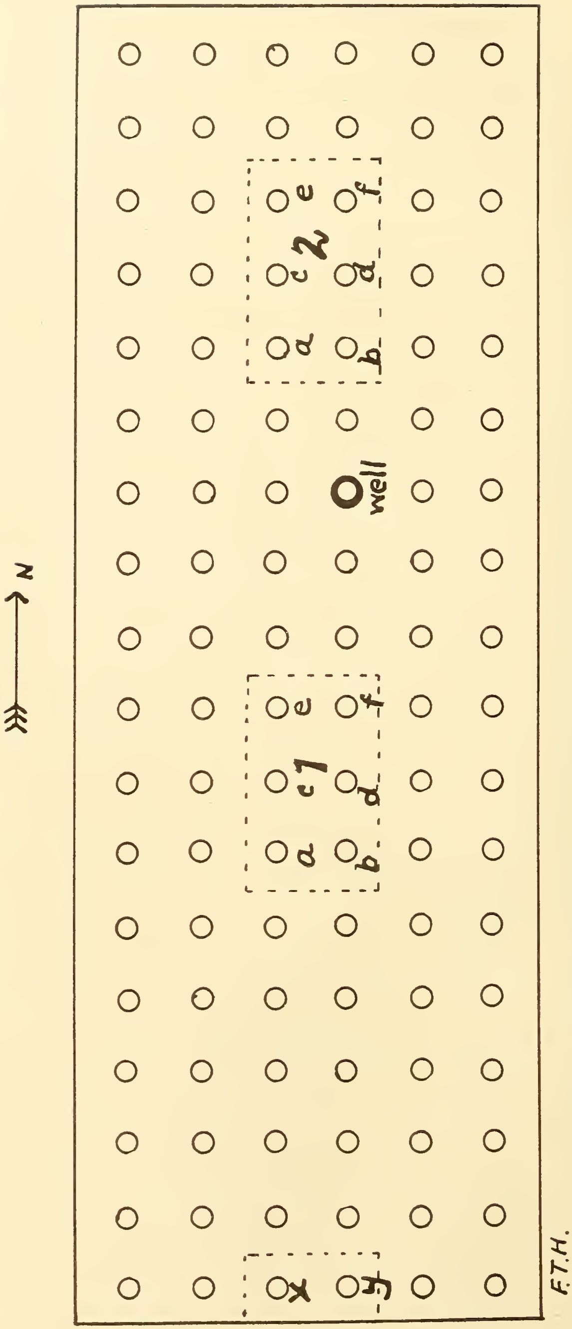

Fig. 1 Portion of orchard at Arlington showing the location of the experimental plots

high and 30 feet apart. The actual experimental trees were northern spy. Each plot consists of 42 trees, six trees in a row one way and seven in a row the other way, the central six being the actual experimental trees. These were carefully selected for uniformity in size, fruitage and infestation. There was a large crop of Baldwin apples in this orchard last year and some of the northern spys produced a fair yield. The check trees of the two plots in this orchard were located in the same north and south rows of trees near the western edge of the orchard, and were some little distance north of the road. Plots 1 and 2 were still further north. These two plots were thoroughly sprayed May 12, 1910 with seven pounds of arsenate of lead (15 per cent arsenic oxide) to each 150 gallons of spray, together with one gallon of a homemade concentrated lime-sulfur wash (Cordley formula, testing probably from 30 to 31° Baumé) to each 25 or 30 gallons of spray. The day was dry, nearly quiet and conditions were almost ideal. The pressure was maintained at from 100 to 150 pounds, Friend nozzles being employed and 150 gallons of spray sufficing for about 105 trees. All of the spraying was from the ground, the hose being tied to poles and the nozzles set at an angle so as to discharge almost directly into all the blossoms. The application was sufficiently thorough to cover practically all of the foliage in a very uniform manner. The trees were fairly well fruited and had just completed blossoming.

The second application was made on plot 2 June 2d. The day was cloudy, with a strong southwest wind and, as a consequence, the spray was applied from only one side, the eastern portion of the trees not being well covered, though special attention was given to the center where the greater portion of the fruit was located. The formula for the spray was practically the same as in the preceding application; 140 gallons were necessary to spray the plot of 42 trees. The fruit was in fine condition and the foliage had made excellent growth since the earlier application, which was plainly evident. At this time there were no signs of codling moth work.

An examination of this orchard June 30th showed a very gratifying condition. The check trees were in excellent foliage and already exhibited a markedly greater codling moth infestation. Plot 1, which received but one spraying, showed practically no wormy fruit and no signs of injury to the foliage. The same was true of plot 2 which was sprayed twice.

The fruit was picked up from under these trees and carefully classified August 23d and September 12th, the remainder being picked October 6th. The condition of the fruit on this latter date was most excellent, the color being fine, the surface smooth and a very high percentage with few defects. A tabulation of the entire data is given below.

Series 1, plot 1

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT Total	CLEAN FRUIT %	WORMY FRUIT Total	WORMY FRUIT %	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 23	9	6	......	3	......	......	......	3	3	.....
	Sept. 12	6	4	......	2	......	......	......	2	2	.....
	Oct. 6	148	135	......	13	......	......	3	10	3	1
		163	145	88.95	18	11.05	......	3	15	8	1
B	Aug. 23	1	1	......	......	......	......	......	......	......	.....
	Sept. 12	8	5	......	3	......	......	......	3	3	.....
	Oct. 6	105	99	......	6	......	1	2	3	2	1
		114	105	92.10	9	7.90	1	2	6	5	1
C	Aug. 23	12	4	......	8	......	......	1	7	7	.....
	Sept. 12	22	13	......	9	......	......	1	8	9	.....
	Oct. 6	409	382	......	27	......	5	7	15	6	.....
		443	399	90.07	44	9.93	5	9	30	22	.....
D	Aug. 23	14	7	......	7	......	......	......	7	7	.....
	Sept. 12	20	13	......	7	......	3	......	4	6	.....
	Oct. 6	593	563	......	30	......	1	2	27	3	.....
		627	583	92.98	44	7.02	4	2	38	16	.....
E	Aug. 23	5	1	......	4	......	......	......	4	4	.....
	Sept. 12	6	6	......	......	......	......	......	......	......	.....
	Oct. 6	160	139	......	21	......	4	3	14	5	1
		171	146	85.38	25	14.62	4	3	18	9	1
F	Aug. 23	12	3	......	9	......	......	......	9	8	.....
	Sept. 12	11	8	......	3	......	......	......	3	3	.....
	Oct. 6	298	275	......	23	......	2	2	19	12	.....
		321	286	89.09	35	10.91	2	2	31	23	.....
	Grand total	1839	1664	90.48	175	9.52	16	21	138	83	

Series 1, plot 2

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT Total	CLEAN FRUIT %	WORMY FRUIT Total	WORMY FRUIT %	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 23	12	11	......	1	......	......	......	1	1	....
	Sept. 12	9	9	......	......	......	......	......	......	......	....
	Oct. 6	441	414	......	27	......	4	......	23	3	....
		462	434	93.93	28	6.07	4	......	24	4	....
B	Aug. 23	3	2	......	1	......	......	......	1	1	....
	Sept. 12	5	3	......	2	......	......	......	2	2	....
	Oct. 6	362	347	......	15	......	......	......	15	4	....
		370	352	95.14	18	4.86	......	......	18	7	....
C	Aug. 23	2	1	......	1	......	......	......	1	1	....
	Sept. 12	9	8	......	1	......	......	......	1	......	....
	Oct. 6	218	215	......	3	......	1	......	2	......	....
		229	224	97.81	5	2.19	1	......	4	1	....
D	Aug. 23	12	7	......	5	......	......	......	5	5	....
	Sept. 12	14	12	......	2	......	......	......	2	2	....
	Oct. 6	954	941	......	13	......	1	......	12	4	....
		980	960	97.95	20	2.05	1	......	19	11	....
E	Aug. 23	7	5	......	2	......	......	......	2	2	....
	Sept. 12	4	4	......	......	......	......	......	......	......	....
	Oct. 6	365	358	......	7	......	......	......	7	4	....
		376	367	97.60	9	2.40	......	......	9	6	....
F	Aug. 23	2	2	......	......	......	......	......	......	......	....
	Sept. 12	27	24	......	3	......	......	1	2	2	....
	Oct. 6	400	393	......	7	......	......	......	7	2	....
		429	419	97.67	10	2.33	......	1	9	4	....
	Grand total	2846	2756	96.84	90	3.16	6	1	83	33	....

Series 1, check trees

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT Total	CLEAN FRUIT %	WORMY FRUIT Total	WORMY FRUIT %	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Aug. 23	68	10	......	58	......	30	20	8	35	13
	Sept. 12	17	......	......	17	......	9	4	3	9	....
	Oct. 6	{ 36	4	......	32	......	4	15	13	19	
		{ 19	82	......	37	......	20	14	3	18	5
		240	96	40	144	60	63	53	27	81	18
Y	Aug. 23	88	6	......	82	......	42	25	15	60	7
	Sept. 12	53	3	......	50	......	20	19	11	36	4
	Oct. 6	{ 75	1	......	74	......	10	51	13	43	7
		{ 255	96	......	159	......	51	92	16	78	4
	Grand total	471	106	22.5	365	77.5	123	187	55	217	22

Average for X-Y ....28.41........72.59

A study of the above tables discloses several very interesting facts. In plot 1 there is not a very wide variation in the fruitage, the number of apples ranging from 114 in tree B to 627 in tree D. The percentage of sound fruit varies from 85.38 per cent in tree E, with its 171 apples, to 92.98 per cent in tree D, having a maximum yield of 627 apples. Note that tree B had only 9 wormy fruit, nearly 8 per cent of the 114 produced, while the most wormy apples were found on trees C and D, each with 44 and forming, respectively, 9.93 and 7.02 per cent of the total product. Here, at least, the percentage comparison is obviously unfair, since the two trees had, as nearly as we can determine, a practically uniform infestation, yet the percentage varies considerably, due simply to the larger crop on one tree. There were no end wormy only on tree A, while the maximum in this classification was 5 on tree C. The side wormy range from 40 in tree D to 8 in tree B. It is perhaps significant that 8.6 per cent of the total fruit in this plot was side wormy, 7.5 per cent of this being side wormy only.

Plot 2 with its second poisoned application produced approximately 6 per cent additional sound fruit. This is nearly half a barrel, or 171 apples. It is probable that the somewhat greater yield of this plot, namely 2846 as compared with the 1839 of plot 1, had its influence in the production of a somewhat larger percentage of sound fruit. It is interesting to note certain details. The minimum tree C, with only 229 apples, produced 97.81 per cent of sound fruit, while the maximum tree D, with 980 apples, yielded 97.95 per cent of sound fruit, a difference of only .06 per cent. Here again we see the obvious injustice of a strictly percentage comparison, since C yielded only 5 wormy apples while D had 20, or, in other words, supported four times as many codling moth larvae, yet, owing to the disparity in fruiting, the percentage was practically identical. The minimum percentage of sound fruit was 93.93 produced by tree A yielding 462 apples, 28 of which were wormy. The minimum number of wormy apples, five, was produced by tree C mentioned above. The number of end wormy only ranges, among the individual trees, from nothing to 4, a total of 6 for the plot, with only 1 end and side wormy. It will be seen at once that only a little over 3.3 per cent of the apples in this plot were either side or end and side wormy, or a reduction in the number of side or end and side wormy of nearly 6.3 per cent from that of plot 1, by far the greater number being side wormy only. The gain following this second application is apparent in the almost total elimination of end wormy fruit and the material reduction in the side wormy, the actual number being nearly one-half that in plot 1.

The two check trees, X and Y, yielding respectively, 240 and 471 apples, a total of 711, 72.59 per cent being wormy, give an excellent idea of the conditions which would have prevailed had there been no application of poison. They produced respectively, only 40 per cent and 22.5 per cent of sound fruit and totals of 144 and 365 wormy apples, 80 of these on X and 242 on Y, or 33 per cent and 51 per cent respectively, of the total yield being side wormy. There were only 28.41 per cent of sound fruit on the two trees. It will be seen that under natural conditions, such as obtained last year, approximately equal numbers were end and side wormy.

Series 2. This series of three plots and two check trees was laid out in the young orchard of Mr C. R. Shons at Washingtonville. These trees are about 18 years old, 16 or 18 feet high, thrifty, rather thickly set and with a steep incline just southeast of the experimental area. The three plots and the check trees, as will be seen by reference to figure 2, were all in the same row of trees, running approximately northeasterly and consisted so far as the experimental trees were concerned, with but one exception, of Baldwins. The two check trees were farthest from the highway. The experimental trees in this series, as in the preceding, were carefully selected so as to obtain, as far as possible, uniformity in fruitage and infestation. Plots 1 and 2 were thoroughly sprayed May 11th with arsenate of lead and bordeaux mixture. The first tank of 150 gallons contained 6 pounds of arsenate of lead (15–16 per cent arsenic oxide). This was applied to the actual experimental trees and the barrier trees, spraying them together with a few trees on the northeast corner of plot 2. The second tank contained 6 pounds of arsenate of lead and was put on the remaining barrier trees on the north side of plots 1 and 2 and also on a portion of the barrier trees on the southeast corner of plot 2. The remainder of the barrier trees, namely, those on the southwest corner of plot 2 and the southern ones on plot 1, were sprayed with 2 pounds of arsenate of lead and 1 pound of paris green to 150 gallons, in con-

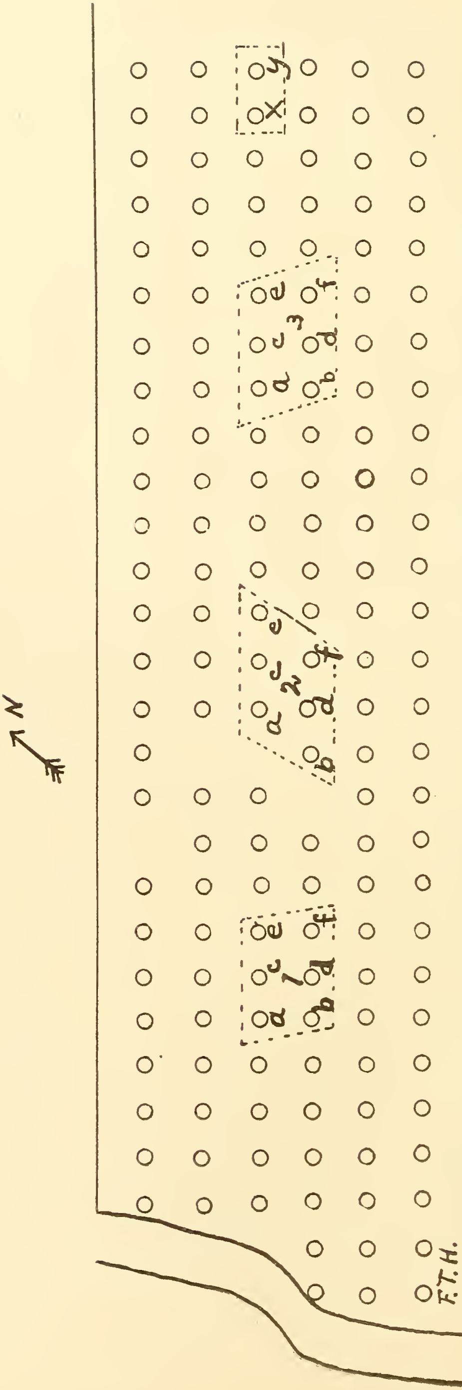

Fig. 2 Portion of orchard at Washingtonville showing the location of the experimental plots

nection with the bordeaux mixture. This latter consisted approximately of eight pounds of copper sulfate with enough lime to satisfy the copper, to 150 gallons.

The day was lowery with an occasional sprinkling of rain, but at no time did enough water fall to materially affect the work. The pressure was uniformly maintained at 85 to 100 pounds, a one horse gasolene engine supplying the power. Friend nozzles were employed, set at an angle and on the end of long extension nozzles, one man standing in a wagon, thus being able to throw the spray down upon even the highest blossoms. The actual experimental trees and the barriers separating them were Baldwins, while the two rows of barrier trees on the northwest were Wagners, and the same was true of the first barrier row on the southeast, the second being Baldwins. The blossoms had just dropped from the trees and the time of application was therefore nearly ideal.

Plot 2 was sprayed a second time June 1st and plot 3 for the first time on the same date. The day was cloudy with an occasional mistiness which did not interfere with the work, as there was not at any time enough moisture to wet the foliage. Six pounds of arsenate of lead (15 per cent arsenic oxide) was used to each 50 gallons of water and approximately the same formula as given above for the bordeaux mixture. 375 gallons of spray were applied to the 85 trees, it being sufficient to cause dripping in almost every instance. There was at this time no evidence of codling moth work, aside from possibly one apple which may have been entered at the side. Larvae of the green-striped apple worm, Xylina antennata Walk. and also those of a Tortricid, were rather abundant. The latter hid between the leaves and ate them as well as contiguous fruit. Apples were picked up under the experimental trees and classified August 24th, September 13th and October 4th–5th.

An examination of this orchard June 30th showed that the conditions were not so satisfactory as at Arlington. There was considerable bordeaux injury, especially on the plots receiving the early application. The poison was very evident on all the experimental trees. Those of plot 3, sprayed only on June 1st, showed less bordeaux injury than the others. The fruitage on some of the trees was disappointing, since many of the blossoms failed to set. Work of the Tortricid leaf roller, mentioned above, and the green fruit worm was quite evident.

An examination October 4th and 5th revealed much injury from the bordeaux mixture, many of the apples checking and codling moth larvae of the second brood entering at such points. An effort was made to approximate this injury and small, random samples from various trees were carefully sorted. The results are tabulated as follows:

Tree	1A	26 smooth,	48 injured
	1B	12 "	31 "
	1C	30 "	25 "
	2C	3 "	30 "
	2D	4 "	32 "
	2F	19 "	19 "
	3A	12 "	18 "
	3B	12 "	25 "
	3D	10 "	29 "
	X	77 "	23 "

We endeavored, in the above table, to put in the smooth class only those apples which were at least fairly smooth. A large proportion of those classed as injured were not seriously affected, aside from appearance, though some were badly gnarled and even cracked. It will be seen at once that a very high percentage of the fruit on all the sprayed trees were more or less rusted, while the proportions are approximately reversed on the unsprayed trees. Burning by bordeaux mixture was strikingly illustrated in Mr Shons' Ben Davis, some 90 to 95 and possibly 99 per cent of the apples being badly rusted and in some cases so seriously affected (pl. 13) that portions of the apple were irregular and more or less covered with rounded, tuberclelike elevations.

A considerable number of apples had been entered at the stem. The Tortricid larva, mentioned above, was still working on the apples in some numbers, either under a leaf, on the side of the fruit or beneath a light web at the blossom end. A note made by Mr Young September 13th records that over 90 of the 115 clean apples dropped from tree E, plot 3, had been gnawed by some larvae, probably that of this Tortricid. The work of this insect is illustrated on plates 10 and 11. A tabulation of the data obtained upon these plots follows.

Series 2, plot 1

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24.......	65	36	....	29	....	1	1	27	23	1
	Sept. 13.......	42	18	....	24	....	.....	1	23	14	.....
	Oct. 4–5.......	310	180	....	130	....	11	1	118	40	.....
	Oct. 18–19.....	249	168	....	81	....	12	2	67	17	.....
		1262	1226	....	36	....	4	.....	32	.....	.....
		1928	1628	84.44	300	15.56	28	5	267	94	1
B	Aug. 24.......	43	28	....	15	....	.....	1	14	11	.....
	Sept. 13.......	52	33	....	19	....	1	.....	18	12	1
	Oct. 4–5.......	391	182	....	209	....	27	5	177	81	.....
	Oct. 18–19.....	259	168	....	91	....	18	.....	73	7	.....
		911	880	....	31	....	8	1	22	.....	.....
		1656	1291	77.96	365	22.04	54	7	304	111	1
C	Aug. 24.......	77	43	....	34	....	1	.....	33	25	.....
	Sept. 13.......	83	58	....	25	....	3	.....	22	20	1
	Oct. 4–5.......	257	156	....	101	....	9	.....	92	38	.....
	Oct. 18–19.....	102	77	....	25	....	4	.....	21	2	.....
		578	568	....	10	....	1	.....	9	.....	.....
		1097	902	82.22	195	17.78	18	.....	177	85	1
D	Aug. 24.......	60	38	....	22	....	1	.....	21	16	.....
	Sept. 13.......	48	33	....	15	....	.....	.....	15	13	.....
	Oct. 4–5.......	185	85	....	100	....	9	5	86	30	.....
	Oct. 18–19.....	183	118	....	65	....	11	2	52	19	.....
		602	585	....	17	....	1	.....	16	2	.....
		1078	859	79.68	219	20.32	22	7	190	80	.....
E	Aug. 24.......	59	44	....	15	....	1	4	10	10	.....
	Sept. 13.......	35	26	....	9	....	2	.....	7	6	.....
	Oct. 4–5.......	279	158	....	121	....	5	.....	116	40	.....
	Oct. 18–19.....	217	161	....	56	....	8	1	47	.....	.....
		902	887	....	15	....	3	.....	12	1	.....
		1492	1276	85.52	216	14.48	19	5	192	57	.....
F	Aug. 24.......	33	16	....	17	....	.....	.....	17	13	.....
	Sept. 13.......	37	25	....	12	....	.....	.....	12	7	.....
	Oct. 4–5.......	152	84	....	68	....	8	2	58	36	.....
	Oct. 18–19.....	133	81	....	52	....	9	1	42	2	.....
		529	515	....	14	....	2	.....	12	.....	.....
		884	721	80.43	163	19.57	19	3	141	58	.....
	Grand total..	8135	6677	82.08	1458	17.92	160	27	1271	485	3

Series 2, plot 2

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT Total	CLEAN FRUIT %	WORMY FRUIT Total	WORMY FRUIT %	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24	70	51	....	19	....	1	1	17	17	.....
	Sept. 13	49	39	....	10	....	......	......	10	6	.....
	Oct. 4–5	273	132	....	141	....	4	......	137	41	.....
	Oct. 18–19	126	86	....	40	....	11	......	29	9	.....
		583	572	....	11	....	3	......	8	.....	.....
		1101	880	79.93	221	20.07	19	1	201	73	.....
B	Sept. 13	227	127	....	100	....	12	......	88	65	.....
	Oct. 4–5	442	335	....	107	....	33	......	74	31	.....
	Oct. 18–19	284	217	....	67	....	13	......	54	7	.....
		1305	1284	....	21	....	4	......	17	2	.....
		2258	1963	86.94	295	13.06	62	......	233	105	.....
C	Aug. 24	38	25	....	13	....	2	1	10	9	.....
	Sept. 13	55	31	....	24	....	......	1	23	11	.....
	Oct. 4–5	226	131	....	95	....	1	......	94	25	1
	Oct. 18–19	127	85	....	42	....	1	1	40	6	.....
		685	675	....	10	....	......	......	10	.....	.....
		1131	947	83.73	184	16.27	4	3	177	51	1
D	Aug. 24	25	18	....	7	....	......	......	7	4	.....
	Sept. 13	69	49	....	20	....	2	1	17	14	1
	Oct. 4–5	192	105	....	87	....	3	......	84	22	2
	Oct. 18–19	182	122	....	60	....	7	1	52	14	.....
		480	473	....	7	....	1	......	6	1	.....
		948	767	80.90	181	19.10	13	2	166	55	3
E	Aug. 24	8	2	....	6	....	......	......	6	6	.....
	Sept. 13	7	5	....	2	....	1	......	1	1	.....
	Oct. 4–5	27	17	....	10	....	......	......	10	2	1
	Oct. 18–19	30	23	....	7	....	1	......	6	1	.....
		62	59	....	3	....	1	......	2	1	.....
		134	106	79.09	28	20.91	3	......	25	11	1
F	Aug. 24	96	64	....	32	....	2	......	30	24	.....
	Sept. 13	103	69	....	34	....	4	1	29	14	.....
	Oct. 4–5	376	214	....	162	....	13	2	147	30	.....
	Oct. 18–19	196	136	....	60	....	4	1	55	16	.....
		973	959	....	14	....	3	......	11	2	.....
		1744	1442	82.68	302	17.32	26	4	272	86	.....
	Grand total	7316	6105	83.45	1211	16.55	127	10	1074	581	5

Series 2, plot 3

Tree	Date	Total fruit	Clean fruit: Total	Clean fruit: %	Wormy fruit: Total	Wormy fruit: %	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24.......	183	60	....	123	....	46	7	70	64	5
	Sept. 13.......	170	77	....	93	....	51	7	35	31	.....
	Oct. 4–5.......	537	140	....	397	....	162	58	177	79	2
	Oct. 18–19.....	219	84	....	135	....	71	9	55	8	.....
		371	308	....	63	....	33	4	26	4	.....
		1480	669	45.20	811	54.80	363	85	363	186	7
B	Aug. 24.......	184	79	....	105	....	30	9	66	70	2
	Sept. 13.......	113	62	....	51	....	23	1	27	13	.....
	Oct. 4–5.......	429	124	....	305	....	140	35	130	69	9
	Oct. 18–19.....	213	104	....	109	....	65	5	39	15	.....
		565	546	....	19	....	12	......	7	......	.....
		1504	915	60.84	589	39.16	270	50	269	167	11
C	Aug. 24.......	52	14	....	38	....	26	1	11	21	1
	Sept. 13.......	42	4	....	38	....	24	6	8	12	.....
	Oct. 4–5.......	115	24	....	91	....	50	14	27	19	.....
	Oct. 18–19.....	46	18	....	28	....	19	2	7	4	.....
		60	54	....	6	....	6	......	......	......	.....
		315	114	36.19	201	63.81	125	23	53	56	1
D	Aug. 24.......	151	50	....	101	....	39	3	59	44	3
	Sept. 13.......	143	60	....	83	....	40	8	35	30	.....
	Oct. 4–5.......	456	156	....	300	....	111	29	160	86	4
	Oct. 18–19.....	185	84	....	101	....	56	3	42	15	.....
		773	746	....	27	....	17	......	10	2	.....
		1708	1096	64.17	612	35.83	263	43	306	177	7
E	Aug. 24.......	229	115	....	114	....	65	1	48	60	2
	Sept. 13.......	164	39	....	125	....	46	37	42	44	1
	Oct. 4–5.......	527	127	....	400	....	196	35	169	94	3
	Oct. 18–19.....	197	66	....	131	....	70	22	39	32	.....
		433	401	....	32	....	13	11	8	5	.....
		1550	748	48.26	802	51.74	390	106	306	235	6
F	Aug. 24.......	87	49	....	38	....	16	1	21	21	1
	Sept. 13.......	37	27	....	10	....	5	......	5	3	.....
	Oct. 4–5.......	138	86	....	52	....	8	5	39	16	.....
	Oct. 18–19.....	133	95	....	38	....	10	5	23	7	.....
		642	556	....	86	....	35	8	43	14	.....
		1037	813	78.39	224	21.61	74	19	131	61	1
	Grand total..	7594	4355	57.35	3239	42.65	1485	326	1428	882	33

Series 2, check trees

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Aug. 24.......	116	10	....	106	....	54	18	34	47	3
	Sept. 13.......	77	9	....	68	....	43	14	11	14	2
	Oct. 4-5.......	136	24	....	112	....	62	16	34	29	.....
	Oct. 18-19.....	50	22	....	28	....	14	6	8	2	1
		117	98	....	19	....	17	......	2	3	.....
		496	163	32.86	333	67.14	190	54	89	95	6
Y	Aug. 24.......	227	22	....	205	....	70	83	52	89	6
	Sept. 13.......	106	23	....	83	....	52	7	24	19	.....
	Oct. 4-5.......	529	68	....	461	....	228	97	136	96	5
	Oct. 18-19.....	290	65	....	225	....	102	71	52	53	3
		352	252	....	100	....	58	12	30	20	.....
		1504	430	28.59	1074	71.41	510	270	294	277	14
	Grand total.....	2000	593	29.65	1407	70.35	700	324	383	372	20

This series, it will be seen by reference to the above tables, presents markedly different conditions in certain respects from those of series 1. There was a considerably larger setting of fruit, the totals for the three plots being remarkably uniform, and in addition there was a very serious infestation by codling moth. This was probably due in part, at least, to local conditions and it is possible that the sprayings were not quite so thorough as those in series 1. The entire equipment was different and it is by no means easy to make exact comparisons. An earnest attempt was made to secure the most thorough work possible under the conditions. It is very likely that a portion of the discrepancy in percentages may be due to the difference in varieties in series 1 and 2. Data upon this point is given in the case of two other varieties in series 3.

A study of the data given under plot 1 shows that the minimum tree F produced 884 apples, 80.43 per cent being sound, while the maximum tree B yielded 1656 apples and but 77.96 per cent free from worms. The maximum percentage of sound fruit, namely 85.52 per cent, was produced by tree E with its total of 1492 apples, while the minimum percentage of sound fruit, 77.96 per cent, contrary to the usual rule, was found on tree B mentioned above. The number of wormy fruit under individual trees ranged from 195 or 17.78 per cent on tree C to 365 or 22.04 per cent on tree B. In the case of the latter, we would call attention to the fact that practically all the wormy apples were on the ground by October 18th. The maximum number of side wormy or end and side wormy apples, 311 or nearly 19 per cent of the total, were found on tree B, less than .5 per cent of these being also end wormy. The minimum number of side or end and side wormy apples was found on tree F. This was 144 or 16.3 per cent of the total yield, less than .4 per cent being also end wormy. The entire plot produced 8135 apples, of which 1298, or 15.9 per cent, were side wormy or end and side wormy, the latter being a practically negligible quantity.

Plot 2 had the minimum yield of 134 on tree E, 79.09 per cent being sound. The maximum number of apples, 2258, was produced by tree B, which yielded 86.94 per cent of sound fruit. This tree also produced the maximum number, 295, of wormy fruit, amounting however, to but 13.06 per cent of the total yield. The smallest number of wormy apples, 28, was found on tree E, and constituted 20.91 per cent of the entire product. Percentage comparisons are very strongly in favor of B, though as an actual fact it bore ten times as many wormy apples. The maximum number of side wormy or end and side wormy apples, 276, occurred on tree F, and comprised 15.8 per cent of the entire product, less than 2 per cent of the whole yield being end wormy. The minimum number of side wormy apples, 25, were found on tree E and amounted to 18.6 per cent of the total yield, less than 2 per cent being end wormy. Here again we see the injustice of strictly percentage comparisons, since F had ten times as many wormy apples as E, yet the percentage of sound fruit is strongly against the latter. This plot as a whole produced 7316 apples, 1084 or 14.8 per cent being side wormy or end and side wormy. A comparison between plots 1 and 2 shows a gain in sound fruit from the second spraying of only 1.37 per cent, though there were 247 less wormy apples on plot 2 than on plot 1.

Plot 3 presents an entirely different set of conditions, since it was sprayed but once and then in early June. The minimum tree C yielded but 315 apples, only 36.19 per cent being sound. The maximum tree D produced 1708 apples, 64.17 per cent being free from worms. The wormy apples range in number from 811 in tree A to 201 in tree C, comprising 54.80 per cent and 63.81 per cent, respectively, of the entire product. The maximum number of end wormy or end and side wormy apples was found on tree A with its 448 thus classed, forming 30.2 per cent of the entire yield. The minimum number of 76 was produced by tree C and comprised 24.1 per cent of the total. The entire plot yielded 7594 apples, 1754 or 23 per cent of the total being side wormy. The plot as a whole yielded but 57.35 per cent of sound fruit, showing a marked discrepancy between it and the two preceding plots.

The two check trees produced 2000 apples, which is not far from a fair average as these trees ran, 1407 or 70.3 per cent of the total were wormy, 707 or 35.35 per cent being side or end and side wormy and 1044 or 51.2 per cent being end or end and side wormy.

Series 3. The young orchard of Mr William Hotaling of Kinderhook, was selected for certain corroborative experiments. The trees are exceptionally fine, only about five or six years old, dwarf in habit and, as a rule, heavily laden for such young trees. They are set in four rows running approximately north, with rows of peach trees between, and, in the case of the experimental areas, the Wealthy apples are alternated with Mackintosh. The actual experimental trees were on the 30th to 35th transverse rows north from the house and located on the two middle longitudinal rows. The check trees were similarly located on the 25th and 26th transverse rows. The data relating to the two varieties has been tabulated separately. The western row of the experimental trees was sprayed with arsenate of lead (15 per cent arsenic oxide) 3 pounds being used to a 44 gallon barrel, and a lime-sulfur solution, the latter composed of 1 gallon of a homemade concentrated wash testing about 35° on a Baumé scale to about 40 gallons. The eastern row of experimental trees received the same application, except that the bordeaux mixture, composed of 4 pounds of lime and 3 pounds of blue vitriol, was substituted for the lime-sulfur wash. The spraying was done May 17th, a hand pump with a rather fine Friend nozzle being employed. Care was exercised to see that the mixture was well stirred. The application was made by Mr Hotaling personally. He took special pains to cover the under, as well as the upper, surface of the leaves, being in this respect possibly a little more thorough than in his efforts to fill the upturned calyx ends of the young fruit. Almost every leaf was well coated and only a very little dripping was observed. It is possible, owing to the slight breeze, that the northeast side of the trees was not sprayed quite so thoroughly as other portions. The intervening peach trees were not sprayed. This orchard had been well sprayed the preceding two seasons.

The fruit was picked September 16th. It is probable that a large percentage, possibly 50 per cent, of the wormy fruit was attacked at points injured by a hailstorm which occurred May 30th. These places afforded almost ideal opportunities for the entrance of young codling moth larvae. The results are tabulated on page 30.

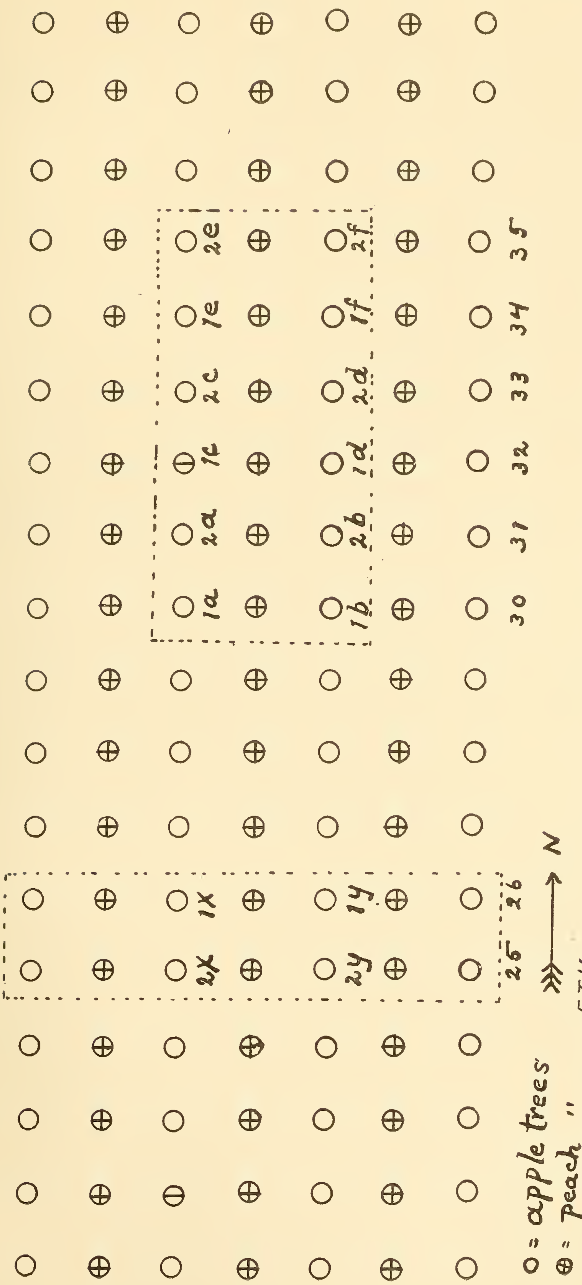

Fig. 3 Portion of orchard at Kinderhook, showing the location of the experimental trees

Series 3, Wealthy

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
1A	106	84	79.25	22	20.75	3	......	19	3	.....
1B	28	23	82.14	5	17.86	2	......	3	.....	.....
1C	160	114	65.22	46	34.78	2	......	44	7	.....
1D	81	51	62.97	30	37.03	1	......	29	5	.....
1E	121	73	60.33	48	39.67	4	......	44	8	.....
1F	33	26	78.79	7	21.21	......	......	7	.....	.....
Grand total	529	371	70.14	158	29.86	12	......	146	23	.....
CHECK TREES										
1X	38	18	47.37	20	52.63	8	6	6	.....	.....
1Y	50	18	36.	32	64.	12	7	13	2	.....
Total	88	36	43.19	52	56.81	20	13	19	2	.....

Series 3, Mackintosh

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole4 2
2A	179	110	61.46	69	38.55	8	2	59	16	.....
2B	16	8	50.	8	50.	1	......	7	3	.....
2C	105	51	48.57	54	51.43	6	......	48	6	.....
2D	87	27	31.04	60	68.96	9	2	49	10	.....
2E	......	......	......	......	......	......	......	......	......	.....
2F	57	23	40.36	34	59.64	1	......	33	9	.....
Grand total	444	219	49.33	225	50.67	25	4	196	44	.....
CHECK TREES										
2X	15	5	33.34	10	66.66	6	1	3	2	1
2Y	375	125	33.34	250	66.66	78	37	135	51	3
Total	390	130	33.34	260	66.66	84	38	138	53	

This series illustrates conditions where a minimum crop is produced. The maximum Wealthy tree C yielded but 160 apples, 65.22 per cent being sound, while the minimum B bore but 28, 82.14 per cent being free from worms. The maximum percentage, 79.25, of sound fruit was produced by tree A, yielding only 106 apples, while the minimum percentage, 60.33, occurred on tree E with its crop of 121 apples and its maximum number, 48, of wormy apples. The minimum number of wormy apples was 5, occurring on tree B and constituting 17.86 per cent of the total product, 11 per cent being side wormy. This plot produced only 529 apples, 70.14 per cent being sound, 27 per cent of the total side wormy, while only 2 per cent were end wormy.

The two check trees yielded 88 apples, only 43.19 per cent being sound and with the side and end wormy nearly equal in number.

The Mackintosh trees in this series show a greater degree of infestation, though they were interspersed with the others. The maximum tree A produced 179 apples, 61.46 per cent being sound, and also the maximum number of wormy fruit, namely 69. The minimum tree B yielded only 16 apples, 50 per cent being sound, while the minimum per cent of sound fruit, 31.04, was found on tree D with its total of 87 apples. The minimum number of wormy apples occurred on tree B, 8, or one-half the total number being thus affected. Summarizing the data for this group of trees, it will be seen that only 49.33 per cent of the total yield of 444 were sound. A total of 45 per cent of the fruit was side wormy, while only about 6 per cent was end wormy.

The check trees produced a total of 390 apples, only 33.34 per cent being sound. 45 per cent were side wormy or end and side wormy, while 31 per cent were end wormy or end and side wormy, showing in this respect a marked difference from the fruit borne by the sprayed trees.

Summary of plots

SERIE	PLOT	TOTAL	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
1	1............	1839	1664	90.48	175	9.52	16	21	138	83	3
	2............	2846	2756	96.84	90	3.16	6	1	83	33	.....
2	1............	8135	6677	82.08	1458	17.92	160	27	1271	485	3
	2............	7316	6105	83.45	1211	16.55	127	10	1074	581	5
	3............	7594	4355	57.35	3239	42.65	1485	326	1428	882	33
3	Wealthy......	529	371	70.14	158	29.86	12	......	146	23	.....
	Mackintosh...	444	219	49.33	225	50.67	25	4	196	44	.....
1	Checks.......	711	202	28.41	509	71.59	186	240	82	298	40
2	Checks.......	2000	593	29.65	1407	70.35	700	324	383	372	20
3	Wealthy checks	88	36	43.19	50	56.81	20	13	19	2	.....
4	M'k't'h checks	390	130	33.34	260	66.66	84	38	138	53	4

A study of the above record shows almost the same percentage of infestation, namely 71.59 and 70.35 respectively, for the check trees in series 1 and 2. These two orchards were in the same general region and the results should therefore be approximately comparable. There is, however, a markedly higher percentage of side or end and side wormy in the checks of series 1, this totaling 322 and amounting to 45.28 per cent, while in series 2 the checks produced 707 side or end and side wormy, or but 35.35 per cent. The number of side wormy alone in these two checks is approximately proportional to the number of apples produced by the respective trees. These figures would indicate, in a general way at least, substantially identical conditions in the two series so far as infestation by the codling moth is concerned. A comparison of the percentage of wormy apples obtained on plots 1 and 2 in series 1 and those obtained on plots 1 and 2 in series 2, shows a marked and constant variation. Plot 1 series 1 produced 90.48 per cent of sound fruit, while the similar plot in series 2 yielded only 82.08 per cent. Likewise, plot 2 in series 1 bore 96.84 per cent of sound fruit, number 2 of series 2 yielding only 83.45 per cent of worm-free fruit. It will be seen that there was a variation of from a little over 8 to over 13 per cent in favor of the plots in series 1. This may be explainable in part by the fact that the orchard in series 1 was younger and somewhat cleaner than in series 2, though it would seem as if some of this discrepancy must be attributed to less efficient spraying in series 2, especially as the experience of last year showed that an apparently minor factor, namely, a slightly less thorough spraying on one portion of a tree, resulted in reducing the amount of sound fruit by 2 to 3 per cent, and it is possible that a slight difference in the thoroughness of application, accentuated perhaps by the lack of an automatic mechanical agitator, was responsible for most of this discrepancy. There may also have been in the case of series 2 less thorough work on the trees adjacent to the experimental area than was the case in series 1. This was especially likely to occur on the trees lying on a steep hillside to the southeast of the experimental trees, where spraying could hardly be so thorough as in the comparatively level orchard where the experiments in series 1 were conducted. Allowance should also be made for the difference in varieties. Furthermore, the trees in this orchard were rather close together and this would be a great hindrance to the best work. It is interesting to compare the side or end and side wormy between these various plots. Plot 1, series 1, produced only 159, constituting some 8.64 per cent for the entire yield, while plot 1, series 2, yielded 1298 such fruit or 15.9 per cent of its entire product. Similarly, plot 2 of series 1 bore 84 side or end and side wormy, only 3.3 per cent of the entire yield, while plot 2, series 2, produced the relatively much larger number of 1084 or 14.8 per cent of the total number. Stated in another way, if we take the check trees as a standard, one application in plot 1 reduced the percentage of side or end and side wormy by 36.64 per cent, while a similar application to plot 1 in series 2 reduced this percentage only 19.45 per cent. Likewise, two applications in series 1 made a difference of 41.98 per cent of side or end and side wormy, while in plot 2 there was a difference in this respect of only 20.55 per cent. These figures all go to show that for some reason there was a decidedly lower efficiency in series 2 than in series 1.

Plot 3 of series 2 illustrates a totally different condition, since the one spraying was not given till about June 1st. We find a much lower percentage of sound fruit, namely 57.35, while the tree yielded

1754 side or end and side wormy apples, or 23 per cent of its entire product, or this one application, taking the check trees again as a standard, reduced the percentage of side or end and side wormy by only about 12 per cent. These figures give an excellent idea of the relative inefficiency of one application made at this season of the year.

A comparison of the totals in series 3 reveals an entirely different condition of affairs. The percentage of sound fruit was only 70.14 on the Wealthy and but 49.33 on the Mackintosh, the former variety yielding 146 side or end and side wormy, or 27 per cent of the entire product, while the latter produced 200 such apples or 45 per cent of the total yield. The checks in the Wealthy and Mackintosh respectively had 43.19 and 33.34 per cent of sound fruit, the former variety producing 32 side or end and side wormy, or 36.36 per cent, while the latter variety yielded 176 such apples, or 45 per cent. Again, taking the checks as a standard, it will be seen that, in the case of the Wealthy, one spraying reduced the wormy apples by 26.95 per cent, while on the Mackintosh the same treatment gave a reduction of only 15.99 per cent. The spraying of the Wealthy trees reduced the percentage of side and end and side wormy by about 9 per cent, while there was apparently no benefit in this respect on the Mackintosh. Percentage comparisons are certainly not very favorable when applied to small trees producing only 16 to a maximum of 375 apples, though they yield from only 5 to 69 wormy apples, a number smaller than that found on any trees in the other series where the percentages of sound fruit are much greater.

Tabulation of side wormy apples

SERIES	PLOT	NUMBER	%
1	1	159	8.64
	2	84	3.3
2	1	1 298	15.9
	2	1 084	14.8
	3	1 754	23.
3	Wealthy	146	27.
	Mackintosh	200	45.
	1 Check	322	45.28
	2 "	707	35.35
	3 "	....	....
	Wealthy check	32	36.36
	Mackintosh check	176	45.

Comparison of data with work of previous year. A comparison of the summarized figures given above with those obtained in 1909 shows that the codling moth was very much more abundant and injurious last season. This is true of the check trees as well as of those which were sprayed. The check trees of last year produced as much sound fruit as some of the sprayed trees in 1910, though this is true only where very exceptional conditions prevailed. The percentage of wormy fruit was very much less than the present year, while the percentage of side and end and side wormy was even smaller, ranging in plots 1 to 6 in 1909 from less than 1 to 1.3 per cent. A similar condition obtained on the check trees, which produced 17.62 per cent of side or end and side wormy.

Conclusions. The data secured shows that it is possible with but one spraying to obtain over 90 per cent of sound fruit in a year when the codling moth is very abundant, even on trees yielding only 300 to 500 apples. A larger crop, as pointed out on preceding pages and in our discussion of the effects of maximum and minimum crops on the percentage of wormy fruit in 1909, would undoubtedly result in the production of a still greater proportion of sound fruit.

Second, we believe that the possibilities of one thorough timely spraying have habitually been underrated. The second application within a week or ten days after the blossoms drop, is practically a confession that the first spraying was not thorough. It is true that ideal conditions are rarely present and it not infrequently happens that spraying must be done even when working at a disadvantage. There are, therefore, times when a second spraying justifies itself, particularly if this is made about three weeks after the blossoms fall and at a time when the young apple worms are beginning to feed upon the foliage and search for a favorable point of entry upon the fruit.

Third, a later application would pay for itself under such conditions as obtained the past season, though the percentage of sound fruit might not be greatly augmented. Here we have an excellent opportunity for exercise of judgment. A large crop with indications showing only a moderate abundance of the codling moth should mean that in the great majority of cases one spraying would afford adequate protection. On the other hand, a small crop, especially if likely to be accompanied by high prices, would at least justify a second application.

Fourth, adverse conditions, such as crowded trees, steep slopes, inferior spraying outfits, etc., make thorough work difficult, and have an appreciable influence in increasing the percentage of wormy fruit, since thoroughness as well as timeliness is an important factor in controlling the pest.

Fifth, an adhesive poison, such as arsenate of lead, appears to be much more satisfactory, since it is not only fully as effective in checking the codling moth but appears to be extremely valuable in controlling such leaf feeders as the Tortricid observed upon the orchards in series 2. This insect and associated feeders are undoubtedly of importance in increasing the amount of wormy fruit.

Sixth, there are those who hold the single spray method to be of comparatively slight importance, even if nearly as efficient, because in many localities it is necessary, or has been considered necessary, to spray several times for the control of fungous diseases. Conditions in the Hudson valley are such as to hardly justify the repeated applications so generally in vogue in the western part of the State. Here, at least, we believe that a knowledge of the possibilities of one treatment will prove an important factor in encouraging thorough spraying and result in the more general production of sound fruit.

JUNIPER WEBWORM

Dichomeris marginellus Fabr.

Twigs of Irish juniper infested by a reddish brown, white-striped larva about one-quarter of an inch long were received February 28, 1910, from Mr S. G. Harris, Tarrytown. These active larvae webbed the needles together and it was found later that they throve almost as well upon the partially dried foliage as though it were in a succulent condition. A larger amount of material was kindly sent by Mr Harris in March and the species was also received through the State Department of Agriculture from Mr L. D. Rhind, Plandome, L. I. A fine series of moths was reared in late May and early June. These were provisionally identified as the above named species, the determination being confirmed by Mr August Busck of the United States National Museum.

This European species does not appear to have been previously discovered in America. Its distribution, as given by Dr H. Rebel, is Europe, except the polar regions and Siberia. A number of English localities are indicated by Meyrick in his British Lepidoptera. This beautiful imported species, easily recognized by its yellowish brown, broadly white-margined fore wings, will hardly become a serious pest, since its food plant is of very little commercial importance.

Life history. The active larvae are gregarious, spin a rather copious web and apparently thrive upon the dead or dying foliage almost as well, if not better, than upon the more healthy tissues. The transformation to the pupa occurs within the webbed mass, the beautiful moths appearing as stated above, the latter part of May or early in June. It is possible that there is more than one generation annually.

Description. *Adult.* Length 7mm., wing spread 15mm. Tongue brownish yellow, slender, length 4mm. Palpi porrect, compressed, about 2.5 mm. long, thickly scaled, the outer and apical portions dark brown, the dorsal part creamy white; near the middle there is a slender, light brown pencil, fuscous apically, nearly as long as the palp and extending dorsally. Antennae long, slender, finely serrate, sparsely scaled. Eyes black. The vertex crowned with a spreading mass of long, creamy white scales. Thorax creamy yellow, margined laterally and anteriorly with fulvous brown scales. Fore wings long, narrow, fulvous brown, anteriorly and posteriorly broadly white-margined, these markings disappearing just before the apex of the wing; the fringe on the apical portion of the fore wing a mottled grayish and dark brown; hind wings satiny white, the fringe long, delicate, the under surface of both wings a nearly uniform pearl-gray. Abdomen yellowish brown, the fifth, sixth and seventh segments slightly darker and apically with a tuft of long, brownish yellow scales. Legs mostly reddish bronze.

Pupa. Length 5.5 mm., rather slender, reddish brown, the wing and antennal cases dark brown and extending to the fourth and fifth abdominal segments, respectively, the latter reddish brown, margined posteriorly with light reddish brown, sparsely setose; terminal segment subacute, narrowly rounded, with a cluster of five or six irregular, long, slender, hooked spines.

Larva. Length 6 mm. Head dark reddish brown with sparse setae. Antennae yellowish brown, short; thoracic shield broad, a variable dark brown, setose. Body light brown, the segments distinct and longitudinally striped as follows: median stripe reddish brown, submedian stripes whitish, sublateral dark brown, the lateral stripes light reddish brown, all somewhat broken. Setae with a length about half the diameter of the body, light brown; tubercles small, brown; thoracic legs dark brown, prolegs yellowish white, apically light brown; anal plate reddish brown, the middle paler, posterior margin dark brown, sparsely setose.

Bibliography. The following are a few of the more accessible publications relating to this species. For additional citations the reader is referred to Rebel (1901).

1781 **Fabricius, J. C.** Spec. Insect. 2:307 (Alucita marginella).
1895 **Meyrick, Edward.** Hndb. Brit. Lepid. p. 607, 608 (Ypsolophus).
1901 **Rebel, H.** Cat. Lepid. Palaearc. Faun. 2:159 (Nothris).
1901 **Felt, E. P.** Econ. Ent. Journ. 3:341.

LARGE APHID SPRUCE GALL

Chermes cooleyi Gill.

Several specimens of this large gall on Colorado blue spruce were received July 22, 1910 through agents of the State Department of

Agriculture. At this time the galls were just opening and hosts of plant lice were issuing from their orifices. The aphids present a general resemblance to those of the more common spruce gall aphid, C h e r m e s a b i e t i s Linn., though the galls themselves are easily distinguished by their greater size and especially their elongate character.

This new gall insect is a native of the Rocky mountain region and the Northwest, having been described in 1907 by Prof. C. P. Gillette, who states that he has observed this gall mostly upon blue spruce in Colorado from 4000 to 8000 feet altitude and chiefly upon Englemann's spruce above the 8000 foot line. He adds that he has seen specimens from the Northwest through the courtesy of both Drs Fletcher and Hopkins, and in each instance they were the typical galls of this new form. He finds this gall most numerous in parks or lawns where the blue spruce and the red fir are clustered together.

Description. The galls (pl. 17, fig. 1) are long, slender, terminal enlargements having a length of two inches or more and a diameter of approximately half an inch. According to Professor Gillette, they are always terminal and kill the end of the twig, except when the lice attack the bases of only a few needles on one side of the new growth, such being uncommon. Professor Gillette states that average galls have from 75 to 150 chambers, the lice from five large sized galls ranging in number from 463 to 996.

Aphids. The plant lice within the galls are light red in color with the bodies more or less covered with a white, waxy secretion which occurs both as a powder and as threads. (Gillette)

Stem mother. In winter or early spring grayish, about .6 mm. long by .3 mm. wide. Body almost black with a white secretion radiating as short, stout threads about the margins of the body and rising in a crest down the median line of the back. (Abstract from Gillette)

Adult viviparous female. Length 1 to 1.5 mm., width .8 to 1.2 mm., dark rusty brown, the dorsal surface mottled with dark spots, the wax glands which occur upon all segments but the last. Glands arranged as follows: A nearly continuous line on the anterior margin of the head and two patches on a side near the posterior margin, the thorax and abdominal segments with three glands on a side, but segments five to eight of the abdomen have the patches more or less united, especially in the dorsal rows, the other glands on the dorsum with pores quite uniform in size and rather small. Ventrally there is a pair of small patches upon the head behind the bases of the antennae and another pair of about the same size just in front of the middle coxae. Antennae very small, about as long as the femora of the fore legs; first and second segments short and stout, about equal; third nearly cylindric, nearly twice as long as segments one and two combined and with two tactile hairs apically.

Legs short, rather weak; tarsi biarticulate, the basal segment very short. (Abstract from Gillette)

Eggs. Length .3 mm., width .17 mm. They are light amber yellow at first, covered with a white powder. They are each attached by a thread, the whole mass adherent, an average sized one with a diameter of 2 mm. (Abstract from Gillette)

Winged female. Bright shining, rufous at first but by the time the wings are expanded the eyes are black and a few hours later the head and mesothorax are black. The other portions gradually darken, the abdomen retaining the rusty color longest. The white secretion begins to show about an hour after the pupal skin is cast and the aphid soon flies away. Length 1.5 to 2 mm. Wings a little smoky with a large stigma that is slightly green and a yellow costal nerve. The median fore wing is about 2.5 mm. long or about 1.6 times the length of the body with two simple discoidal veins and one stigmatal; hind wing with one discoidal vein, length of the hind wing about equaling the length of the body. Antennae dusky, with five segments, about ¾ as long as the greatest transverse diameter of the head; segments one and two short, stout, cylindric, about equal in length, segment one smooth, the others with impressed, transverse lines or wrinkles; segments three to five subequal, with segment three a little stouter and more conical; segments four and five rather slender, not especially enlarged apically nor swollen for the transverse sensoria, of which there is one to each of the three terminal segments, the fifth with two short hairs apically. (Abstract from Gillette)

Life history. The small, hibernating form of this aphid winters upon the twigs of its host plant with its long setae thrust into crevices in the bark between the needles. The heavy winter skin is cast about the middle of April and in a day or two the white, waxy secretion indicates the location of the louse, which is invariably on the under side of the twig. The first eggs are deposited in Colorado the latter part of April and before the female has attained her maximum size. The white, waxy threads completely hide both the egg and the female; a mass contains 500 eggs. The earlier deposited eggs begin to hatch before the females have completed laying, a large number of young being observed the latter part of the month. The formation of the gall is evidently produced by the young plant lice locating at the base of the young needles. The galls develop with surprising rapidity and are due to the thickening and lateral enlargement of the bases of the needles together with a swelling of the stem. They become fully developed about the first of July and by the middle or the latter part of that month most of the lice escape, a condition paralleled by our observations in New York. This generation in Colorado flies to the red fir, establishes itself upon the leaves and begins almost immediately to lay eggs which accumulate in large piles beneath the wings. Individuals of this generation may produce about 150 eggs. Occasionally a few specimens feed and oviposit upon the blue or silver spruce, though this is unusual. The aphids hatching from these eggs remain upon the red spruce throughout the winter and are probably the chief, though perhaps not the only, source of the variety coweni Gill. It is also considered probable that the stem mothers for the two summer broods of C. cooleyi Gill. come in a similar manner from the winged females of variety coweni Gill. of the red fir. (Abstract with additions from Gillette)

Remedial measures. It is probable that, as in the case of the spruce gall aphid, Chermes abietis Linn., thorough spraying of the infested trees in April with a whale oil soap solution, 1 pound to 2 gallons of water, would prove very effectual in checking this insect. The galls may also be cut off and burned in June, thus destroying the aphids before they have an opportunity to escape.

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ASH PSYLLA

Psyllopsis fraxinicola Först.

A number of small, yellowish or green, black-marked Psyllids, accompanied by badly curled ash leaves (pl. 15), were received from Rochester June 18, 1909. The insects were evidently very abundant and causing serious injury. The affected foliage was not only badly curled, but streaked here and there with purplish veins. The only other record of this European species in America appears to be that by Dr John B. Smith in his list of insects issued in 1899. He states that this Psyllid was imported from Europe and is quite injurious to ash trees. Dr L. O. Howard, through whose courtesy this species was determined, states that this form was found many years ago on the grounds of the Department of Agriculture, Washington, D. C. This species is reported as occurring all over Europe and, contrary to what we find in this country, the foliage is not deformed. It is about the same size as the widely distributed and much better known pear Psylla, Psylla pyricola Först, though easily distinguished therefrom by the white, tufted young, the lighter color and its occurrence upon ash.

Description. Length about 1/20 of an inch, yellowish or greenish and with yellowish or dark brown markings as follows: Submedian triangles on the pronotum; submedian and sublateral longitudinal stripes on the mesonotum and most of the metanotum. Antennae long, slender, yellowish or greenish, the first segment short, obconic, the second stout, cylindric, the third slender, fully three times the length of the second, the fourth less than ½ the length of the third and rather closely united with the somewhat longer fifth, the sixth, seventh, eighth and ninth, each subequal and about as long as the fifth, the tenth about ⅔ the length of the ninth, the eleventh reduced, ½ the length of the tenth and apically with stout spines, the ninth and tenth distally and the eleventh somewhat enlarged; eyes reddish. Fore wings mostly hyaline, variably fuscous along the anterior margin, near the distal third, in the region of the distal fourth and apically (pl. 16, fig. 1). The legs are a variable yellowish or green, the tarsi (pl. 16, fig. 6) being somewhat darker. The abdomen is yellowish or greenish with variable fuscous markings. The male of this species is remarkable because of the greatly developed genitalia projecting dorsally. The anterior organ is subtriangular and with a length about equal to half the width of the wing, while the posterior organ is irregularly subquadrate, stemmed and fuscous. A view of the extremity of the male abdomen is given on plate 16, figure 3. The female has somewhat the same general appearance as the opposite sex, being easily distinguished therefrom by the abdomen tapering to a subacute apex, bearing the ovipositor and secondary sexual organs (pl. 16, fig. 4).

The nymphs or young have the dorsum of the head mostly fuscous, the wing pads brown, the anterior abdominal segments greenish, the posterior fuscous and ornamented with a waxy secretion, the latter being produced at the lateral and posterior angles as long, waxy threads. The antennae are yellowish green, the basal and distal segments fuscous. The legs are yellowish green, the tarsi fuscous.

Life history. This species appears to have about the same life cycle as the pear Psylla, the adults wintering on the bark of the tree and the insects becoming abundant in June.

Control measures. It is probable that this pest could be controlled where circumstances warranted, by scraping the bark and spraying thoroughly in early spring with a contact insecticide, such as a lime-sulfur wash, a kerosene or petroleum emulsion, a strong whale oil soap solution or a tobacco extract for the purpose of destroying the hibernating Psyllids.

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NOTES FOR THE YEAR

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

FRUIT INSECTS

Pear slug (Eriocampoides limacina Retz.). This insect very frequently occurs upon cherry and pear foliage in midsummer. The slug, only about one-half an inch long when full-grown is easily recognized by the slimy secretion covering an apparently olive colored or blackish, sluglike body, the anterior portion being distinctly enlarged. The work of this pest is very characteristic, since it skeletonizes the upper surface of the leaves more or less completely, the injured portion soon drying and turning brown. This species was unusually numerous the past summer in the vicinity of Kinderhook, N. Y., and extraordinarily abundant in the outskirts of Albion. The insect winters in the ground, the small, black, 4-winged, many veined sawflies, only about one-fifth of an inch long appearing in early spring and depositing their eggs singly in a slit through the upper surface of the leaf. The eggs hatch in about two weeks, the voracious slugs completing their growth in about twenty-five days. There are two generations, the larvae of the second usually being the more abundant and frequently occurring in numbers during July and early August.

It is comparatively easy to control this pest when necessary by spraying with a poison, since the somewhat sensitive slugs feed upon the upper surface and are therefore easily destroyed. One pound of arsenate of lead (15 per cent arsenic oxide) to 100 gallons of water would probably be sufficient, since paris green has been recommended at the rate of 1 pound to 250 gallons of water. The poison may also be applied dry or the slimy slugs destroyed by liberal, and if necessary, repeated applications of dry materials, such as air-slaked lime, land plaster, or even road dust.

Cigar case bearer (Coleophora fletcherella Fern.) Very few specimens of this destructive leaf miner were observed in apple orchards in the towns of Byron and Stafford, Genesee county, though it was quite abundant in some sections the preceding year and has been responsible, in part at least, for the practical destruction of several orchards. A serious infestation by this pest is likely to mean the loss of a crop, since the voracious caterpillars, after wintering in their characteristic cigar-shaped cases attached at right angles to the twigs and nearly a quarter of an inch long, are very hungry and devour the young leaves and developing blossom buds with equal avidity. Very thorough early applications of a poison, using preferably arsenate of lead (15 per cent arsenic oxide) is advisable wherever this pest is numerous, though we have yet to find an orchard which has been well sprayed for several years, badly infested by this pest.

Cherry fruit fly (Rhagoletis cingulata Loew). This relatively new pest of the cherry grower has been somewhat abundant and injurious to Morello cherries in particular, at Germantown and vicinity. Mr S. E. Miller states that in 1909 the cherry crops of some five or six growers in that section were rather seriously affected by this maggot, though an investigation of local conditions in 1910 leads us to believe that in some instances at least, the injury may have been due in part to the plum curculio, Conotrachelus nenuphar Herbst. An examination of conditions June 29, 1910 in the orchard of Mr Miller showed that a few adult flies could be found upon each tree. There were no signs of oviposition, though the insects were frequently observed upon the fruit. We found a number of cherries infested by the curculio, though there was no evidence of the presence of maggots. Mr Miller was not certain but that the major portion of the serious injury of last year was due to curculio attack rather than to the work of the fruit fly. This year he sprayed with a poisoned lime-sulfur wash earlier in the season and the application was doubtless of service in controlling the plum curculio. Mr Miller, at our suggestion, had sprayed the trees with sweetened arsenate of lead (3 pounds of sugar and 4 ounces of arsenate of lead to 5 gallons of water) the previous week, probably the 23d. The mixture was dry and very evident upon the margins of the leaves, though none of the flies were observed working thereupon. There was no evidence of dead insects.

The orchard was visited on the afternoon of July 5th by Assistant State Entomologist Young. The day was sunny and very hot and comparatively few flies were then seen. The next morning flies were more in evidence, especially in certain portions of the orchard. They were taken in copula and a number of individuals captured. The insects became more active as the day advanced though oviposition was not observed. Some of the poisoned bait prepared by Mr Miller and described above, was sprinkled on a branch at 9.55 a. m. at what seemed a favorable place for the flies, and, although there were numbers about the tree, it was five minutes before one alighted upon the sprinkled leaves. It appeared to feed and then walked about on the leaves and finally came to rest. It was observed for some thirty minutes moving about normally and then suddenly disappeared. A serious defect in the mixture is the rapidity with which it dries. It was found that individual flies could be captured by bringing the fingers near to the insect and then as it lit thereupon suddenly closing them. Subsequently it was found that the flies were attracted to the fingers probably because they were stained with cherry juice. This suggests that the poisoned bait mentioned above might be made more effective by the addition of some such flavor.

The evidence obtained the past season, while far from being as satisfactory as one would wish, is certainly not very promising so far as this poisoned bait is concerned. It is probable that our cherry growers will find a large measure of relief, if not practical immunity from injury, by picking cherries as soon as they are ripe and taking special pains to secure all the fruit, thus reducing the opportunities for the breeding of the flies and consequently lessening the danger of trouble the following season. We are inclined to believe that so far as this insect is concerned, prompt and thorough harvesting will afford a practical solution of the difficulty. Injury by plum curculio, an associate of the cherry fruit fly, can be controlled by persistent use of the beetle catcher or the employment of a poisoned mixture such as that used by Mr Miller the past season.

Lined red bug (Lygidea mendax Reut.).[1] Several years ago the late Professor Slingerland noticed briefly, as an apple insect, a small, red Hemipteron under the popular name of red bug (Heterocordylus malinus Reut). The form under discussion is very similar in appearance to the earlier described species, though easily separated therefrom by the much more prominent eyes and especially, as pointed out by our wellknown authority in this group, Mr E. P. Van Duzee, by the black line along the posterior margin of the pronotum.

The work of this new apple pest may be observed during May and early June on the three or four terminal, more tender leaves. These are more or less curled and frequently form partially inclosed retreats containing a brilliant red, partly grown bug. It is probable that this species injures the fruit as well as the red bug. The affected leaves have much the appearance of being injured by plant

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[1] 1909 Acta Soc. Scient. Fenn., v. 26, no. 2, p. 47.

lice or aphids, though the ill-defined, brown spots suggest the possibility of their having been affected by sun scald or some obscure disease. The spotting of the tender leaves is somewhat the same as that on currant foliage, produced by the 4-lined leaf bug (Poecilocapsus lineatus Fabr.). Many tips were thus affected on the apple trees of Mr S. E. Miller of Germantown and the insect was somewhat abundant in the orchard of Mr C. R. Shons of Washingtonville, the nymph, presumably of this species, being taken in the last named orchard June 1st and three adults June 30th. The latter were secured only after repeated collecting, since the insects were by no means abundant. It is possible that some of the work described above is due to the operations of the red bug (Heterocordylus malinus Reut.) a species having similar habits.

These two forms resemble each other very closely and we take this opportunity to put on record their salient characteristics.

Lygidea mendax Reut. *Adult.* Length 6 mm., rather slender, the width 2 mm. The color varies from yellowish red to rather bright red and may be variably suffused with fuscous, this invariably forming a median stripe extending from the scutellum to the tip of the wing and including the membrane. Head dark red or yellowish red, the clypeus fuscous; rostrum extending to the posterior coxae, a variable fuscous yellowish, fuscous basally and apically. Eyes large, very protuberant, coarsely granulate. Antennae fuscous, hairy, first segment stout, with a length only half that of the greatly produced, slender second segment, the third segment slender, about half the length of the second, the fourth a little shorter than the third. Pronotum coarsely punctured, sparsely setose and margined posteriorly with a broad, black line, sometimes slightly broken mesially. Scutellum reddish or yellowish red, the posterior half, especially the submedian areas, a variable fuscous; the clavus, the internal angles of the wing, and the membrane mostly fuscous, forming a variable broad median stripe. Abdomen a variable red. Coxae red, trochanter and femora pale yellowish; tibiae fuscous yellowish or fuscous, the biarticulate tarsi a variable fuscous.

Partly grown nymph. Length 3 mm., width 2 mm., bright red, the tips of the wing pads a variable fuscous. Antennae yellowish fuscous. Legs mostly fuscous yellowish, the tibiae and tarsi slightly darker.

Heterocordylus malinus Reut. Length 6 mm., rather slender, width 2 mm., yellowish red or dark red with conspicuous fuscous markings and sparsely clothed with fine, whitish or yellowish white scales. Head triangular, mostly fuscous, the front sparsely clothed with small, whitish scales; rostrum a variable reddish brown and extending nearly to the posterior coxae. Antennae dark reddish brown, the first segment stout, length about ⅓ that of the greatly produced, more slender second segment, the slender third segment about ½ the length of the second, the fourth shorter than the third, the apical ⅔ slightly dilated. Eyes rather prominent, coarsely granulate and reddish brown. Pronotum reddish brown, the anterior third fuscous, except the lateral angles, all sparsely clothed with small, white scales. Scutellum, the most of clavus and the membrane fuscous; the corium mostly red with a variable fuscous area in the middle and sparsely clothed with fine scales. Abdomen reddish brown; coxae, femora and tibiae mostly reddish brown, the tarsi somewhat fuscous.

This species is easily distinguished from the preceding by the fuscous area anteriorly on the pronotum, the absence of a fuscous margin posteriorly and by the fine, whitish scales on the head, thorax and wings.

Professor Crosby of the Cornell Agricultural Experiment Station finds a tobacco whale oil soap solution applied just before blossoming to be an effective spray for use against the young red bugs.

Pear psylla (Psylla pyricola Först.). It will be recalled that the season of 1903 was remarkable for the excessive abundance of this jumping plant louse. It was so numerous then that pear trees with blackened, scanty foliage or almost none at all, were common sights during the summer, not only in the Hudson valley but also in central and western New York. Since then there has been comparatively little injury, at least of a general nature. Last season this pest was rather abundant in the pear orchard of James Clark at Milton. On July 21st there were numerous nymphs and some adults upon the trees and considerable honeydew, though this latter had disappeared largely following the rain of a few days earlier. There were very little or no Psylla to be seen upon the pear trees of Mr J. A. Hepworth near the river or upon those belonging to other growers in the immediate vicinity. Reports were received of serious injury by this pest in the central part of the State.

The experience of the past few years has shown that thorough spraying in early spring with a lime-sulfur wash, such as is used for the control of San José scale, is at least a powerful deterrent, if not a preventive of Psylla outbreaks. Mr J. R. Cornell of Newburgh believes that the efficacy of such treatment is materially increased by previously scraping the rough bark from the trees. This is undoubtedly true, and where orchards are liable to injury by this species we would advise careful scraping prior to the application of a lime-sulfur wash or a miscible oil. This should be followed in every instance by closely watching the trees during the summer. Should Psylla begin to be abundant it should be checked at once by thorough spraying with a kerosene or petroleum emulsion, a whale oil soap solution, or a tobacco preparation, making the application, if possible, just after a rain and using a coarse, forcible spray. The advantage of spraying just after a rain is that the moisture washes away in large measure the sticky excretion which protects the young Psyllas and thus renders them more susceptible to the application. A coarse spray is more effective than a fine, drifting fog because of its tendency to remove this protecting secretion.

San José scale (Aspidiotus perniciosus Comst.). The experience of the past year has but served to confirm the value of early and thorough applications of a lime-sulfur wash for the control of this pest. It is comparatively easy at the present time to find orchards which have been infested by San José scale for ten or fifteen years and yet show very few signs of its presence. This is due, in our opinion, to two factors. First, our methods of spraying have been gradually perfected so that the work of later years has been exceedingly thorough. Second, there has been a marked development in the preparation of the lime-sulfur washes, particularly in the commercial brands. There is no doubt as to the value of a well prepared homemade lime-sulfur wash, whether an excess of lime or a larger proportion of sulfur be employed. The formulas generally used till within the last year or two, usually called for a little more lime than sulfur. This preparation has demonstrated its effectiveness time and again and must still be regarded as an exceedingly valuable insecticide. Nevertheless, the so called concentrated lime-sulfur washes, distinguished from the earlier formulas by the use of approximately twice as much sulfur as lime by weight, have given exceedingly satisfactory results and possess several important advantages. This latter type of wash can be made up months in advance without danger of crystallization, provided freezing does not occur, and in a well made wash of this character there is practically no sediment. These two considerations are of great importance to the fruit grower who is frequently pushed for time in early spring, when the spraying can be done to best advantage, and is therefore unwilling or unable to take time to prepare the wash while spraying operations are being conducted. It is perhaps needless to add that this lack of sediment greatly reduces the danger of clogging nozzles and consequent delay in operations. Experiments have shown that the clear concentrated lime-sulfur wash is as effective, or at least nearly so, in destroying the scale as the old type of wash with its large excess of lime and frequently considerable sediment. The one trouble with the use of the clear mixture is the difficulty of doing thorough work, because when recently applied it can not be seen readily. This trouble can be obviated to a large extent by adding a little milk of lime to the diluted mixture, using it simply as a marker.

Certain reports have come to this office to the effect that the San José scale was becoming less abundant or even dying out in restricted localities here and there in the State. There are undoubtedly trees, and possibly orchards, where the scale has not thrived to any great extent in recent years, but we have yet to find substantial evidence showing this to be at all general. The scale appears to be most abundant upon vigorous trees, and while we would not state it as a general rule, we believe that in most instances freedom from infestation is correlated in large measure with reduced vitality and a consequently limited fruition.

Blister mite (Eriophyes pyri Nal.). This small pest, as shown by personal examination, is generally present in the orchards of Byron and Stafford, Genesee county, frequently being very abundant in those which have not been sprayed. This mite is widely distributed in the Hudson valley, though very rarely numerous enough to cause material injury. It was observed by the writer somewhat generally distributed in orchards at Clarksville, Albany county, and also very prevalent in the orchard of Mr Cecil Boudewyns at La Grangeville. There is no question as to the efficacy of early spring applications of a lime-sulfur wash or a miscible oil for the control of this pest. The general characteristics of its work and control methods have been discussed by the writer in Museum Bulletin 134, page 48.

GARDEN AND GRAIN INSECTS

Rose scale (Aulacaspis rosae Bouché). This insect is widely distributed in both Europe and America, occurring mostly upon rose, blackberry and raspberry bushes, particularly in sheltered locations. It is easily recognized by the thin, papery white, oval scale of the female only about one-sixteenth of an inch in diameter and with a small, yellowish patch, the protection of the immature stage, near its apex. The white male scale is easily recognized by its smaller size, the narrow three ridges and the small, yellowish particle at one extremity. The appearance of a blackberry cane rather badly infested by this insect is well shown in figure 4, while the female and male scale are represented much more enlarged in figure 5.

This rose pest is widely distributed in America, having been recorded from Florida and Louisiana northward to New York, and even from California. It is said to hibernate in an immature condition in the extreme south. Professor Comstock records the issuing of males, oviposition by females and hatching of eggs February 22d from material taken in Florida, while Professor Morgan states that young appear in Louisiana the last of March.

Fig. 4 Portion of blackberry cane enlarged and showing a rather bad infestation by the rose scale. Numerous female and male scales are represented.

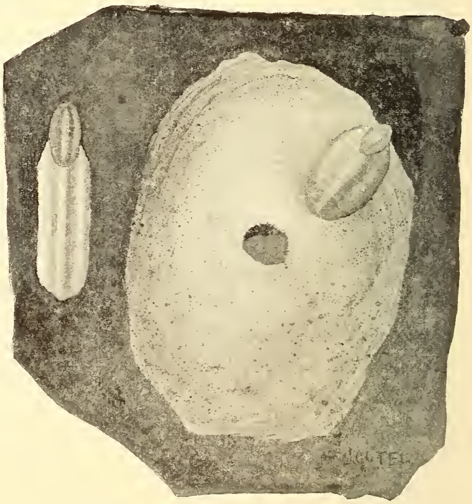

Fig. 5 Male and female rose scales much more enlarged

The middle of May 1901, infested twigs were received from Concordville, Pa., on which were gravid females, eggs and issuing males. Dr John B. Smith states that this species may winter in New Jersey in any stage from egg to gravid females, while we have at hand specimens from Ballston Spa taken in November 1910, showing both gravid females and eggs and indicating that this species probably winters in this condition. Office records show that this pest has been received from Cornwall-on-Hudson, Poughkeepsie, Hudson, Castleton, Ballston Spa, Cobleskill and Brighton near Rochester. Young were appearing in considerable numbers on the material received from Hudson in early June and the same was true of specimens from Cobleskill collected October 18th. This species begins to breed in New York State the latter part of May or in June and apparently produces young in greater or less numbers throughout the season, though Professor Smith believes that there are not more than three generations in New Jersey. Material collected in New York State showed the presence of several parasites, Arrhenophagus chionaspidis Aur., while Professor Toumy has reported the rearing of Aphelinus diaspidis How. from this species.

This pest, as was observed by Professor Smith, is very likely to be abundant in sheltered, shady situations, especially beside buildings. It can be controlled best by thorough spraying in the spring at the time the reddish young appear, with a whale oil soap solution, using about one pound to six or seven gallons of water and repeating the applications at intervals of a week or ten days, so long as the abundance of the pest appears to justify the treatment. A kerosene emulsion, the standard formula diluted with at least nine parts of water, should be equally effective.

Greenhouse leaf-tyer (Phlyctaenia rubigalis Guen.). The pale green, rather slender, black spotted caterpillars of this species were brought to our attention in October by John Dunbar, Assistant Superintendent of Parks, Rochester, N. Y. because of their feeding upon the underside of chrysanthemum leaves. He found that they also attacked geraniums and some other plants. Mr Dunbar attempted to control the species with applications of hellebore, nicotine and even by fumigation, using one ounce of cyanide of potassium to 5000 cubic feet of space without apparent results, though this last named treatment is an effective check upon the white fly.

This insect has been known in entomological literature by several names. It was first described by Guenee in 1854 as Scopula rubigalis, while other authors published descriptions of this form under the names of Botys oblunalis Led. and Botis harveyana Grote. This species has been assigned to other genera such as Margaritia, Pyrausta and Pionia. It has been frequently discussed under the name of Phlyctaenia ferrugalis Hübn., a nearly cosmopolitan, world-wide form distinct, according to Hampson, from the species we are considering. This latter appears to be widely distributed in North America, having been recorded in localities from the Atlantic to the Pacific coast and from Keywest north into Canada. It appears in its northern distribution at least, to be preeminently a greenhouse species.

The reddish brown and indistinctly black marked moth has a wing spread of about three-fourths of an inch. The fore wings are a variable yellowish brown with indistinct, serrate, blackish lines and spots. The hind wings are grayish and mostly indistinctly marked, both wings being margined by a row of rather distinct black spots. When at rest the hind margins of the posterior wings touch and the moth has a flattened, triangular shape.

The full-grown caterpillar is about three-fourths of an inch long, green or greenish yellow in color and somewhat transluscent. The head is light amber with obscure, pale brown, irregular markings, the first thoracic segment usually with a subdorsal pair of small, black spots, or the cervical shield may be transparent. The remainder of the body has a broad, greenish white dorsal stripe extending to the subdorsal region, with the darker alimentary tract showing through. This stripe in some individuals is whitish transparent and margined by narrow, white, subdorsal lines. The sides are pale yellowish green. The tubercles are small, piliferous, semitransparent and shiny. Anal segment with a subdorsal pair of small, irregular, black spots. The true legs are yellowish transparent, the prolegs semitransparent.

This caterpillar is a very general feeder, having been recorded by various writers as attacking celery, cabbage, beets, tobacco, Ageratum, geranium, ground ivy, German and Kenilworth ivy, violet, heliotrope, wall flower, wandering Jew, dahlia, daisy, Justicea, chrysanthemum, carnation, Cineraria, begonia, abutilon, roses, anemone, nasturtium, moon vine, Swainsonia, Genista, Plumbago, Matricaria, Passiflora, Ruellia, Tydaea, Lobelia, Veronica, Lantana, Deutzia, nodding thistle (Carduus), Ambrosia, several species, and Sisymbrium.

These somewhat general feeders are most noticeable in secluded situations and display a marked preference for the terminal leaves, eating holes in the latter. They feed chiefly at night, resting by day in one location, a retreat in which the final transformations usually occur. The duration of the larval existence extends from about three to possibly five weeks, and that of the pupa from one to presumably two weeks. It will thus be seen that several generations annually may be produced in greenhouses, considerable depending upon the conditions.

The experience of others as well as that of Mr Dunbar, cited above, shows this insect to be quite resistant to insecticides, such as hellebore, tobacco extracts, or fumigation with hydrocyanic acid gas. It is very probable that judicious and early under-spraying with a poison, particularly arsenate of lead, would prove an important means of controlling this pest. Such treatment is, as a rule, objectionable in greenhouses because of the accompanying disfiguration of the foliage.

Systematic hand picking, in connection with other work and including the destruction of the moths when at rest in a greenhouse, is perhaps as effective as any control method. This should be supplemented by isolating infested plants wherever noted and taking special pains to destroy all the insects thereupon before they are returned to the benches. Prevention of infestation is by all means the most satisfactory, and we would urge the exercise of great care to see that greenhouses are stocked in the fall with plants uninfested by this pest. There is always the possibility of moths of this species entering ventilators or doors in early fall. A careful watch should be kept for such infestations and should they occur great care exercised to destroy the caterpillars before the pest becomes abundant enough to cause serious trouble later in the season.

An extended account of this species, with references to other literature is given by F. H. Chittenden in Bulletin 27, new series, Division of Entomology, United States Department of Agriculture, from which certain of the above statements have been taken.

Wheat wireworm (*Agriotes mancus* Say). This common wireworm is best known because of its depredations upon wheat, its injuries being particularly severe in the Middle States. Mr Purley Minturn of Locke forwarded specimens and reported under date of May 20, 1910 that this pest had been quite injurious to oat fields in his vicinity, entirely ruining some. He adds that all badly infested fields had been in meadow for five years or more and were sown to buckwheat last year and to oats this spring. This species has also been recorded as injuring corn and potatoes.

The slender, tapering, brownish, slightly hairy parent insects, instantly recognized as click beetles or snapping beetles, occur in June. They are of a dark, waxy, yellow color and not readily differentiated from other numerous, very similar allies. The destructive form or larva of this species may be easily distinguished from other wireworms by the pointed posterior extremity and especially by the two dark brown or black pits on either side of the last segment and almost touching the preceding segment. These wireworms, when full grown, are from about one and one-fourth to one and one-half inches long, waxy, yellow, slender and hard. The parent insects presumably deposit their eggs near the roots of grasses and the young hatching therefrom require three years to complete the life cycle. The transformation to the delicate pupa occurs within an earthen cell in late summer or early fall, the beetles emerging the latter part of the following May or during June.

Owing to the hard, chitinous covering of the wireworms, they can not be readily destroyed by the application of insecticides of any kind. Their subterranean habits and preying upon field crops of comparatively small commercial value, also increase the difficulties of satisfactorily controlling the pests. Destructive wireworms are most likely to be abundant in sod, particularly that which has been seeded for some time, and it is therefore unwise to plant on badly infested sod crops liable to serious injury. Should the latter be necessary, something can be accomplished by plowing in early fall, since this process destroys the delicate pupae in their hibernating cells. Experiments have shown the practicability of killing the parent click or snapping beetles by the judicious use of poisoned baits, such as clover or lettuce dipped in strong paris green water. This can be done successfully only in midsummer, at the time the parent insects are abroad, and should be continued so long as numbers of beetles are attracted to the bait. Unfortunately, these measures are of no immediate service in a field badly infested by the pest. Prof. H. T. Fernald, as a result of certain experiments, provisionally recommends tarring corn and then placing the same in a bucket containing fine dust and paris green mixed in such proportions that the corn, after being shaken up in the bucket, shows a greenish color. Such corn feeds through a seeder without difficulty and in the experiments came up satisfactorily, while check rows were badly injured. Examinations later showed that the wireworms were present close to the seed but that they did not molest the seed itself, apparently being repelled by the application. It is by all means advisable, as pointed out above, to avoid trouble, if possible, by planting on land free from these pests those crops which can not be protected. A rotation of crops will do much to prevent this pest becoming unduly abundant, since it is primarily a grass-feeding species and requires some three years to complete its life cycle.

Harlequin cabbage bug (Murgantia histrionica Stal.). This insect, though well known as a common and injurious pest of cruciferous plants in the South, is rare in the northern states. Dr John B. Smith, in his list of Insects of New Jersey, published in 1899, reports its occasional presence in destructive numbers in southern New Jersey. We find on referring to our records, that in the report of this office for 1900 this species was reported from Elmira and Oswego, and Jamaica, L. I., the two latter localities being brought to our notice through the courtesy of Dr L. O. Howard. The past summer specimens of this bug were received from Mr Roy Latham at Orient Point, the extreme eastern end of Long Island. This latter record is interesting, showing the continued presence of the insect on Long Island and its extension over practically all of that section. It is hardly probable that this species will ever become abundant enough in New York State to cause material injury.

SHADE TREE INSECTS

Elm leaf beetle (Galerucella luteola Müll.). This pest continues to attract a great deal of notice on account of its serious depredations, especially in the Hudson valley. Numerous trees almost defoliated or with badly skeletonized leaves were rather common in the cities and villages of the valley from New York city northward to Stillwater and vicinity. A noteworthy feature was a report of serious injury accompanied by numerous specimens received from Mr Frank T. Clark of Ticonderoga. This appears to be the northermost record for the occurrence of these beetles in numbers in New York State. The injury by this pest was severe in the Mohawk valley at Schenectady and locally at Amsterdam. The elms of Ithaca, judging from reports received, have also been seriously injured.

The season of 1910 has been remarkable in the Hudson valley because of the prolonged drought following a scarcity of water the preceding season. This condition undoubtedly had an important influence upon the thrift of the trees, a fact easily demonstrated by examining elms where there were practically no elm leaf beetles. The foliage on many of these trees was thin and, though not skeletonized, was in a far from satisfactory condition. As a consequence, trees suffering from drought and exposed to a further depletion of energy through the attacks of a voracious leaf feeder, were more seriously affected than usual by this latter injury. Many trees will go into the winter with a reduced vitality, and it is to be expected that considerable dead wood will be found another spring. All such trees should receive special attention next season. The dead wood should be removed and this possibly supplemented by judicious pruning, the exposed cut surfaces being protected from the weather by applications of tar, paint or similar materials.

Most important of all, these trees should also be protected from the continued ravages by the elm leaf beetle. Experience has demonstrated time and again the entire practicability of controlling this pest by thorough and timely applications of an arsenate of lead (15 per cent arsenic oxide) to the under surface of the foliage at about the time the leaves are three-quarter to full grown, something depending upon the number of trees to be treated. The most effectual spraying for this pest must be done between the middle of May and the 25th of June. It is practically useless to apply poison after the grubs commence to forsake the trees unless the foliage has been so thoroughly skeletonized that the majority of the leaves will drop and a new crop appear. Spraying for the protection of this new foliage is always justified by results, and the late applications may also be of service in protecting foliage which had escaped injury earlier in the season. There are three important factors to be observed in this work if one would secure satisfactory results; namely, timeliness, the securing of proper material and its thorough application to the under surface of the leaves. Inattention to any one of these details will result in unsatisfactory work, if not in a complete failure in the efficacy of the operations. Our modern high power spray apparatus makes it possible to treat such trees rapidly and without great expense. These methods, if carried out faithfully, should insure practical immunity from serious injury and enable the elms to regain some of their normal vigor. It is perhaps unnecessary to add that so far as the elm leaf beetle is concerned, the application of sticky bands to the trunks of the trees, or the scraping off of the rough bark, are of so little value as not to deserve serious consideration at the hands of the practical man.

Bag worm (Thyridopteryx ephemeraeformis Haw.). Numerous half grown larvae of this species were received June 3, 1910 from Mr M. C. Albright, who took them at New Baltimore. This, as has been previously pointed out, is near the northern limit of this species.

Sugar maple borer (Plagionotus speciosus Say). The presence of this pernicious borer at Fulton was recorded in our report for last year. An examination the present season shows that the destructive work has continued without abatement, there being several centers of infestation. One is near the northwest corner of the park and is marked by a nearly dead maple tree having a trunk diameter of about 18 inches and showing approximately fifty of the characteristic exit holes, some of them being a year or more old. There has been a spread from this center of infestation upon either side and the existence of adjacent trees is threatened. Several similar centers were found on Cayuga street, namely, a row of four dead or dying magnificent trees between Second and Third streets, another on South Third street beside the church facing Cayuga street, and a fourth at the corner of Cayuga and Fourth streets. The above probably represents only a portion of the maples seriously affected by this pest. A complaint accompanied by specimens shows this insect to be destructive to the sugar maples at Carthage, and at Palmyra.

Elm scurfy scale (Chionaspis americana Johnson). This species is more or less abundant upon elms throughout the State. A very badly infested limb was brought in May 10, 1910 by Mr W. B. Landreth of Schenectady, with the statement that the tree, set some twenty years previously, and with a trunk diameter of about 15 inches, was in poor condition. Last year many of the young leaves dropped when they were partly out and another crop developed. The tree is said to be in a somewhat better condition this year, though apparently far from vigorous. Judging from the specimen submitted, this scale insect appears to be responsible for the major portion of the injury, since the twig is well spotted with scales and numerous crawling young are to be seen upon the bark.

False cottony maple scale (Phenacoccus acericola King). There has been an unusual number of complaints concerning this insect, the majority coming from Mt Vernon and vicinity, though reports of injuries were received from Newburgh and Batavia. Personal observation showed that this pest was somewhat abundant on trees at Newburgh and, to a less extent, at Hopewell Junction.

This species is easily distinguished from the older and better known cottony maple scale[1] by the fact that it occurs in conspicuous felted masses upon the trunks of infested trees and also forms large, cottony aggregations on the foliage (fig. 6), two situations where the cottony maple scale is never found with its contrasting white covering.

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[1] Pulvinaria vitis Linn.

The full-grown females of the false maple scale may be found on maple leaves in summer and are then about one-quarter of an inch in length and with a slightly less transverse diameter. The parent insects are concealed by an oval mass of powdery, slightly stringy wax within which is the female and her eggs (frequently 500 in number), the former occupying the anterior portion and her

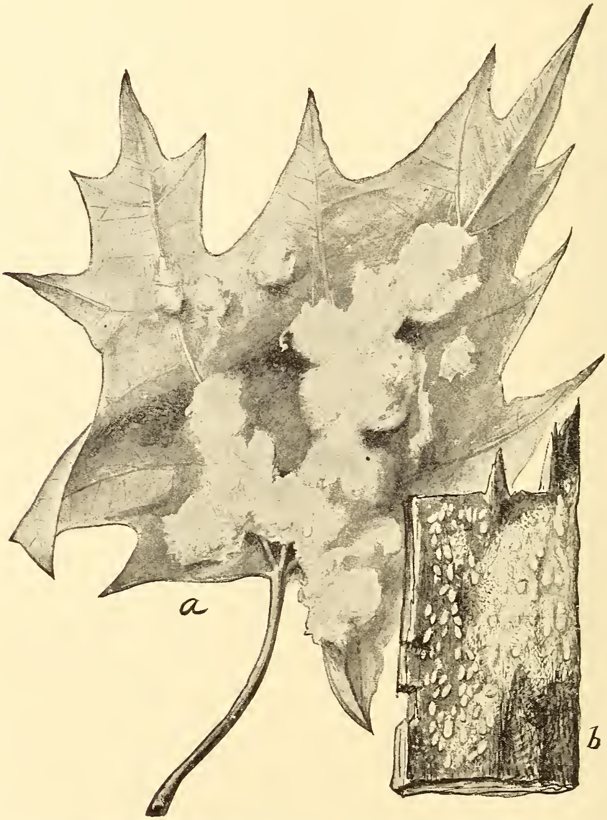

Fig. 6 False cottony maple scale. *a*=adult females on leaf; *b*=young females and males on bark. Natural size. (After Howard. Insect Life. 1894. 7:235)

body constituting about one-quarter the bulk of the mass. The young remain on the leaf after emerging from the eggs, unless it is too crowded, in which event they crawl down the petiole and seek nourishment on healthy foliage. The males, on attaining full growth, become restless and wander over the trunk and limbs for from seven to ten days, finally secreting themselves beneath or upon the rougher outer bark, form the conspicuous felted masses frequently seen, and therein transform to pupae. There are probably three generations in this latitude, the winter being passed by the young in crevices of the larger limbs. Observations at Poughkeepsie last fall showed that crawling young were very numerous October 4th. Affected trees drop their foliage earlier in the fall while that of others is still green and at least moderately vigorous.

This scale insect can be controlled by thorough applications, in winter or early spring, of a contact insecticide, using 1 pound of whale oil soap to a gallon of water. The kerosene emulsion, the standard formula diluted with 4 parts of water, has been found very effective in controlling the cottony maple scale and would doubtless prove equally efficient in the case of this species. Several oil preparations now on the market under various trade names have also been employed successfully.

FOREST TREE INSECTS

Large black carpenter ant (*Camponotus herculeanus* Linn.). The work of this large wood ant is rather common in the Adirondacks where it appears to display a marked partiality for balsam trunks, excavating them in a very characteristic manner as illustrated and pointed out by the author several years ago.[1]

An examination of the balsam shows at once that the ants had eaten out the softer portions of the wood, and left in large measure the harder parts formed toward the end of the season when growth was comparatively slow and the wood correspondingly firmer. This style of galleries was also compared with the very irregular and markedly different work of this species in elm. The latter is undoubtedly due to the fact that the fibers of elm wood interlace and, as a consequence, there is very little difference in the relative hardness of the wood laid down at different seasons of the year. The past season we secured from Silas H. Paine of Silver Bay an exceptionally fine specimen of the work of this species in poplar. By reference to plates 19, 20, it will be seen that the method of excavation is somewhat intermediate between that obtaining in poplar and the elm and presumably explainable by the nearly uniform, soft texture of poplar wood. The general plan shows a series of horizontal chambers connected by numerous more or less regular, perpendicular galleries traversing the heartwood. Portions of the galleries strikingly suggest the ruins of an ancient castle. This ant

[1] 1905 N. Y. State Mus. Mem. 8, 1: 90, pl. 31.

occasionally establishes itself in houses and, if allowed to multiply unrestricted, may seriously weaken the timbers.

Abbott's pine sawfly (*Lophyrus abbotii* Leach). This rather common and occasionally destructive species was unusually abundant in the foothills of the Adirondacks last summer. This insect was reported as defoliating pines in August, by Mr Andrew Lackey of Johnsburgh and by Messrs Wesley Barnes and J. W. Wilson of Olmstedville. Mr Lackey stated that the insects had injured quite a number of his pines, while a personal examination showed that this sawfly was abundant on a comparatively few trees at Olmstedville, being restricted to some 40 or 50 pines in the creek bottom. One of these trees was nearly 50 feet high and so badly injured that practically all the foliage was destroyed, while at its base were to be found thousands of half-grown larvae unable to secure nourishment necessary to the attainment of their normal growth. Many cocoons were observed in the needles at the base of this tree August 9th and 10th. None appeared to be of normal size, since they were from one-third to even one-fourth smaller than cocoons made by larvae received early in August from Mr Lackey. The other affected pines at Olmstedville were all small, rarely more than 25 or 30 feet high and none of them were so badly injured as the one described above. In some instances there were numerous full-grown larvae, specimens of which were secured. It was also stated that this insect was at work on near-by pines, though a cursory examination revealed no evidence of their operations. There were signs here and there of pines being injured, presumably by this insect, along the line of the Delaware and Hudson Railroad running from Corinth to North Creek. Rev. G. H. Purdey reported under date of August 22d, similar injury here and there to pines in the vicinity of Warrensburgh. No adults developed last season from the cocoons collected in August. There appears to be but one generation annually.

The destructive caterpillars, when full-grown, are nearly an inch long and easily recognized by the black head and the yellowish white body ornamented with two rows of oblong, square, black spots down the back. On each side there is another row of about eleven black, nearly square spots, a little longer than broad. These false caterpillars, when disturbed, throw back the head and move the upper portion of the body in a manner very similar to that of caterpillars belonging to the genus Datana. The larvae spin their brownish, oval cocoons among the leaves. Dr Riley states that some of the flies appear early in spring, while others do not issue till the latter part of June. One parasite, Limneria lophyri Riley, has been reared from this sawfly. This species may occur upon both white and hard pines from midsummer till late fall. The parent insects deposit their eggs in little slits in the leaves. They are rather stout, 4-winged sawflies, the common name being given because of the sawlike appendage at the tip of the female abdomen. This sex has a wing spread of about two-thirds of an inch, is honey-yellow, the head and thorax being a little darker, the latter and the abdomen being slightly marked with black. The male has a wing spread of about one-half of an inch, and the body is black, except the yellowish underside and the tip of the abdomen.

Experience has shown that this species is most likely to injure young pines, consequently it is well, where feasible, to watch for the appearance of the pests in such plantings and if circumstances warrant, adopt repressive measures. Many larvae can be jarred from small trees by vigorous shaking and their ascent prevented by an application to the trunk, of a sticky band such as tree tanglefoot. There is no doubt but that thorough spraying with a poison, preferably arsenate of lead (15 per cent arsenic oxide) would destroy these leaf feeders. It might pay to resort to such practices where only a few trees are badly infested, largely for the purpose of reducing the likelihood of more extended subsequent injury.

Spotted Cornus sawfly (Harpiphorus tarsatus Say). This greenish yellow, black spotted sawfly was received September last from Joseph H. Dodge of Rochester, through the State Department of Agriculture, accompanied by the statement that the larvae were very abundant and destructive to Cornus mascula. This sawfly appears to be a rather common form and widely distributed, since it has been recorded from Canada, Massachusetts, Connecticut, Indiana and West Virginia. The eggs, according to Dr Dyar, are deposited under the lower epidermis through a slit cut from above. They are close to the midrib in a long line, the cuts united. One edge of the swelling is on the midrib or large vein, the other parallel to it but wavy and composed of numerous saw cuts. The recently hatched larva is nearly colorless, with a slightly fuscous head. The latter becomes darker as development progresses and eventually black, while the body remains whitish or pale olivaceous, the black marks appearing in the sixth stage. The following description was drafted from full-grown living larvae:

Larva. Full-grown. Length 2.5 mm. General characters: head black, body greenish yellow with subdorsal and sublateral rows of black spots, venter orange-yellow.

Head subglobose, shining black, the single ocellus on each side, black. Antennae with the basal segment whitish transparent, the four distal segments with a yellowish tinge. Labrum yellowish; mandibles reddish basally, shining black apically; maxillary palpi, labium and labial palpi whitish transparent. Body segments 6 annulate dorsally, the first thoracic segment with the anterior two or three annulae mostly yellowish or yellowish orange; dorsum mostly yellowish green. The subdorsal row of black spots is composed of two on each segment, the anterior one extending over three annulae, the posterior on two, the first being approximately subquadrate, the second transverse and with a length nearly twice its width; the lateral row composed of large, irregular, quadrate spots, one to each segment and extending over four annulae. Anal plate with submedian, quadrate, black areas anteriorly and a median, quadrate, black area posteriorly, the remainder yellowish. Spiracles oval, brownish black, the subspiracular and ventral area orange-yellow; true legs pale yellowish, slightly fuscous apically; prolegs on abdominal segments 2 to 8 and 10.

The parent sawfly has been described by Norton[1] as follows:

Length, male, 0.32. Br. wings 0.52 inch. Length, female, 0.60. Br. wings 1.12 inch.

Female and male. Body long and stout; antennae longer than base of thorax, stout, flattened, serrate, black, with the four apical joints white; head as in E. varianus, with the sutures at sides of ocelli widened below and inclosing the base of antennae; nasus deeply incurved, rugose; labrum white, its edge rufous; tegulae piceous or yellow; scutel in middle white; legs black; all the trochanters, the apical half of four anterior tibiae and their tarsi and the posterior tarsi, except first joint, white (sometimes the first joint also). Wings smoky hyaline, base of stigma white; second recurrent nervure a little removed from intersection of second and third submarginals.

Blue Cornus sawfly (Harpiphorus versicolor Norton). Numerous specimens of these sawfly larvae were received from Dr L. F. Rinkle of Boonville, September 18th, accompanied by the statement that they had entirely stripped one bush of Cornus alternifolium. This sawfly appears to be less abundant than the preceding, having been recorded from Illinois and New Jersey. The eggs, according to Dr Dyar, about three in number, are laid side by side under the lower epidermis from above, forming a short row nearly parallel to a side vein. The young larva has a pale brown head and a curled, whitish body, the latter becoming well covered with a white, mealy secretion in the third stage. The following description of the full-grown larva was drafted from living specimens.

[1] 1867 Norton, Edward. Amer. Ent. Soc. Trans. 1:231.

Larva. Full grown. Length 2 cm. This species is most easily recognized by the black head and the mostly black, transversely blue-banded dorsum, the ventral surface being orange-yellow.

Head shining black, the one lateral ocellus brownish black. Antennae short, fuscous yellowish, ventral fourth of head mostly fuscous yellowish including the labrum. Mandibles brownish black apically; labium, maxillary and labial palpi fuscous yellowish. Body segments irregularly 6 annulate dorsally, the first thoracic segment with the anterior two or three annulae orange-yellow, the others with the first three and the fifth annulae shining black, the fourth being light blue dorsally and subdorsally, black laterally and the sixth light blue. Anal plate black and with a few short spines or hairs. Spiracles oval, brownish black, the subspiracular area and venter orange-yellow; true legs yellowish transparent, fuscous apically; prolegs on abdominal segments 1 to 7 and 10.

The parent insect has been described by Norton[1] as follows:

Length 0.40. Br. wings 0.80 inch.

Female. Body long and not very stout, color chestnut-red; antennae not longer than base of thorax, thick, serrate beneath, third joint but little longer than fourth, the two basal joints piceous, the three next black, remainder white; face as in E. varianus, not so much depressed below antennae; clypeus not deeply notched; a black spot from below antennae to summit; labrum and tegulae white; thorax black, scutel black, basal plates rufous, legs rufous, trochanters and tarsi white; coxae, basal tip of the four anterior femora and the apex of posterior tibiae blackish; wings smoky, base of stigma white; second recurrent nervure a little removed from junction of first and second submarginal cells.

Spotted pine weevil (Pissodes notatus Fabr.). Seedling pines shipped from Oudenbosch, Holland and submitted for examination April 13, 1910 through the State Department of Agriculture, had the terminal shoots infested by a number of active, though full-grown larvae of this species. Pupation occurred shortly thereafter and several adults were reared in early May. The operations of this European form were very similar to those of the common American white pine weevil, Pissodes strobi Peck, though in this instance at least, there was a marked difference in the life history, since this imported insect appears to winter as a larva.

This European species, kindly identified by Dr A. D. Hopkins of the United States Bureau of Entomology, is about one-third larger than our native Pissodes strobi Peck and is most easily distinguished therefrom by the indistinct ochreous red coloration and the smaller, more inconspicuous, whitish spots on the distal

[1] 1867 Norton, Edward. Amer. Ent. Soc. Trans. 1:230.

third of the wing covers. Dr Hopkins states that this weevil is a very important enemy of the pine in Europe, and that owing to the danger of its becoming a serious pest in this country, every precaution should be adopted to prevent its obtaining a foothold in America. In passing, we would call attention to the fact that Ratzeburg has recorded 29 species of parasitic Hymenoptera living at the expense of this weevil. Nevertheless, it would certainly be much safer to exclude seedling pines, particularly as there is also grave danger of importing a very destructive fungous disease.

Snow-white linden moth (Ennomos subsignarius Hübn.). This insect, which has come into prominence during the last three years on account of its extended depredations in the Catskills and, to a lesser extent, in the Adirondacks, was again abundant in at least limited sections of the Catskills. A number of eggs of this species were brought in March 28th by Mr Edward Thomson of Frost Valley, Denning, Ulster county, accompanied by the statement that they were numerous in his vicinity. Mr Edmund Platt of Poughkeepsie stated, under date of July 16th, that the caterpillars of what were undoubtedly this species, were very abundant just southeast of Shokan, also in Ulster county, at an elevation of about 2000 feet. The foliage was badly eaten and the caterpillars were observed hanging from the leaves in every direction. Evidently they had cut off many leaves, pieces of which were strewn on the ground. Beeches, maples, moosewood and apparently every variety of forest tree in that vicinity, were eaten. The caterpillars were so thick as to make it very disagreeable walking through the woods. There were a few at lower elevations and again near the top of the mountain. Miss Maud M. Meyer stated, under date of July 20th, that the maple trees in the vicinity of Bushnellsville, Greene county, were being destroyed by caterpillars, undoubtedly this species. A specimen of the moth was transmitted by Dr James C. Ayer of Glen Cove, under date of July 22d, this gentleman fearing it might be the much more dangerous brown tail moth. This report from Long Island shows that the insects were probably somewhat abundant there, while personal observation disclosed the fact that they were to be found in small numbers July 22d at Milton and Marlborough, and also on the electric cars at Hudson and near Valatie. Apparently this pest is less numerous than it was last year and it is to be hoped that natural enemies, birds in our estimation occupying a prominent place in this respect, will soon reduce their numbers so greatly as to prevent extensive injury in the future.

There should be no difficulty in distinguishing this species from the brown tail moth mentioned above. The parent insect is a rather slender-bodied, usually snow-white moth (pl. 21, fig. 2) having a wing spread of about one and one-half inches, the female being a little larger. It is decidedly more slender than the brown tail moth and the latter, though flying at about the same time, may be instantly recognized by the characteristic bright reddish brown tuft on the tip of its abdomen.

The eggs of the snow-white linden moth are deposited in irregular masses (pl. 21, fig. 1) about half an inch in diameter, each containing from 50 to over 100 eggs. The individual eggs lay at an oblique angle to the supporting surface, are about 1 mm. in length, barrel-shaped, light brown and with a conspicuous salmon-colored ring at the extremity.

The full-grown caterpillar has a length of about two inches. The head is a dull reddish or yellowish brown, distinctly broader anteriorly, the clypeus sunken, yellowish brown, the labrum pale yellowish with a few conspicuous yellowish setae, while the antennae are short, the basal segment yellowish, the second segment prolonged, reddish yellow, narrowly yellowish at the extremities and with a few coarse setae apically. The mandibles are reddish brown, fuscous apically and irregularly bidentate; labial palpi triarticulate, mostly pale yellowish; spinneret concolorous. The thoracic shield is darker than the head and distinctly fuscous along the margins. The body is mostly a dull brownish black, the anal plate and the anal prolegs being yellowish brown. There are irregular, yellowish markings along the sublateral lines, they being represented by inconspicuous dots on the second and third thoracic segments. These markings are so thick on the first abdominal segment of some specimens as to give the appearance of short sublateral lines extending most of the length of the segment. On the third abdominal segment the yellowish markings are distinctly produced laterally and toward the median line, forming a pair of submedian irregularly oval, yellowish marks very suggestive of tubercles. These sublateral marks are indicated on the remaining segments only by inconspicuous dots, a pair on the anterior and posterior annulets of each segment, the yellow markings becoming a little thicker and more irregular on the 11th, 12th and 13th segments.

The true legs are a variable yellowish and reddish brown, the distal segments being somewhat darker. The first pair of prolegs are dark brown basally and yellowish brown apically; the anal prolegs are mostly yellowish brown; the venter is nearly the same color as the dorsum, except that part between the prolegs which is variable yellowish green and yellowish brown.

The pupae occur among the leaves, being sheltered in very light, thin, yellowish brown cocoons. The pupa is about one inch long, the general color being a yellowish brown irregularly spotted with black. The antennae, legs and wing sheaths are closely fused and extend to the tip of the fourth abdominal segment; the terminal segment is pale yellowish or yellowish straw; the cremaster is composed of an irregular group of four stout, dark brown, recurved hooks, two distal, two subapical and then two pair of more slender ones, the more distal being lateral and the others dorsal.

Control measures. This species, as stated before, is not an important shade tree pest, since the English sparrow can usually be relied upon to keep it within bounds. The control of this insect in woodlands is a much more serious problem and must depend in large measure upon natural enemies, such as parasites and especially our native insectivorous birds. These latter should be protected in every feasible manner.

Birch leaf skeletonizer (Bucculatrix canadensisella Chamb.). This small leaf feeder was generally abundant, though not exceptionally numerous, upon the white birches at Kinderhook. This occurrence is probably the western border of a severe outbreak in New England, recently recorded by William R. Thompson[1] and comprising areas in Connecticut, Massachusetts, New Hampshire and Maine, at least. Nine years ago this species was exceedingly numerous in the vicinity of Albany, skeletonizing practically all of the foliage of our ordinary white or gray birch, Betula populifolia. The full-grown caterpillar is only about one-fourth of an inch long, light green or yellowish green and most easily recognized in association with the peculiar, oval or circular, whitish, moulting cocoons about one-twelfth of an inch in diameter. The larvae may be found upon the trees in August or early September, feeding upon the soft parenchyma of the leaf and, when numerous, skeletonizing the foliage. The winter is passed in a narrow, brownish yellow, ribbed cocoon about one-fifth of an inch long. The parent moth is a delicate, bright brown insect with a wing expanse of three-eighths of an inch. The wings have two subtriangular blotches on the inner margin which, when these organs are closed, form two white dorsal saddles, while, in addition, there are three silvery white bars which run from the outer edge about half

[1] 1910 Journ. Econ. Ent. 3:436.

way across the wing obliquely toward the apex. Behind the anterior white saddle there is a tuft of raised, black scales and several similar ones at the apex of the fore wings. This species can hardly be considered as of much economic importance, since its food plant has very little commercial value.

Beech tree blight (*Pemphigus imbricator* Fitch). This rather common insect is easily recognized by the woolly plant lice or aphids occurring in masses on the under side of the limbs. This species is quite resistant to cold, since it was observed the latter part of October, 1903, after the temperature had been quite cold and while an inch of snow was to be seen on adjacent hillsides. It is a widely distributed species, having been reported from various parts of the State. It was undoubtedly this species which was reported by Dr D. B. Miller, Jersey City, N. J., under date of October 31st, as being abundant on the lower small branches of young beech trees in Delaware county. Mr George C. Wood, writing from the Trenton camp grounds at Barneveld, Oneida county, August 22d, stated that they were having a great deal of trouble with the insect, adding that every beech tree was covered with it and that it was fast killing the branches. Mr Frank A. Schmidt of Ilion, writing under date of September 14th, states that practically all of the beech trees in that vicinity were affected by this pest. The insects were so numerous that the lower branches of nearly all the beech trees were completely covered with the white, woolly aphids. These limbs seemed to have lost all vitality, since those half an inch in diameter could be bent and twisted like a piece of rope.

The great abundance of this insect over so large an area appears to be unusual for New York State. Owing to the fact that it occurs upon forest trees, active remedial masures are ordinarily impractical. We must depend in large measure upon natural enemies. One of the most important of these is the caterpillar of a native butterfly, *Feniseca tarquinius* Fabr. The mother insect deposits her eggs upon the twigs of beech, alder etc. in the midst of colonies of woolly aphids. The caterpillars, upon hatching, spin a thin web and devour many of the plant lice, completing their growth within thirteen days.

Silver fir aphid (*Chermes piceae* Ratz.). Nordmann's firs received from Europe the past season and submitted for examination by the State Department of Agriculture, were infested by a Chermes which was provisionally determined as the above named species by Dr A. D. Hopkins of the United States Bureau of Entomology and the writer. An examination of the literature shows that there may be a question as to the specific identity of this European form. We have used the above specific name and given illustrations of the insect (pl. 18, figs. 1, 2), since our material was not sufficiently abundant to permit of an authoritative identification. This form may prove, as has been stated in the case of at least one Chermes on fir, to be a synonym of Chermes funitectus Dref.

Apparently, this is the first record of the introduction of the species into America. A Chermes discussed under this name by Gillanders is recorded by him as very destructive to young silver firs, comparatively young specimens of Abies nordmanniana and even fairly old trees of Abies nobilis. He states that young silver firs in nurseries are often killed outright by this insect. The data at hand justifies us in considering this species a dangerous form which should be excluded, if possible.

MISCELLANEOUS

Blow fly (Calliphora viridescens Desv.). Several larvae and two pupae of this species were received under date of July 30, 1910, from Mrs H. B. Reist of Schenectady, accompanied by the statement that they had been found under a rug in a study on the second floor of a new house. Subsequent correspondence developed the fact that the rug had been sent a month earlier to a vacuum cleaning establishment located over a stable. There appears to be no other probable explanation for the occurrence of the larvae in this strange environment, other than that they may have worked into the fabric from some adjacent nitrogenous material while at the cleaning establishment, since the common blow fly larvae, as is well known, thrive in fresh or decaying flesh, cheese or nitrogenous vegetables. The parent flies, kindly determined by Mr D. W. Coquillett of the United States National Museum, appeared August 10th. They are about one-third the size of the more common blow fly, Calliphora vomitoria Linn., with a somewhat similar steel-blue or violet-blue abdomen, though easily recognized by the grayish black thorax in marked contrast to the duller black thorax of C. vomitoria. It is perhaps needless to add that both of these blow flies are distinguished from the rather slender, grayish banded, exceedingly common house fly by their larger size, greater stoutness and violaceous coloring.

Stable fly (Muscina stabulans Fall.). This rather common fly was reared last May from larvae in bee comb found in association with a few small beetles which live in decaying animal matter. This record is not unprecedented, since, according to Dr Howard, this species has similar habits in Europe. The maggots of this fly usually occur in decaying vegetable matter, fungi etc., though they have been reported as living in cow dung, and Megnin records finding puparia in the mummified bodies of children. This species was captured at Washington several times on human excrement.

Saturnia pavonia Linn. One specimen of the dark reddish brown cocoon of this Bombycid was found on nursery stock at Rochester. The cocoon is 3.5 cm. in length, 2.5 cm. in diameter and with one end somewhat produced and partially open. The moth, which was easily reared, has a wing spread of 7.5 cm., is smaller than our well known Calosamia promethea Drury, and the coloring is mostly in shades of gray with distinct ocellate spots on both the anterior and posterior wings. There should be no difficulty in excluding this rather large species.

Insects and paper. Three years ago, through the courtesy of the A. T. de la Mare Printing & Publishing Company of New York, we received a large sheet of paper badly disfigured, though just from the calendering rolls. An examination showed that a May or June beetle had been caught in the heavy rolls and literally crushed into the paper, its body fluids making a smear some 12 inches long. A most interesting feature was the preservation of the hard parts, especially the legs and antennae, so perfectly that there was no difficulty in referring the victim to the genus Lachnosterna. An equally interesting specimen of this kind of work was discovered in a recent publication. The victim this time was a crane fly. The paper presented substantially (pl. 17, fig. 2) the same appearance as noted above, portions of the insect remaining even after the paper had been subsequently printed upon and bound. These accidents suggest the possibility of a novel ornamental card or sheet made by rolling into the paper the delicate wings of certain common insects, thus obtaining an effect impossible from purely artificial methods.

Agromyza melampyga H. Lw. Numerous specimens of this small, yellowish and black marked fly were reared the latter part of May 1910 from walking-leaf, Camptosorus rhizophyllus, collected at Hudson Falls May 16, 1910 by Stewart H. Burnham, assistant to the State Botanist. The infested leaves presented a peculiar appearance at that time, since many of them were margined on the upper surface with a more or less linear series of equidistant, brownish elevations which, upon examination, proved to be the tips of the puparia. The larvae evidently live in communal mines and, when full-grown, cut a slitlike orifice and transform so as to leave the brownish bispinose apex of the puparia protruding from the orifice. A series of these presents an unique appearance. The puparium is about 2 mm. long, nearly 1 mm. wide, rather stout, a variable reddish brown, the exposed tip being a little darker. Apically there is a pair of dark brown, short, stout, chitinous, recurved processes. One parasite, kindly described through the courtesy of Dr L. O. Howard, by Mr J. C. Crawford as Sympiezus felti, was reared at the same time the flies issued.

The parent insect has been described[1] by C. W. Johnson under the name of A. flaviventris as follows:

Head light yellow, occiput black; antennae yellow, aristae black. Thorax light yellow, with a large black dorsal spot, which extends narrowly from the cervix, expanding dorsally, with lobes above the humeri and base of the wings; scutellum yellow, metatarsus black. Abdomen dull light yellow, terminal segment black; halteres and legs yellow. Wings grayish hyaline. Length of the larger specimen 2 mm.; the smaller one 1.5 mm.

These specimens were taken at Niagara Falls. It has been listed by Smith from New Jersey, recorded by Loew from the District of Columbia and identified from the Bahamas.[2] In addition this species has been reared at Washington, D. C., by Coquillett[3] from leaf mines in a species of cultivated Philadelphus and also from the common Plantain, Plantago major.

Coquebert's Otiocerus (Otiocerus coquebertii Kirby). The slender, yellowish or yellowish red marked insects belonging to this species and resembling somewhat in general appearance Caddis flies, are rather common and widely distributed, having been recorded from Canada, south to Texas and, in addition, from several Eastern and Middle States. The delicate adults have been taken upon a variety of trees, namely hickory, oak, beech, maple and also on grape.

This attractive insect belongs to the Hemipterous family Fulgoridae, noteworthy because of the large exotic lantern flies. The Brazilian Laternaria phosphorea has a wing spread of

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[1] 1902 Can. Ent. 34:242.

[2] 1908 Psyche 15:80.

[3] 1898 U. S. Dep't Agric., Div. Ent., Bul. 10 n.s., p. 77.

fully 6 inches and an enormous miter-shaped head as long and nearly as thick as its body. The subfamily Derbidae to which Otiocerus is referable, is a group of moderate extent, comprising some of the most beautiful and delicate forms found in the Hemiptera. The head in this subfamily is generally produced forward, sometimes extremely compressed and with the sides prominently carinate as is the case with Otiocerus.

The adult of this species when at rest is nearly half an inch long to the wing tip (the length of the body is only three-sixteenths of an inch). It rests with the long, delicate wings folded together parallel and thus presents a general resemblance to a Caddis fly. It may vary in color from a nearly uniform, pale yellowish or yellowish green in the one female obtained to a yellowish green marked with strongly contrasting red or reddish brown in the males as follows: The broad stripe extends from the tip of the head on either side to the bronzy or blackish eyes, is continued by broken spots just below and behind these organs, and a larger, reddish area laterally on the pronotum and on the anterior portion of the mesonotum, and may be followed as an oblique stripe from the base of the fore wing to its posterior margin near the distal third, which latter is marked by a slight marginal fuscous line. From this point the reddish markings are produced in a more or less broken, marginal line to the anal angle, there being a small subapical branch near the distal fifth and a much more conspicuous one at the distal third and extending as an irregular, oblique mark to the anterior distal angle. There is, in addition, an irregular, reddish mark near the middle of the wing; the hind wings are nearly colorless. The head is strongly compressed, being greatly produced anteriorly and with strong lateral dorsal carinae. The male antennae are a variable reddish and remarkable, since each is composed of three irregular branches apparently arising from a basal segment, the anterior distinctly capitate. The antennae of the female are but two-branched, the anterior one slightly capitate and apically with a bristle nearly as long as the branch. The ovipositor is short, the organs uniting to form a conical apex. The legs are a nearly uniform yellowish transparent. The pale yellowish abdomen extends only to about the middle of the wings and is variously shaded with reddish. The male is easily recognized by the conspicuous pair of yellowish transparent, inflated, strongly curved clasping organs.

A colony of nymphs of this species were taken at Poughkeepsie, N. Y. May 12, 1910 under the dead bark of a stump, possibly beech. The insects moved slowly, and eleven days later adults emerged.

Nymph. Length one eighth of an inch, width about one-sixteenth of an inch. Color an obscure brown, the sutures yellowish brown; the head small, partially concealed by the prothorax; the wing pads short, extending to the third abdominal segment, each of the latter with a series of obscure tubercles, fuscous basally, lighter apically; along the anterior third the head and thorax apparently with similar though more rudimentary structures. Legs a yellowish brown.

It is remarkable that such an apparently large adult should develop from so small a nymph. A partial explanation is found in the fact that the abdomen of the adult is much shorter than one would be led to expect from the length of the wings.

PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1910. Fifty are given with title[1], time of publication and a summary of the contents of each. Volume and page numbers are separated by a colon, the first superior figure gives the column and the second the exact place in the column in ninths: e. g. $75:9^{15}$ means volume 75, page 9, column 1 in the fifth ninth, i. e. about one-half of the way down.

Grain Weevil. Country Gentleman, Jan. 6, 1910, $75:9^{15}$

A summary discussion of repressive measures.

Two New Cecidomyiidae. Entomological News, Jan. 1910, 21:10–12

Lasioptera tripsaci and *Cecidomyia opuntiae* described.

Deformed Apples. Country Gentleman, Jan. 27, 1910, $75:82^{16}$

A brief discussion of the work of the tarnished plant bug, *Lygus pratensis* Linn. The plant louse outbreak of 1909 is commented upon and control measures discussed.

Corn, Cutworms and Ants. Country Gentleman, Feb. 3, 1910, $75:107^{25}$

A brief discussion of methods for controlling various cutworms and ants in cornfields.

Scale and Fungus Attacks. Country Gentleman, Feb. 3, 1910, $75:107^{33}$

The San José scale, *Aspidiotus perniciosus* Comst. is identified and remedial measures briefly discussed.

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

Observations on the House Fly. Economic Entomology Journal, 1910, 3:24–26

Summary of experiments showing that the house fly, Musca domestica Linn. does not invade darkened apartments.

Some Tree Crickets. Country Gentleman, Feb. 24, 1910, 75:182[27]

Oecanthus niveus DeG. appears to be limited mostly to apple trees, while O. nigricornis Walk. and O. quadripunctatus Beutm. have been recorded as the species injurious to raspberry and blackberry bushes. Preventive measures are discussed.

Control of Flies and Other Household Insects. New York State Museum Bulletin 136, 1910, p. 1–53 (Issued Feb. 26, 1910, a revised and extended edition of Bulletin 129).

Contents

Work with the Codling Moth. Country Gentleman, Mar. 3, 1910. 75:230[11]

A summary comparison of results obtained against codling moth, Carpocapsa pomonella Linn., between coarse and fine sprays and one, two and three applications. One thorough application of a mist spray gave 98–99 per cent of worm-free fruit.

Struggle with the Scale. New York Apple Orchards Saved. Rural New Yorker, Mar. 5, 1910, 69:256[11]

A summary account of the work against San José scale, Aspidiotus perniciosus Comst., with special reference to the success of Mr W. H. Hart in his old orchard.

Bleeding Elm — Beetle. Country Gentleman, Mar. 10, 1910, 75:245[42]

Discusses the causes of bleeding in trees and gives remedy for the elm leaf beetle, Galerucella luteola Müll.

The Apple Maggot. Country Gentleman, Mar. 17, 1910, 75:271[25]

A general discussion of Rhagoletis pomonella Walsh, with reference to work against fruit flies in South Africa with poisoned syrups.

Spraying for Codling Moth. Country Gentleman, Mar. 31, 1910, 75:322[27]

A summary discussion of remedial measures for Carpocapsa pomonella Linn., with special reference to results obtained with the single spray and with observations on prepared insecticides.

Schizomyia ipomoeae n. sp. Entomological News, April, 1910, 21:160–61

A description of this West Indian species reared from the flower buds of Ipomoea.

Methods of Controlling the House Fly and thus Preventing the Dissemination of Disease. New York Medical Journal, April 2, 1910, 91:685–87

A summary account of the house fly, Musca domestica Linn., with special reference to control measures.

Oyster-Shell Scale. Country Gentleman, April 7, 1910, 75:347[15]

Remedial measures for Lepidosaphes ulmi Linn.

Spraying for the Codling Moth. Economic Entomology Journal, 1910, 3:172–76

Summary of experiments for the control of Carpocapsa pomonella Linn., and emphasizing the effectiveness of one thorough application of poison.

Leopard Moth. Country Gentleman, April 21, 1910, 75:396[45]

Brief economic account of Zeuzera pyrina Fabr., with special reference to control measures.

Peach Twig Borer. Country Gentleman, May 12, 1910, 75:470[32]

Summary economic account of Anarsia lineatella Clem.

Borer. Country Gentleman, May 26, 1910, 75:517[26]

A brief discussion of the peach borer, Sanninoidea exitiosa Say and methods of controlling it.

Cutworms in the Garden. Country Gentleman, May 26, 1910, 75:518[36]

A discussion of remedial and preventive measures.

West Indian Cecidomyiidae. Entomological News, 1910, 21:268–70

Cecidomyia manihot on Cassava, Camptoneuromyia meridionalis from flower buds of Ipomoea are described as new. The larva of Schizomyia ipomoeae Felt is also characterized.

Maple Leaf Aphis. Country Gentleman, June 23, 1910, 75:603[14]

A brief general account of Pemphigus tessellata Fitch on maple.

Beet Leaf Miner. Country Gentleman, June 30, 1910, 75:622[35]

A summary economic account of Pegomya vicina Lintn.

Flies in the Stable. Country Gentleman, June 30, 1910, 75:628[11]

A general discussion of the house fly problem, Musca domestica Linn., with special reference to stables and methods of preventing breeding.

Onion Maggot. Country Gentleman, July 7, 1910, 75:642[17]

Remedies for Phorbia ceparum Meign. are briefly discussed.

Apple Tree Borer. Country Gentleman, July 7, 1910, 75:642[37]

Brief discussion of remedial measures for Saperda candida Fabr.

Green Fruit Worm. Country Gentleman, July 7, 1910, 75:646[47]

Records injuries by a green fruit worm, Xylina antennata Walk., in New York State.

Beans Hurt by Maggot. Country Gentleman, July 14, 1910, 75:660[11]

A summary account of Phorbia fusciceps Zett., with special reference to remedial measures.

Flea Beetle. Country Gentleman, July 21, 1910, 75:682[26]

A brief practical account of Epitrix cucumeris Harr.

Corn Worm. Country Gentleman, July 28, 1910, 75:703[13]

Control measures for Heliothis armiger Hubn. are briefly outlined.

Maple Scale. Country Gentleman, July 28, 1910, 75:703[17]

A summary discussion of the cottony maple scale, Pulvinaria vitis Linn., with mention of the woolly Phenacoccus acericola King and the alder and maple plant louse, Pemphigus tessellata Fitch.

Plant Lice. Country Gentleman, August 4, 1910, 75:722[24]

General directions for spraying for plant lice or Aphididae.

25th Report of the State Entomologist on the Injurious and Other Insects of the State of New York, 1909. Education Department Bulletin. N. Y. State Mus. Bul. 141, 1910, p. 1–178, 22 pl. (Issued August 4, 1910)

Contents

Malaria and Mosquitos in New York State. Atti della Societa per gli studi della malaria, vol. 9, 1910, Separate p. 1–12

Summary discussion of malaria in New York, with a brief notice of the malaria-carrying species, their breeding places, enemies and legislation in relation thereto. A brief account is given of the mosquito control work in the State.

The Elm Leaf Beetle. Country Gentleman, Aug. 11, 1910, 75:740[25]

A record of injury with a summary discussion of remedial measures for Galerucella luteola Müll.

Recent Observations upon European Insects in America. Economic Entomology Journal, 1910, 3:340–43

Notes are given on Pissodes notatus Fabr., Dichromeris marginellus Fabr., Hyponomeuta malinella Zell., Saturnia pavonia Linn., Monarthropalpus buxi Lab. and Chermes piceae Ratz., all recently brought into this country.

Gall Midges of Aster, Carya, Quercus and Salix. Economic Entomology Journal, 1910, 3:347–56

A tabulation of the American species of Cecidomyiidae occurring upon the above named plants — 46 being recorded on willow. A new genus, Asteromyia, is erected and two new species, Oligotrophus salicifolius and Dasyneura corticis, described.

Scientific Notes. Economic Entomology Journal, 1910, 3:381

Galerucella luteola Müll is recorded from Fort Ticonderoga and serious injuries are reported throughout the Hudson valley. Observations are presented on the work and flight of the snow-white linden moth, Ennomos subsignarius Hübn.

Red Spider. Country Gentleman, Aug. 18, 1910, 75:762[36]

A discussion of injuries and remedial measures.

Melon Aphis. Country Gentleman, Aug. 18, 1910, 75:764[12]

Remedial measures for *Aphis gossypii* Glov. are given.

Tree Spraying. Country Gentleman, Aug. 25, 1910, 75:789[15]

Observations on methods employed by "tree-protecting companies" and those of service in controlling elm leaf beetle.

Scale on Maple. Country Gentleman, Aug. 25, 1910, 75:789[26]

Putnam's scale, *Aspidiotus ancylus* Putn. is identified and spraying with a lime-sulfur wash advised where the scale is abundant.

Vermin in the House. Country Gentleman, Aug. 25, 1910, 75:800[21]

The bed bug, *Cimex lectularius* Linn. is briefly described and exterminative measures fully discussed.

Asparagus Beetles. Country Gentleman, Sept. 8, 1910, 75:840[24]

Arsenical applications, preferably arsenate of lead, are recommended for the control of both species of asparagus beetles, *Criocerus asparagi* Linn. and *C. duodecimpunctata* Linn.

Tulip Scale. Country Gentleman, Sept. 8, 1910, 75:840[32]

Spraying with contact insecticides in early September to destroy the young of *Eulecanium tulipiferae* Cook is advised.

Harvest Mites. Country Gentleman, Sept. 8, 1910, 75:840[37]

The life history of this pest is briefly sketched and methods of avoiding infestation and allaying the irritation following an attack given.

Woolly Aphis. Country Gentleman, Sept. 8, 1910, 75:840[42]

Remedial measures are given for the woolly aphis, *Schizoneura lanigera* Hausm. and also for the scurfy scale, *Chionaspis furfura* Fitch.

Horticulture: Diseases and Pests. New York State Education Department. Review of Legislation, 1907–8. Legislation 391, p. 119–22 (Issued Sept. 1910)

A review of legislation for the years 1907 and 1908.

The Leopard Moth. Country Gentleman, Sept. 29, 1910, 75:922[21]

This insect, *Zeuzera pyrina* Fabr. and its work is described and control measures summarized.

ADDITIONS TO COLLECTIONS, OCT. 16, 1909-OCT. 15, 1910

The following is a list of the more important additions to the collections:

DONATION

Hymenoptera

Thalessa atrata Fabr., black long sting, adult on maple, June 13, S. W. Stillwell, Charlotteville

T. lunator Fabr., lunate long sting, adult, July 23, A. L. Kampfer, Albany

Aulacidea tumidus Bass., gall on Lactuca, August 30, Roy Latham, Orient Point

Neuroterus batatus Fitch, galls on white oak, July 8, J. H. Dodge, Rochester. Through State Department of Agriculture

Lophyrus abbotii Leach, Abbott's sawfly, larvae on pine, August 3, Andrew Lackey, Johnsburg. Same, from J. W. Wilson, Olmstedville

L. ? lecontei Fitch, Leconte's pine sawfly, larvae on pine, October 20, Townsend Cox, jr, Setauket

Trichiocampus viminalis Fall., poplar sawfly on poplar, August 29, H. S. Post, Albany

Eriocampoides limacina Retz., cherry and pear slug, larvae on cherry, August 22, L. A. Rose, Rensselaer

Harpiphorus tarsatus Say, sawfly, larvae on Cornus mascula, September 15, J. H. Dodge, Rochester. Through State Department of Agriculture

H. versicolor Nort., sawfly, larvae on Cornus alternifolium, September 18, L. F. Rinkle, Boonville

Coleoptera

Entimus imperialis Forster, diamond beetle, adult, May 7, Richard Lohrmann, Herkimer

Calandra granaria Linn., granary weevil, adults in grain bins, December 27, P. A. Schaefer, Allentown, Pa.

Magdalis ? barbita Say, black elm snout beetle, grubs on elm, March 18, S. L. Frey, Palatine Bridge

Pissodes strobi Peck, white pine weevil, larvae on pine, July 13, Benjamin Dorrance, Dorranceton, Pa. Through Hermann Von Schrenk

Phloeodes diabolicus Lec., adult on Polyporus growing on Eucalyptus, March 20, Hermann Von Schrenk, Southern California

Bruchus obtectus Say, bean weevil, adults, March 21, F. A. Fitch, Randolph

Haltica ignita Ill., strawberry flea beetle, adults on Virginia creeper, August 3, Miss L. E. Clarke, Canandaigua

Galerucella luteola Müll., elm leaf beetle, larvae and pupae on elm, July 19, F. T. Clark, Ticonderoga

Melasoma scripta Fabr., cottonwood leaf beetle on poplar, September 7, Theodore Foulk, Flushing. Through State Department of Agriculture

Centrodera decolorata Harr., adults on locust, October 18, Mrs J. De P. Lynch, Barneveld

Desmocerus palliatus Forst., cloaked knotty horn, adults on elder, June 6, H. T. Brown, Rochester

Elaphidion villosum Fabr., maple and oak twig pruner, work on oak, July 31, W. A. Payne, Bronxville

Prionus laticollis Dru., broad-necked Prionus, adult, July 18, Burton Ellison, Poughkeepsie

Xyloryctes satyrus Fabr., rhinoceros beetle, August 1, D. T. Marshall, Hollis

Euphoria inda Linn., bumble flower beetle, adult, September 6, J. D. Keating, Fort Edward

Cotalpa lanigera Linn., goldsmith beetle, adult, April 15, J. R. Gillett, Kingston

Thanasimus rufipes Brahm, adult, July 29, L. H. Joutel, New York (European)

Podabrus rugosulus Lec., adults, June 16, H. B. Filer, Buffalo

Agriotes mancus Say, wheat wireworm, larvae on oats, May 20, Purley Minturn, Locke

Diptera

Calliphora viridescens Desv., larvae, July 30, Mrs H. G. Reist, Schenectady

Bombyliomyia abrupta Wied., adult, July 26, H. E. A. Dick, Rochester

Rhyphus fenestralis Scop., adults, April 24, G. C. Hodges, New Hartford

Bibio xanthopus Wied., adult, May 18, Richard Lohrmann, Herkimer

Contarinia johnsoni Sling., grape blossom midge, adult, May 28, Fred Johnson, North East, Pa.

Monarthropalpus buxi Lab., pupae on box, May 19, A. E. Stene, Kingston, R. I.

Joanissia aurantiaca Kieff., Aprionus miki Kieff., A. pinicola Kieff. MS., Monardia stirpium Kieff., Bryomyia bergrothi Kieff., Miastor cerasi Kieff. MS., Brachyneura squamigera Winn., Winnertzia fusca Kieff. MS., W. pinicola Kieff. MS., Colomyia clavata Kieff., Colpodia anomala Kieff., Dicerura scirpicola Kieff., Porricondyla venustus Winn., Camptomyia ? binotata Kieff., C. nigricornis Kieff., Holoneurus pilosus Kieff. M.S., Lasioptera rubi Heeg., Baldratia salicorniae Kieff., Stefaniella atriplicis Kieff., Trotteria sarothamni Kieff., Rhizomyia silvicola Kieff., Cystiphora taraxaci Kieff., Macrolabis stellariae Kieff., Arnoldia castanea Kieff. MS., A. sambuci Kieff., A. cerris Koll., Lasiopteryx (Ledomyia) divisa Kieff., L. (Ledomyia) lugens Kieff., Dasyneura sisymbrii Schrnk., D. urticae Perris, Rhabdophaga karschii Kieff., R. pierrei Kieff., Mikiola fagi Hart., Psectrosema tamaricis Stef., Schizomyia galiorum Kieff., Zeuxidiplosis giardiana Kieff., Stenodiplosis geniculati Reut., Thecodiplosis brachyntera Schw., Bremia longipes Kieff., B. ramosa Kieff., Aphidoletes urticariae Kieff., Massalongia rubra Kieff., Hormomyia cornifex Kieff., Monarthropalpus buxi Lab., Pseudhormomyia granifex Kieff., Xylodiplosis aestivalis Kieff., X. nigritarsis Zett., Putoniella marsupialis F. Lw., Endaphis perfidus Kieff., Macrodiplosis volvens Kieff., Clinodiplosis galliperda F. Lw. All from Prof. J. J. Kieffer, Bitsch, Germany, and especially valuable because a number are cotypes

Lepidoptera

Sphecodina abbotii Sm. & Abb., Abbott's sphinx, larva on woodbine, July 13, Mrs Carriere, Albany

Saturnia pavonia Linn., Emperor moth, cocoon on French nursery stock, January 31, Rochester. Through State Department of Agriculture

Anisota senatoria Sm. & Abb., larvae on oak, September 9, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Basilona imperialis Dru., Imperial moth, larva on pine, August 18, Andrew Lackey, Johnsburg

Ctenucha virginica Charp., larvae on pine and gooseberry, L. H. Adams, Johnstown. Through State Department of Agriculture

Halisidota caryae Harr., hickory tussock moth, larvoe on maple, July 11, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Arsilonche albovenosa Goeze, larva, September 27, William Hotaling, Kinderhook

Xylina antennata Walk., green fruit worm, larvae on maple, June 16, Alex Anderson, Stonyford. Same, larvae on apple, June 28, Geneva. Through State Department of Agriculture

Notolophus antiqua Linn., rusty tussock moth, eggs, March 9, H. W. Gordinier, Troy. Same, caterpillars on elm, June 18, H. E. Vaughan, Ogdensburg

Datana ? integerrima G. & R., larvae, July 11, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae on apple, September 10, C. C. Perry, Eagle Bridge

Synchlora viridipallens Hulst, adult, August 4, Louis Capron, Menands

Cingilia catenaria Dru., chain-spotted geometer, larvae on sweet fern, bayberry, August 2, L. C. Griffith, Sag Harbor. Through State Department of Agriculture

Ennomos subsignarius Hübn., snow-white linden moth, eggs on maple, March 28, Edward Thomson, Frost Valley, Denning. Same, adult, July 22, J. C. Ayer, Glen Cove

Phobetron pithecium Sm. & Abb., hag moth caterpillar, larva, September 13, W. A. Bullis, West Sand Lake

Zeuzera pyrina Linn., leopard moth, pupae, July 1, H. I. Newell, Richmond Hill. Same, exuviae on maple, July 5, T. J. Beam, Port Chester. Through State Department of Agriculture. Same, larva on apple, September 17, E. G. Serins, South River, N. J. Through Country Gentleman

Hyponomeuta malinella Zell., ermine moth, larvae on imported French apple stock, June 24, J. H. Dodge, Rochester. Same, larvae on apple, June 27, J. J. Barden, Orleans

Ancylis nubeculana Clem., larvae on apple, September 1, R. H. Ham, Niverville

Dichomeris marginellus Fabr., Juniper webworm, larvae on Juniper, February 28, S. G. Harris, Tarrytown. Same, larvae on Irish Juniper, April 26, L. D. Rhind, Plandome. Through State Department of Agriculture

Aspidisca splendoriferella Clem., resplendent shield bearer, winter cases, March 24, Benjamin Hammond, Fishkill

Hemiptera

Belostoma americanum Leidy, giant waterbug or electric light bug, adult attached to a fish, May 4, J. D. Collins, Utica

Brochymena quadripustulata Fabr., adult, July 15, D. H. Cook, Altamont. Same, nymphs, August 26, W. P. Thorne, Lagrangeville

Blissus leucopterus Say, chinch bug, nymphs on corn, August 5, Fred Wheeler, Mongaup Valley. Through State Department of Agriculture

Haematopinus piliferus Burm., sucking dog louse, adult on dog, January 8, V. P. D. Lee, Altamont

Ormenis pruinosa Say, lightning leaf hopper on matrimony vine, August 26, Mrs C. F. Webber, Athens

Aleyrodes vaporariorum Westw., white fly on coleus, August 26, Mrs C. F. Webber, Athens

Chermes abietis Linn., spruce gall aphis, galls on spruce, June 23, F. F. Briggs, Pocantico Hills. Same, adults on spruce, June 26, S. G. Harris, Tarrytown. Same, galls on spruce, October 12, Theodore Foulk, Flushing

C. cooleyi Gill., galls on Colorado blue spruce, August 4, White Plains, State Department of Agriculture

C. pinicorticis Fitch, pine bark aphid, adults on pine, May 12, M. T. Richardson, New York city. Same, eggs, February 12, Miss Pauline Goldenmark, New York city

C. piceae Ratz., adults and eggs on Nordmann's fir, May 17, Rochester. Through State Department of Agriculture

C. pinifoliae Fitch, pine leaf aphid, adult on black spruce, January 29, Miss Edith M. Patch, Orono, Me.

C. consolidatus Patch, adults on larch, January 29, Miss Edith M. Patch, Orono, Me.

C. floccus Patch, adult on black spruce, January 29, Miss Edith M. Patch, Orono, Me.

C. lariciatus Patch, adults on white spruce, January 29, Miss Edith M. Patch, Orono, Me.

Pemphigus imbricator Fitch, beech blight, nymph on beech, August 31, G. C. Wood, Barneveld

P. tessellata Fitch, woolly maple leaf aphid, adults on maple, June 16, A. P. Knapp, Hillsdale, N. J. Through Country Gentleman. Same, eggs, June 20, Miss May Seymour, Lake Placid

Schizoneura americana Riley, woolly elm leaf aphid, adults on elm, June 5, R. M. Boren, Ballston Lake. Same, adults and young on elm, June 10, W. P. Judson, Broadalbin. Same, adults on elm, June 18, H. E. Vaughan, Ogdensburg

S. lanigera Hausm., woolly apple aphis, nymph on apple, November 9, C. S. Ashley, Old Chatham. Same, Mrs S. H. Niles, Coeymans. Same, November 10, J. F. Rose, South Byron. Same, November 13, Bell & Smith, Castleton. Same, C. C. Woolworth, Castleton

Lachnus abietis Fitch, on balsam, September 8, C. H. Peck, Lake Placid

Psylla pyricola Forst., pear psylla, adults on pear, September 20, John Dunbar, Rochester

Pachypsylla celtidis-gemma Riley, hackberry nodule gall, galls on hackberry, February 16, H. B. Smith, Nashville, Tenn. Through Garden Magazine, Doubleday, Page & Co.

Eulecanium tulipiferae Cook, tulip tree scale on tulip, August 31, O. W. Peterson, Fairfield county, Conn. Through Country Gentleman

Asterolecanium pustulans Ckll., golden oak scale, adults on oak, May 16. Through State Department of Agriculture

A. variolosum Ratz., on oak, September 7, Theodore Foulk, Flushing. Through State Department of Agriculture

Phenacoccus acericola King, false cottony maple scale, young, January 21, Archibald Beresford, Mt Vernon. Same, eggs on maple, July 18, Mrs Alice G. Fisher, Batavia. Same, females and young on maple, October 4, Miss Fanny G. Dudley, Newburgh

Pseudococcus longispinus Targ., mealy bug, February 24, C. E. Olsen, Winfield. Same, larvae on coleus, August 30, Albany. Through Country Gentleman

Pulvinaria vitis Linn., cottony maple scale, females and young on maple, July 26, G. W. Morley, Haverstraw. Through State Department of Agriculture

P. occidentalis subalpina Ckll., immature, August 31, T. D. A. Cockerell, Boulder, Col.

Gossyparia spuria Mod., elm bark louse on elm, July 9, R. H. C. Bard, Syracuse. Through State Department of Agriculture

Eriococcus azaliae Comst., on azalea, November, Brooklyn. Through State Department of Agriculture

Aulacaspis pentagona Targ., West Indian peach scale, adult on imported Japanese flowering cherry, January, P. L. Huested, Kingston. Same, adult on Japanese cherries, February 3. Through State Department of Agriculture

A. rosae Bouché, rose scale on rose, November 13, C. C. Woolworth, Castleton. Same, adults on rose, April 29, L. L. Woodford, Pompey

Chionaspis americana John., elm scurfy scale, crawling young, May 10, W. B. Landreth, Schenectady

C. euonymi Comst., euonymus scale, eggs on ? Euonymus, May 19, C. H. Hechler, Roslyn

Fiorinia fioriniae var. japonica Kuw., adults on Japanese hemlock, June 9, Long Island. Through State Department of Agriculture

Orthoptera

Chortophaga viridifasciata DeG., green-striped grasshopper, nymphs, March 26, N. Ashley, Old Chatham

EXCHANGE

Galls received from Prof. Mario Bezzi, Torino, Italy

Cystiphora sonchi F. Lw. on Sonchus arvensis L., Sondrio, Italy
Dryomyia circinans Gir. on Quercus cerris L., Mantua, Italy
Dryomyia lichtensteinii F. Lw. on Quercus ilex, Macerata, Italy
Dasyneura sisymbrii Shrnk. on Nasturtium silvestris L., Milan, Italy
[1] Perrisia sp. on Cucubalus bacerifer (?) L., Bergamo, Italy
Perrisia sp. on Polygonum bistorta L., Sondrio, Italy
Perrisia alpina F. Lw. on Silene acaulis L., Sondrio, Italy
Perrisia capitigena Br. on Euphorbia cyparissias L., Macerata, Italy
Perrisia crataegi Winn. on Crataegus oxyacantha L., Milan, Italy
Perrisia ericina F. Lw. on Erica carnea L., Como, Italy
Perrisia fraxini Kieff. on Fraxinus excelsior L., Sondrio, Italy

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[1] A synonym of Dasyneura.

Perrisia oenophila Haimh. on Vitis vinifera L., Sondrio, Italy
Perrisia pustulans Rubs. on Spiraea ulmaria L., Sondrio, Italy
Perrisia rosarum Hdy. on Rosa canina L., Sondrio, Italy
Perrisia salicariae Kieff. on Lythrum salicaria L., Milan, Italy
Perrisia ulmariae Br. on Spiraea ulmaria L., Sondrio, Italy
Rhabdophaga rosaria H. Lw. on Salix purpurea L., Sondrio, Italy
Mikiola fagi Hart. on Fagus silvatica L., Bergamo, Italy
Rhopalomyia artemisiae Bouché on Artemisia campestris L., Sondrio, Italy
Oligotrophus sp. on Juniperus communis L., Mallare, Italy
Oligotrophus capreae Winn. on Salix caprea L., Sondrio, Italy
Oligotrophus corni Gir. on Cornus sanguinea L., Relegon, Como, Italy
Oligotrophus reaumurianus F. Lw. on Tilia parviflora Clerk., Sondrio, Italy
Oligotrophus solmsii Kieff. on Viburnum lantana L., Sondrio, Italy
Oligotrophus taxi Inchb. on Taxus baccata L., Mallare, Italy
Mayetiola poae Bosc. on Poa nemoralis L., Sondrio, Italy
Asphondylia sp. on Scrophularia canina L., Selvius, Bergamo, Italy
Asphondylia sarothamni H. Lw. on Sarothamnus scoparius Link., Sondrio, Italy
Schizomyia pimpinellae F. Lw. on Pimpinella magnus L., Como, Italy
Harmandia petioli Kieff. on Populus tremula L., Sondrio, Italy
Harmandia tremulae Winn. on Populus tremula L., Sondrio, Italy
Clinodiplosis vaccinii Kieff. on Vaccinium uliginosum L., ? Valmaleneo, Sondrio, Italy

APPENDIX

MIASTOR AMERICANA FELT

An account of pedogenesis

The remarkable larvae of Miastor, presumably M. americana Felt, were found Oct. 5, 1910 under the partially decayed inner bark and in the sapwood of a chestnut rail used to fence a shady roadside in the vicinity of Highland. Additional material was secured October 19th, and from these two lots we have been fortunate in being able to follow through the larval life cycle and to actually witness pedogenesis, now regarded as a modification of parthenogenesis. These minute larvae are very easily handled and studied and should therefore be extremely serviceable to teachers of zoology and biology desiring to give their classes first-hand information respecting this phase of reproduction. Our studies of this form are given below in some detail in the hope that many teachers will find it advantageous to make use of these larvae in their class work.

Habitat. The moist inner bark of various trees showing incipient decay is the most likely place to find Miastor larvae. Those discussed in these pages were discovered in the fall, working in the partially decayed chestnut bark of a rail fence along a shaded roadside. The larvae were most abundant in the soft, partly decayed bast just beyond the point invaded by various borers in dead wood and the accompanying predaceous Dipterous larvae. An allied, though undetermined, species was taken under similar bark of a chestnut stump in a wood lot. European observers report the occurrence of these and allied larvae under the bark of a variety of trees, such as beech, birch, poplar, oak, elm, ash and ironwood, and even in sugar beet residue.

Recognition characters. It is very probable that these larvae have been repeatedly overlooked by collectors, simply because when occurring singly or in small colonies they present no very striking characteristics. Large colonies of this remarkable form are easily recognized by the masses of more or less adherent yellowish or whitish larvae, and especially by the presence here and there of larger, motionless individuals, some of which usually contain young so well developed as to be easily seen with a hand magnifier. A careful examination with a pocket lens will show, even in the case of isolated larvae, a distinct head and a fuscous ocular spot in the sedgment just behind. The head is flattened, triangular, with a pair of diverging antennae and quite different from the strongly convex, usually fuscous head of Sciara larvae sometimes occurring in similar situations. Predaceous larvae likely to be associated with Miastor, may be instantly recognized by the body tapering to the small anterior segments, and especially by the chitinized, usually fuscous, hooked mouth-parts. Small Dipterous maggots having a length of one-twentieth to one-eighth of an inch and occurring under conditions described above, should be carefully examined if one is searching for this or allied species.

Value to zoologists and biologists. Miastor larvae and their allies should be of great service to teachers of zoology and biology, since they admit of the study at first-hand of one form of parthenogenesis. It is possible with a no more elaborate outfit than an ordinary student's microscope equipped with a three-quarter objective, a microscopic slide and a few cover glasses, to observe the vital activities of the young larva, to see the muscular, respiratory, digestive and nervous systems, to identify the ovaries and to watch the gradual development of the semitransparent embryos within the mother larva. Furthermore, this larva is well adapted to more exact histological methods, being soft and therefore an excellent subject for serial sections and stains, particularly as it is comparatively easy to secure from one colony a series of individuals representing different stages of development.

There are other considerations aside from the interest attaching to their morphology and biology which should appeal strongly to the teacher of zoology. These larvae are widely distributed and, with an understanding of their habits, there should be little difficulty in finding them. Moreover, they are small, and a piece of wood six inches long, three inches wide and half an inch thick may contain or produce material enough for a fair sized section or class in zoology. The larvae are prolific and under favorable conditions would probably multiply at any season of the year. This is certainly true of the fall, the early winter and the spring. They are so amenable to artificial conditions as to make it possible to keep them alive for at least a month in microscopic cells, and with care a larval generation will develop in such restricted quarters. We have kept larvae healthy and multiplying for more than three months with nothing more elaborate than a moist piece of decaying wood clamped lightly to an ordinary microscopic slide. These remarkable larvae are very hardy. Prolonged dryness simply results in a suspension of activities, while they are quite resistant to an abundance of moisture. We have kept them alive in sealed water-filled cells without food for five weeks. With our present knowledge we see no reason why artificial colonies might not be established in the vicinity of a zoological laboratory and maintained with very little or no attention from year to year, if not for a decade or more.

Description. The parents of these remarkable larvae are small midges belonging to the Dipterous family Itonidae, better known as the Cecidomyiidae or gall midges. The members of this family are all small Diptera with the tibiae unarmed apically, the coxae not produced and the wings usually with but three or four long veins and no cross veins. Extreme forms may have six or seven long veins and one cross vein or, as a result of reduction, the veins may have nearly disappeared.

The subfamily Heteropezinae, to which Miastor and its allies belong, comprises a number of exceedingly peculiar forms, some of them most remarkable on account of the great degree of specialization by reduction — physiological as well as morphological. Members of this subfamily may be separated from the Itonidinae by the absence of circumfili, and from the Lestremiinae by the great reduction in the venation, there being at most, three long veins. The metatarsus may be longer than the following segment, while the number of tarsal segments may be reduced to two. Certain species have quinquearticulate tarsi and the wing membrane thickly clothed with rather broad, striate scales. The production of larvae by larvae or pedogenesis is known to be true of several genera referable to this subfamily, the larvae of which appear to live for the most part in decaying vegetable matter and are therefore likely to be found in searching for Miastor larvae. The adults of Miastor appear in June, while the one known American species of Oligarces was taken in July. The following table will facilitate the recognition of the genera in this group.

KEY TO GENERA

a Metatarsus longer than the second segment
- *b* Tarsi quadriarticulate; 3 long veins; palpi biarticulate — Miastor Mein.
- *bb* Tarsi triarticulate; 2 long veins; antennal segments cylindric — Heteropeza Winn.

aa Metatarsus shorter than the second segment
- *b* Tarsi quinquearticulate
  - *c* Wing membrane finely haired
    - *d* 3d vein extending to the apex of the wing
      - *e* Palpi quadriarticulate
        - *f* 5th vein forked — Haplusia Karsch
        - *ff* 5th vein simple — Johnsonomyia Felt

ee Palpi triarticulate — Meinertomyia Felt

dd 3d vein not extending to the apex of the wing

eee Palpi uniarticulate — Leptosyna Kieff.

e Palpi biarticulate — Frirenia Kieff.

ee Palpi triarticulate — Epimyia Felt

cc Wing membrane scaled; 3 simple veins; palpi triarticulate — Brachyneura Rond.

bb Tarsi biarticulate — Oligarces Mein.

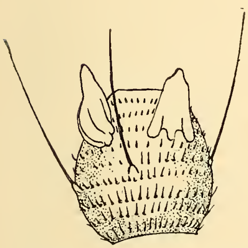

Fig. 7 Fifth antennal segment of Miastor americana, greatly enlarged. (Original)

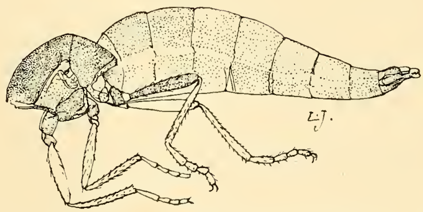

Fig. 10 Side view of thorax, legs and abdomen of Miastor americana. (Original)

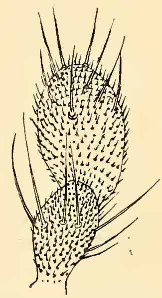

Fig. 8 Palpus of Miastor americana, greatly enlarged. (Original)

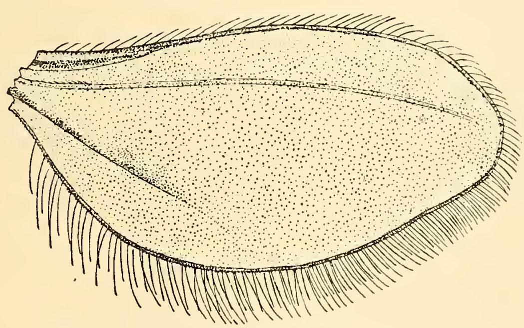

Fig. 9 Wing of Miastor americana, greatly enlarged. (Original)

M. americana. *Female.* Length 2.5 mm., slender. Antennae extending to the base of the coxae, sparsely haired, brown; 11 segments, the first short, stout, irregularly subglobose, the second ½ longer, the fifth subcylindric, with a length about ¼ greater than its diameter, tapering at both extremities, subsessile; a very sparse subbasal whorl of stout setae; subapically and apparently on the ventral surface, a pair of large, irregularly subconic, semitransparent processes (fig. 7); the distal segment subglobose, broadly rounded apically. Palpi biarticulate, the first segment irregularly oval, the second ½ longer, broadly oval, both sparsely setose. Mesonotum dark brown. Scutellum reddish brown, postscutellum fuscous yellowish. Abdomen pale salmon, fuscous basally, yellowish apically. Wings hyaline, costa pale yellowish, subcosta uniting with the margin at the basal third, the third vein, curving distally, just before the apex, the fifth simple and disappearing just before the basal half; fringe long, slender. Legs a nearly uniform yellowish brown, the tarsi quadriarticulate, the first segment short, about ½ longer than the second, which latter is distinctly longer than the third, the fourth a little longer and stouter than the second; claws long, slender, simple, the pulvilli nearly as long as the claws. Ovipositor short, the lobes long, slender, triarticulate, the basal segment stout, subtriangular, the second longer, subrectangular, the third narrowly oval, all sparsely setose; on the venter of the seventh abdominal segment there is a submedian pair of obpyriform, chitinous appendages, possibly orifices of odoriferous glands.

Larva (presumably M. americana). Length 1.25 to 4 mm. Young larvae yellowish or whitish transparent, the larger larvae whitish or reddish orange. The large, white larva is rather stout, tapering somewhat at both extremities and frequently nearly filled with white adipose tissue. There are 13 body segments. The head (pl. 26, fig. 2) is small, triangular and frequently retracted within the body segments. The palpi are short, stout, biarticulate and arising from the anterior portion of the head, the tip of the head usually fuscous. The irregularly bilobed ocular spot is usually seen as a fuscous mass in the third segment. The posterior extremity tapers to an obtuse apex bearing a series of 6 stout, frequently recurved, cuticular processes. The body segments are banded ventrally (pl. 29, fig. 2) with closely set series of short, stout spines pointing backward, these spines being most strongly developed upon the anterior body segments, especially the third, fourth and fifth (pl. 22).

The quiescent larva, easily recognized by its somewhat stiff attitude, due probably to the relaxation of the transverse muscles girdling each segment, may be whitish and contain semitransparent embryos, easily seen by reflected light (pl. 23, fig. 1) or yellowish and filled with nearly mature embryos (pl. 24, fig. 1).

The young larvae are 1.2 to 2 mm. long and present all the characters described above for the larger white larvae except that they are yellowish or yellowish transparent, usually more slender and appear to have a relatively much better developed musculature.

Musculature. The muscles are especially well developed in the young larvae. They consist of a series of longitudinal and oblique muscles extending from the anterior to the posterior margins of the body segments. There are a number of transverse, girdling muscular bands, which are particularly well developed at the union of the body segments, though several distinct broad bands may be observed near the middle of each segment.

Respiratory system. The tracheal trunks comprise a double series on each side extending nearly the entire length of the body and sending minute branches to lateral spiracles on the fourth to the eleventh body segments. The dorsal trunks are united to each other by transverse tracheae in the posterior third of body segments five to eleven inclusive and, in addition, send minute branches to the various organs of the body. The tracheal system of a living, semitransparent larva may be easily examined in a water mount.

Nervous system. This is composed of the pyriform submedian optic lobes and the fuscous, lobulate, socalled ocular spot, the bilobed brain in the fourth and fifth body segments and a series of ganglia united by submedian nerves as follows: A broadly oval ganglion occupying the length of the third body segment and with a width fully equal to half its diameter; a shorter, more slender ganglion in the anterior portion of the fourth segment; a broadly pyriform ganglion in the anterior third of the fifth body segment. Separated slightly therefrom, another ganglion lies in the posterior portion of the fifth and the anterior part of the sixth body segments. It is a little narrower than the preceding though it has an equal length. The fifth and sixth ganglia, each short, subquadrate, occur in the sixth body segment; the seventh ganglion is one-half longer than the sixth and is situated in the middle of the seventh body segment; the eighth to the twelfth body segments each appear to have one ganglion, the posterior one almost extending to the anterior margin of the thirteenth body segment.

Digestive system. The digestive system, difficult to study because of its being largely inclosed by nearly opaque adipose tissue, consists, according to Kahle, of a comparatively simple tube extending the entire length of the body, the granular salivary glands occurring in the fifth to the ninth body segments, while the long, slender, malpighian tubes may be found in the 11th to 13th segments, inclusive.

History of pedogenesis. The discovery of this remarkable phenomenon is credited to Nicolas Wagner, professor of zoology at Kasan. He published a short note in the *Journal of the University of Kasan* in 1861 or 1862, and in 1865 a detailed account. The latter was held by the editor for almost two years because of its "almost increditable" character. The observations of Wagner were confirmed by Meinert and Pagenstecher in 1864, and by Hanin, Leuckart and Mecznikoff in 1865. Wagner believed at first that the embryos originated in the adipose tissue, at the expense of which they develop very largely. Later he, Leuckart and Mecznikoff satisfied themselves that the embryos originated from ovaries.

The investigations of these scientists covered approximately a decade, 1862 to 1872, which was followed by a long period of apparent lack of interest in these larvae, very little original being published from the latter date until the exhaustive studies in 1908 by Kahle, who employed modern laboratory methods, demonstrated the general correctness of the earlier observations and satisfied himself that the process was a true parthenogenesis. It does not seem to have occurred to any one that these larvae might be of great service to the teacher of biology.

This method of reproduction has been observed by Meinert in Miastor, Oligarces and Meinertomyia (Pero Mein.) and by Kieffer in Leptosyna. The latter believes the same to be true of Frirenia, though he has not observed mother larvae, since the females contain the unusually large eggs characteristic of genera reproducing in this manner.

Pedogenesis or close approach thereto is known to occur in the Chironomidae. Grimm in 1870 describes a larval Chironomus in which eggs develop, they escaping, however, from paired submedian ventral orifices in the eighth abdominal segment of the pupa. This must be construed as at least a modification of the process exhibited by Miastor and its allies. Professor Johannsen recorded in 1910 a pedogenetic larva, Tanytarsus dissimilis Jhns., which had come under his observation and that of the late Dr James Fletcher, though no data has been published to show the exact character of this process. Professor Johannsen also refers to an account of pedogenesis in this genus observed in Bohemia by Professor Zavrel.

Habits. These larvae appear to thrive only in the moist, partly rotten inner bark and punky sapwood which has not been invaded to any considerable extent by other Dipterous larvae or Coleopterous borers. They exhibit a manifest tendency to occur in segregated masses, frequently between loose flakes of bark or in rather broad crevices. These colonies contain in autumn old empty skins of mother larvae; a number of yellowish mother larvae with approximately five to fifteen young within; very numerous, small, yellowish larvae showing no trace of embryos; a number of white, various sized active larvae, frequently white, sometimes semitransparent; and a few quiescent white larvae containing young embryos. Such larval colonies are most likely to be found in somewhat flaky inner bark, especially where conditions allow several larvae to lie side by side (pl. 26, fig. 1).

Slender, yellowish larvae are often found lying between wood fibers, in some instances apparently having penetrated several inches from the nearest adjacent larvae. These latter do not appear to grow so rapidly as is the case in the more populous colonies, and they also seem to be less prolific, since the few larvae we have observed under such conditions, produced only three or four, and mostly but one, young. The small, yellowish larvae lying in crevices, mentioned above, frequently occur in series, sometimes one or two lying side by side. They move comparatively little, action being confined largely to the head and the semitransparent anterior body segments. Such larvae appear to remain almost unchanged for two weeks or more. These muscular larvae, with their bands of retrose spines especially well developed on the anterior body segments, are admirably adapted for forcing their way between partially rotten tissues, a procedure which is also of material service in giving them relative immunity from attack by natural enemies. The small yellow larvae were most abundant in our material during the winter months.

Active larvae crawl rapidly over moist wood and glass, and have even been observed wriggling between colonies of mold. Lack of moisture appears to cause a partial suspension of vital activities, while flooding does not seem to be very injurious. The mouthparts of the larvae, though the anterior portion of the head is strongly chitinized, appear to be comparatively weak, and, while we have repeatedly observed these larvae moving the head about and examining adjacent tissues, we have seen no indication of gnawing or boring. The alimentary canal contains little that can be discerned with the aid of a compound misroscope, and we are inclined to believe that a considerable portion of their nourishment is absorbed by osmosis after escaping from the mother larva, as well as before. It would appear as though the several types of larvae occurring in a colony are possibly only modifications, due to the relative amount of nourishment obtained by the individual.

Normally, reproduction by pedogenesis occurs throughout the warm months of the year and even into late fall, and commences in early spring, the cold weather of winter simply causing a suspension of activities. Dr Kahle, after an extended series of observations, was led to believe that asexual multiplication might continue uninterruptedly for possibly a period of two or three years. This appears reasonable, since somewhat recent experiments by Slingerland have shown that a plant louse might produce nearly 100 asexual generations in almost four years and presumably was capable of continuing this much longer. The adults of Miastor and Oligarces occur in midsummer, a season when the midges of most of these forms are probably abroad.

Biological observations. The first larvae secured were taken October 5, 1910, placed in an ordinary fruit jar with moist sand and subsequently allowed to become rather dry. A second lot was obtained October 19 and on examining the latter November 18th, an adherent mass of young larvae evidently recently escaped from the mother larva was found. Soft, partially rotten wood was taken from the earlier lot presumed to contain little or nothing alive, and one or two of these young larvae placed in a groove in each piece of wood, the latter being attached by light clamps, either directly to a microscopic slide or held between a pair. These preparations were kept in a closed tin box on damp blotting paper. It was hoped that we would be able to watch the development of the one or more larvae thus placed in each piece of wood. Most of these for some reason or other escaped and we soon found that the additional moisture given these pieces resulted in renewed activities on the part of many larvae concealed in the woody tissues. On November 28, ten days after these preparations had been made, numerous young larvae were observed in most of the preparations, the majority probably recent young of larvae stirred to renewed activity by the addition of moisture. Throughout November and in early December large, white mother larvae capable of producing from five to perhaps fifteen embryos were frequently seen. The latter part of December and during January large, white larvae were difficult to find and the major portion of the reproduction was by the small, yellow mother larvae usually occurring in crevices in the sapwood and producing only one or two young. These preparations afford an excellent opportunity for determining the duration of the quiescent period under nearly natural conditions. This was found, as a result of observations upon a number of larvae, to be in the vicinity of a week, the movements of the embryo with the fuscous ocular spot and brown anterior portion of the head being observable about five days prior to the escape of the young. The occurrence of a small amount of mold did not seem to have a material effect upon the health of the larvae, and the same was true respecting the presence of mites, Tyroglyphus, which were upon occasions rather abundant in some of the preparations. The larvae crawl readily between the glass and the wood, occasionally making their way to the margin of the preparation and sometimes escaping. A few were found lying upon the damp blotters in the bottom of the box, others between the blotters and more under the lower blotter on the tin bottom of the box. The larvae are evidently able to remain active for considerable periods without nourishment and with comparatively little oxygen, since it was observed that flooding of the preparation, even though continued for two or three days, apparently had no ill effect upon the larvae — subsequently we found that larvae would live submerged several weeks and the embryos develop.

The above was continued by isolating one or more larvae on ordinary microscopic slides. Each of these contained several small slivers of wood approximately .2 mm. thick and 1 to 1.5 em. long. These were laid upon the slide, moistened, several larvae added and a square cover glass placed over the whole, the margins being more or less perfectly sealed with vaseline. These preparations were designed primarily to secure more accurate data as to the length of the quiescent period, to facilitate observation upon the development of the embryo and also to ascertain the feasibility of rearing the larvae under such conditions. It was soon noted that while the vital processes were not at once inhibited by submersion, they were greatly retarded and if flooding was long continued, the embryos were unable to escape from the mother larva, though apparently well developed.

One moderate sized, apparently quiescent larva with finely granular contents and a brownish discoloration on one side was placed in such a cell December 12, 1910, together with a moderate sized, yellowish or yellowish white larva and a number of smaller ones. The 16th it was evident that the adipose tissue of this large larva was disintegrating, the several embryos being about one-half the length of the mother larva. On the 22d the embryo was apparently about three-fourths the length of the mother larva and there were no signs of either head or ocular spot. The next day the developing ocular spot was seen as a pair of narrowly oval, fuscous, submedian bodies, while most of the posterior part of the larva was filled with large, cuboidal cells arranged in a series of columns. The embryo at this time extended from the fifth to the thirteenth body segments of the mother larva. The following day the ocular spot was more evident and the apex of the head discernible. The 27th we were able to recognize two embryos, both with the large cells as described above. The 30th there was a distinct bulging of the mother larva in the region of the fifth body segment, a condition presaging the nearly developed embryo. The next day the ocular spot was black. Observations were continued daily from January 1st to the 13th, during which time development appeared to be slow and a clear definition of the changes undergone almost impossible because of the condition of the cell. January 16th the embryos had escaped.

The moderate sized, yellowish or whitish larva mentioned above was lost sight of for a time, not being located till December 23, 1910, at which time it was found well established on the underside of a splinter of wood and with a length of about 3 mm. It remained moderately active for a time, two embryos being observed the 26th, at which time its color approximated closely that of the wood and accounted in large measure for its being overlooked earlier. The 28th the adipose tissue of the mother larva had nearly disappeared and on the 31st an ocular spot was visible in the young. January 1st the head and ocular spot of two embryos were recognized, and on the 5th embryonic movements were observed. The next day one embryo had extruded its head through the skin of the mother larva. Our records show that embryos remained within this mother larva till the 20th, possibly one or more perishing.

There were at least three small, yellowish larvae placed in this preparation with the two larger ones discussed above. These remained active for some days, two being located as quiescent, each containing an embryo about half the length of the mother larva, December 23, 1910, and from this on were subjected to daily observation. The first of these showed a grouping of the cells in rows the 24th, which became more distinct the next day, and on the 26th a median tract of darker cells was observable. The 28th the embryo extended from the second to the eleventh body segments of the mother larva and showed rather distinct masses of adipose and mesodermal tissue (pl. 35, fig. 3). The ocular spot was evident and the head slightly fuscous. On the 30th movements of the anterior extremity of the embryo and streaming of the body contents were observed, the mesodermal tissue was less conspicuous and the adipose tissue occupied more space. The embryo escaped from the mother larva January 1st. This was unusually early and may have been hastened by artificial causes.

The second small, yellowish, quiescent larva was located December 23, 1910 at which time it contained a large-celled embryo with a length fully one-half that of the mother larva. Three days later the embryo extended from the fifth to the thirteenth segments of the mother lavra, the cells being arranged in indistinct rows and larger at the extremities. Owing to its position, it was impossible to properly illuminate this mother larva. The ocular spot and fuscous head were observed on the 30th and an active, well-developed larva seen January 2d, which remained within the skin of the mother larva till the 12th, an unusually long period, due possibly to the mother larva being partially surrounded by vaseline and therefore deprived of a proper supply of oxygen.

Three months after the establishment of the cell containing the larvae discussed above, their progeny were living under substantially the same conditions and gave every indication of producing young in due time.

A large, white, active larva was isolated under another slide December 12, 1910 with the conditions practically as outlined above. Six days later this larva had worked itself to the margin and become practically inclosed in a vaseline, water-filled cell where it remained for over a month, namely till January 20th. The development was unusually slow, probably due in large measure to the deficient supply of oxygen. Young, oval embryos were observed in the region of the sixth and seventh body segments December 19. On the 24th several embryos were found on the venter in the region of the tenth or eleventh segments, each with a length nearly equal that of the body diameter. There was a gradual increase in length and on the 26th one extended from the eleventh to the fourteenth segments of the mother larva. The adipose tissue was yellowish and reticulate by the 29th, though no signs of ocular spot or mouth parts were to be seen. January 2d a slight row of cells was visible in one embryo, this median streak becoming more apparent on the 5th. Extended masses of large, cuboidal cells were observed on the 7th, the ocular spot showing as a pair of minute, brownish spots. On the 16th well formed, embryonic heads and brown ocular spots were visible. This appeared to be about as far as development could go without additional oxygen, and though the vaseline cell was ruptured on the 20th no larvae escaped. The record is interesting since it gives an idea of the vitality of these larvae under adverse conditions.

Another quiescent, white larva containing at least two embryos was isolated December 12, 1910. The adipose tissue was granular and irregular. On the 16th the larva was nearly filled with whitish transparent embryos, the latter with a distinct median streak. Five days later one embryo had a length equal to one-half that of the mother larva, the embryonic adipose and mesodermal tissue were rather distinct, while the adipose tissue of the mother larva was largely absorbed. On the 22d the form of the mother larva was distinctly modified by the obliquely-lying young, each with a length approximately three-fourths that of the parent. The next day we observed the mesoderm, composed of irregularly arranged, subhexagonal cells, accompanied by the appearance of incipient ocular spots in various embryos. The tip of the head became fuscous by the 28th and on January 5th, slight movements of the embryos were observed. Owing to the reduced oxygen supply, due to the larva being in a practically sealed cell, the embryos experienced difficulty in escaping. One was observed January 9th with the seven anterior segments protruding from the posterior extremity of the mother larva, remaining in the same position and nearly motionless the three following days. The cell was opened January 14th and the mother larva given air, but the action was apparently too late, as the young failed to revive. There appears to be sufficient oxygen in the tissue of the mother larva to permit the embryos to become fully developed.

Methods. The material taken in October was kept in ordinary fruit jars for a time, some of these at least being allowed to become rather dried. There was very little or no multiplication. On November 18th small pieces or slivers of somewhat dried wood containing these larvae were either clamped directly to ordinary microscopic slides or laid between two held together by means of light wire clips. These portions of infested wood were kept on moistened blotting paper in a dark, tin box, being examined every two or three days. Large, white mother larvae were produced from time to time and occasionally considerable colonies of small young were observed in the vicinity of the empty skins of mother larvae. Such preparations enabled us to keep track, not only of a colony but, by noting the location of quiescent larvae, even of individuals. Later this series was supplemented by a few fragments of wood laid upon microscopic slides, covered with large, square cover glasses and the margins more or less perfectly sealed with vaseline. The cell thus formed was kept moist and sometimes flooded with water. Under such conditions full grown white larvae, quiescent larvae and small, white or yellowish larvae were also studied. They apparently thrived for one week at least. Finally we selected a series of small, yellowish, active and quiescent larvae, placed them in water cells and observed the embryos and their various stages of development, photomicrographs being successfully made from this living material.

The observations on the small lots of material noted above were checked by examinations of the fruit jars containing larger amounts of material. The latter jars were especially useful because the very numerous maggots made it possible to select at one time practically all stages, which were mounted in considerable abundance. Some of the larvae were cleared with potassium hydrate and then stained with Fuchsin, Hematoxylin, Eosin and Eosin-Hematoxylin. The actions of the stains were all somewhat unsatisfactory and the majority of our most successful mounts were entire larvae in ordinary balsam preparations which had been thoroughly cleared. The study of the mounts was checked by examination of living material as detailed above.

Embryology. The development of the embryo may be observed in the living larva. It is easily seen in the larger, white individuals common in the fall and producing a number of young, though the changes in the embryo are best observed in the small, yellow larvae, especially if they are mounted in shallow water cells.[1]

The region of the ovaries is marked in the large, white larvae by an irregular, yellowish green streak in the tenth or eleventh segments. A close examination of such a larva may disclose the oval, large-celled ovaries nearly concealed by the submedian masses of opaque, white adipose tissue, especially if the larva rolls slightly. These organs are more easily detected in the young yellowish larva. They are submedian, whitish transparent, contrast rather strongly with the darker, more refractive adipose tissue and are located in the posterior portion of the tenth or the anterior part of the eleventh segment, one frequently being somewhat in advance of the other. They are composed of globular or oval, nucleated cells.

The youngest embryos we have observed are oval, granular and may be found in the large, white larvae in the vicinity of the ovaries. The motion of the internal organs appears to distribute the embryos through the body, there being from one to as many as seventeen in individual mother larvae. The young embryos are semitransparent and present a strong contrast to the opaque adipose tissue of the large, white larvae or the denser cells of the small, yellowish larvae. The youngest embryo photographed is

[1] We have used a ring of vaseline to support the cover glass and found such a cell very satisfactory as well as economical.

represented on plate 30, figures 2 and 3. It occurred in a small, yellow larva and had a length nearly equal to that of the ninth segment of the mother larva, its width being about one-fourth the diameter of the parent. This embryo is evidently in the morula stage, it being composed of a rather indistinct mass of irregular, closely placed cells, apparently with a slight infolding, the beginning of the blastoderm. At the posterior extremity there is a group of nucleated, large, polar cells. The next stage observed, though not photographed, was seen in larva Y. This embryo had a length equal to nearly twice the diameter of the mother larva. It was narrowly elliptical, with a length approximately three times its diameter and the polar cells, though visible, were not so evident as in the embryo described above. At its anterior extremity there was a slight thickening, apparently the much reduced cells of the corpus luteum. The median portion was occupied by a rather broad streak of dark, granular cells, bordered on either side and at the extremities by lighter, small-celled tissue. A more advanced stage is shown on plate 30, figure 1, and plate 31. This represents an embryo dissected from the large, white type of mother larva. It shows a distinct darker ectoderm and a lighter mesoderm, the anterior extremity having a conspicuous cap of large, dark cells. Portions of the posterior extremity and of the middle of the same embryo are represented still more enlarged on plate 31, figures 1 and 2. The time required for the small embryos to migrate from the region of the ovaries and develop to such an extent as described above and thus produce a quiescent stage in the large, white type of mother larva is approximately four to five days, much appearing to depend upon the size of the mother larva and the number of embryos present. The latter are perhaps most easily seen when viewed by reflected light (pl. 23 fig. 1, 2). The next stage in the development is illustrated on plate 32, figure 1. The embryo has a distinct cephalic cap of dark-celled tissue, a well defined germinal streak, the latter being broadly produced to one side in the region of the anterior third. The same general condition, though in a more advanced stage and apparently from a somewhat different viewpoint, is illustrated on plate 32, figure 4, and plate 33, figure 2, the dark ectoderm occupying one-third the width of the embryo and extending from approximately the region of the sixth to the twelfth segments; the cephalic cap persists as before. This condition appears to be followed shortly, though we have observed it somewhat clearly only in embryos developing in the large, white mother larvae, by a great increase in the ectoderm, accompanied by its folding and extension anteriorly around the posterior extremity, the development of the large lobes anteriorly and its segregation into somatic masses, indistinctly shown on plate 27, figure 2, and apparently producing a peculiar cuboidal aspect illustrated on plate 28. The greatly developed mesoderm includes a series of large, cuboidal cells, some at least probably being the polar cells, and a certain portion destined to develop into a much more conspicuous mass to be described later. These changes are accompanied by a shrinking of the embryo from the extremities of the amniotic sac and the development of the digestive system by an invagination from both extremities. This latter is indicated in living embryos of young yellowish larvae, by the formation of irregular lobes at each extremity and the appearance in the region of the sixth to the twelfth segments, of a considerable mass of large-celled tissue, occupying most of that portion of the body cavity and which we believe to be mesoderm (pl. 35, fig. 2) and identical with that mentioned above. The changes from now on are rapid. This conspicuous mass of mesoderm gradually becomes absorbed or reorganized into organs such as the digestive system, its appendages and especially the ovaries, while the developing adipose tissue expands, occupies more space and produces a three-rowed appearance in the embryo (pl. 35, fig. 3). Development of the head now proceeds, the mouth parts become more definite, the ocular spot visible and the lobes at the posterior extremity become well defined. Motion may be observed in the embryo and shortly it is ready to escape from the mother larva. The length of the fully developed embryo is about 1 mm. It is frequently nearly as long as the small, yellow mother larva and approximately half as long as the large, white larva.

The development of the embryo reacts upon the mother larva and she soon assumes a rather characteristic quiescent form, undoubtedly an outcome of her lowered vitality due to the rapid absorption of nourishment by the young. This results in the relaxing of the muscles, especially the transverse girdling bands at the margins of the segments. The change in the condition of the mother is probably explainable solely upon physiological grounds. The time elapsing between the assumption of the quiescent stage by the mother larva and the escape of the young is about seven days. The first part of this period the embryos rarely exhibit signs of life, though distinct motions of the head and anterior segments may be observed five days before they escape. The embryos are inclosed in the amniotic sac, which latter is ruptured before they escape from the body of the mother larva. There is a marked tendency among the embryos, when more than one occurs, to develop with their heads toward both extremities of the mother larva.

The growth of the embryo is correlated, as alluded to above, by interesting modifications in the mother larva. The large, well developed mother larva is easily recognized by her plump condition and the nearly solid, submedian masses of white adipose tissue filling the body from the fifth or sixth segment to the posterior extremity. Shortly after the escape of the embryos from the ovaries we observe clear patches (pl. 23, fig. 1), here and there in the mother larva, bordered by cells well filled with adipose tissue. Within a few days there is a striking modification and these large cells lose, probably by osmosis, a large proportion of the white, fatty matter and assume a somewhat reticulate character (pl. 23, fig. 2), which is soon followed by their disappearance, and the embryos absorbing practically all of the contents of the mother larva.

Records of individual embryos. The embryo in larva *A* was first detected January 17th. It then had a length about equal to two and one-half body segments of the mother larva. There was a distinct median streak of large, irregular cells, with a broad projection to one side near the anterior third, and a distinct cephalic cap of dark cells at the anterior extremity (pl. 32, fig. 1). The next day the germinal strip occupied an area approximately equal to one-third the width of the embryo (pl. 32, fig. 2), extending the following day to about half the width of the embryo, the clear space just behind the cephalic extremity being decidedly smaller. At this time the embryo had increased in length so that it extended from the posterior third of the fifth to the anterior fourth of the eighth body segment of the mother larva. There was some increase in length and minor changes in development from that date to the 27th, at which time there was a remarkable change, the germinal streak and its production to one side becoming narrower and being composed of unusually large cells; this change was soon followed by disintegration, the condition on the 28th being well illustrated on plate 32, figure 3.

The embryo of larva *B* was recognized January 17th, at which time it extended from the fourth body segment of the mother larva to the twelfth. The greater portion of the embryo consisted of a nearly uniform series of small, globular cells, though a darker area was visible on one side near the middle (pl. 34, fig. 1). Pulsations were visible in the body of the mother larva. The next day a series of moderately large, cuboidal cells were observed near the posterior extremity. This tissue became more distinct as development progressed, it becoming more evident by the 21st and occupying a still more prominent place the 23d and 24th. On this latter date two-thirds of the posterior portion of the embryonic body were filled with this tissue, somewhat as illustrated on plate 35, figure 2. The masses of adipose tissue on either side commenced to develop and eventually overspread and apparently absorbed in considerable measure the substances of the mesodermal tissue, a portion of which apparently develops into the ovaries. The embryonic digestive tract, apparently marked by large-celled tissue, appeared on the 27th to be nearly continuous throughout the entire length of the embryo. The embryo had shrunk a perceptible distance from the ends of the amniotic sac and the developing extremities were observed. The lobes of the antennae were recognized the following day as obtuse, buttonlike projections having a length less than three-fourths their diameter. Two days later the antennae had a length a little greater than their diameter; the ocular spots were indicated by indistinct, submedian, pigmented areas; the lobes of the brain could be traced; the salivary glands were submedian, narrowly lanceolate masses of large, glistening cells lying in presumably the sixth or seventh segments of the embryo, while the mesodermal tissue had retracted somewhat. The posterior extremity of the embryo was also well defined. February 1st there were three distinct rows of embryonic tissue, the two strips of adipose tissue and the large-celled mesoderm, the latter being less extensive the following day and largely obscured by adipose tissue on February 3d. There was a slow development from this time subsequently. On the 8th the ocular spots were light brown, diffuse, and the semitransparent mouth parts well developed, a fuscous appearance showing on the 9th. This embryo failed to escape from the mother larva.

The embryo in larva *C* extended from the third to the eleventh segments of the mother larva and had a distinct median streak January 17th. The latter on the 20th was seen to be composed of smaller, dark cells. The next day the embryo extended from the third to the middle of the twelfth segment of the mother larva. Development continued until the 27th, at which time it was nearly in the condition illustrated on plate 35, figure 2, the posterior portion being largely occupied by the mesodermal tissue. The anterior five or six segments of the embryo were semitransparent and the ocular spots represented by minute, brownish, submedian, pigmented areas. The next day the three-rowed condition, indicating the development of adipose tissue, was more apparent, while the lobed posterior extremity of the embryo was fairly definite. On the 30th developing salivary glands were distinguished near the anterior extremity of the adipose tissue. Free movements of the embryo were noted the 31st, and on February 1st it was seen that the head was well developed though semitransparent, the antennae having a length twice the diameter. The mesodermal tissue was obscured or absorbed to a considerable extent by the developing sublateral masses of adipose tissue. The head of the embryo was slightly infuscated on the 2d and the ocular spots purplish brown. Free movements of the embryo continued and on the 6th the mesoderm was largely concealed by adipose tissue. There was comparatively little development from this date onward, though the embryo continued active in the mother larva till the 10th. Owing probably to an insufficient supply of oxygen it was unable to escape.

One larva (*H*) separated January 17th, contained two embryos, each with a length about half that of the mother larva and both showing a distinct infolding near the middle of the germinal streak. The posterior extremities of these embryos showed several exceptionally large, compound cells — polar cells. Six were observed in the anterior embryo and apparently three in a row in the posterior embryo, the latter apparently moving anteriorly. Unfortunately this promising larva was accidentally destroyed.

Larva *I*, isolated January 17th, contained an embryo extending from the fifth to the eleventh body segments of the mother larva. The next day four presumably polar cells were recognized at the posterior extremity. There were no evident streaks in the embryo. On the 19th one very large aggregation of unusually dark cells was observed just before the posterior extremity, the opposite extremity being largely filled with globular ectodermal cells, especially abundant on one side. The following day a distinct tract of darker tissue was observed on one side of the embryo, extending from its anterior third to its posterior fifth and representing approximately the area occupied by the mesodermal tissue. January 21st the embryo extended from the fifth to the anterior margin of the thirteenth segment of the mother larva. There was a distinct fold of ectodermal tissue, presumably in the region of the eighth to the twelfth embryonic segments, extending a little over half the width of the embryo. Posteriorly there were several large, globose, nucleated cells, presumably polar cells, while at the opposite end there was a considerable mass of large cells having a diameter of one-fourth to one-third that of the embryo. Two days later the posterior extremity of the embryo contained a mass of large-celled tissue in which were several larger, indistinct, presumably polar cells. The large, glistening mesodermal tissue was observed in the region of the ninth to the twelfth segments, while the sublateral developing adipose tissue was seen on either side. This condition is well shown in a photograph taken the following day (pl. 35, fig. 2), at which time the embryo exhibited distinct movements. The rather well formed head was colorless and moved from side to side. Streaming of the body contents was observed though the fat bodies occupied a comparatively small space on either side. The fine-celled, slender, malpighian tubes were noted. The posterior extremity had well developed lobes. On the 25th the median mass of mesodermal tissue had begun to contract, the developing adipose tissue increasing considerably. Two days later the head was well developed; the ocular spot black; the salivary glands were recognized; the malpighian tubes were distinct, while the mesodermal tissue extended approximately from the tenth to the twelfth segments and had a width only about one-fourth the diameter of the embryo. The following day the embryo escaped from the mother larva.

Larva *N* was a small, yellow larva separated January 30th and containing an embryo extending from the posterior third of the ninth to the posterior third of the eleventh segment of the mother larva. The embryo exhibited a distinct germinal strip extending from the anterior third to the posterior fourth and with a broad band of ectodermal tissue extending to one side and including approximately the middle of the embryo. The anterior extremity of the embryo is capped as it were with dark-celled tissue, while large yolk cells may be seen here and there in the germ plasma. This embryo was about as far advanced as the one illustrated on plate 32, figure 4. The next day there was a median germinal strip of lighter cells and on one side a layer of decidedly darker cells, much as shown in plate 30, figure 1. February 1st the two layers described above were more distinct and broader, the median lighter one being crowded a little to one side by the greater development and consequent breadth of the darker ectoderm, which latter extended almost to the middle of the embryo and from its anterior third to its posterior fourth. The anterior extremity of the embryo is characterized by irregular series of moderately large cells in the germ plasm. February 2d the median mesodermal tissue was crowded still further to one side by the darker ectoderm which now extends to the middle of the embryo and appears to have elongated somewhat. Both extremities of the embryo have retracted a little from the tip of the amniotic sac and are occupied by irregular series of large cells. The following day the mesoderm was crowded still further to one side by the darker ectoderm. At the anterior extremity of the embryo there was a mass of rather dark, fine-celled tissue, possibly the corpus luteum and apparently separating by fission, while the greater portion appears to be composed of globular, highly refractive cells grouped much as at the posterior extremity, which latter is narrowly margined by rather large, highly refractive, indistinctly grouped cells, one or more being unusually large. February 4th there was a distinct clear space in each extremity of the amniotic sac. The anterior extremity of the embryo is distinctly lobed, the broader, less produced portion capped with a mass of large, refractive cells, the small protuberant lobe composed of fine tissue. The posterior extremity of the embryo is distinctly bilobed. Unfortunately the numerous changes observed in this embryo from this point on at least appear to be abnormal, since the embryo disintegrated February 9th, though pulsations in the mother larva continued normally till the 15th.

A very interesting embryo was discovered in larva *Y* February 6th. The embryo extended from the seventh to the eighth abdominal segments and had a length equal to nearly twice the diameter of the mother larva. It was narrowly elliptical, with a length approximately three times its diameter. The polar cells, though visible, were not so conspicuous as in the younger embryo illustrated on plate 30, figures 2 and 3. This embryo is composed of nearly uniformly developed, rather transparent, semicuboidal, ectodermal cells. At the anterior extremity there was a slight thickening, apparently the much reduced cells of the corpus luteum. The median portion was occupied by a rather broad streak of dark, granular cells bordered on either side, including the extremities, by lighter, smaller-celled tissue. The mother larva was alive, as evidenced by distinct pulsations. The following day a distinct though small cap of cells was observed at the anterior extremity of the embryo. At the posterior third of the embryo there was a distinct constriction, almost a division, the tissues adjacent thereto being markedly larger and darker, while at the posterior extremity there was a distinct lobe occupying about two-thirds the width of the embryo. February 8th there was a shrinking from both extremities of the amniotic sac, and other changes which are not described in detail, since they appeared to be preliminary to disintegration the next day, though the mother larva continued alive until the 15th.

An active, moderate-sized, white larva was isolated February 27th and its granular ovaries were seen partially to divide into irregular lobes, the one at the posterior extremity of the left developing into an ovum larger than the remainder of the ovary. The anterior third of the ovum was filled with darker, granular matter, while the remainder consisted of clear plasm containing about seven large, nucleated cells. This ovum increased in size until it was larger than the remainder of the ovary in which it originated, gradually separating therefrom by fission and shortly developing into a small embryo in the morula stage with distinct polar cells much as is illustrated on plate 30, figures 2 and 3.

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EXPLANATION OF PLATES

PLATE 1

Codling moth work

Sprayed but once

1*a* Picked fruit: 135 sound, 13 wormy apples
1*c* Picked fruit: 382 sound, 27 wormy apples
1*d* Picked fruit: 563 sound, 30 wormy apples

Plate I

Sprayed apples

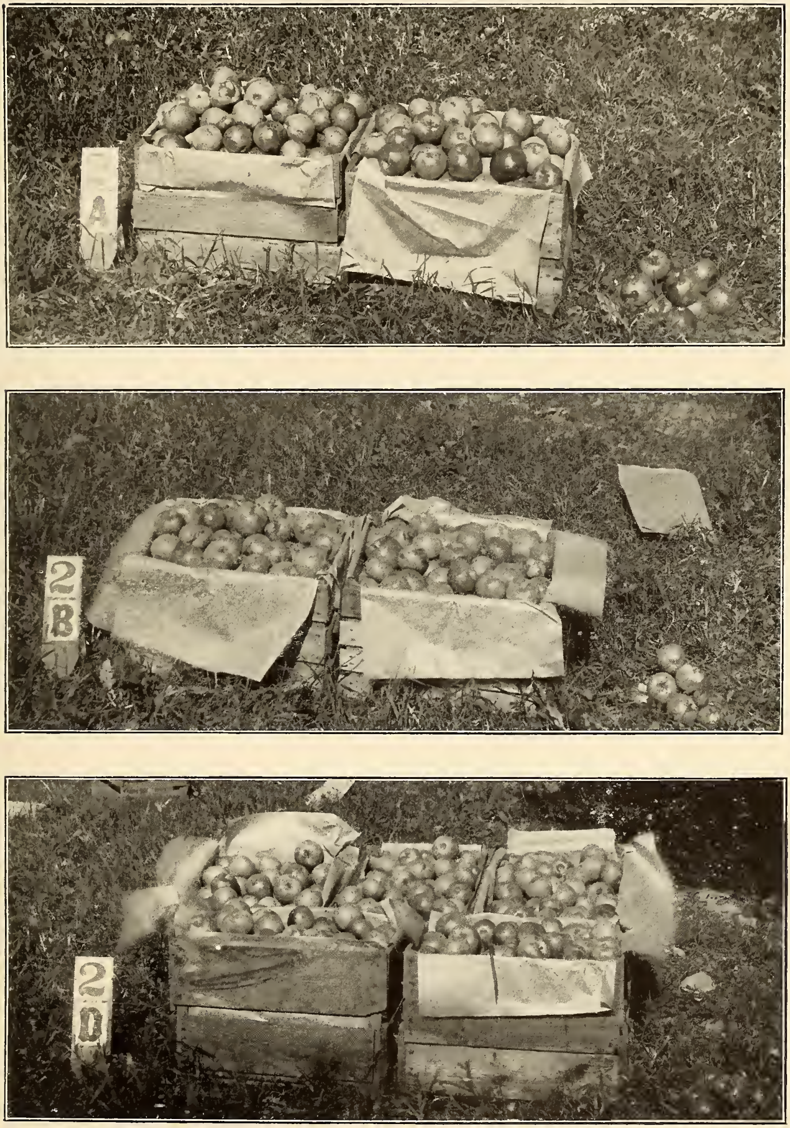
PLATE 2

Codling moth work

Sprayed twice

2a Picked fruit: 414 sound, 27 wormy apples
2b Picked fruit: 347 sound, 15 wormy apples
2d Picked fruit: 941 sound, 13 wormy apples

Plate 2



Sprayed apples

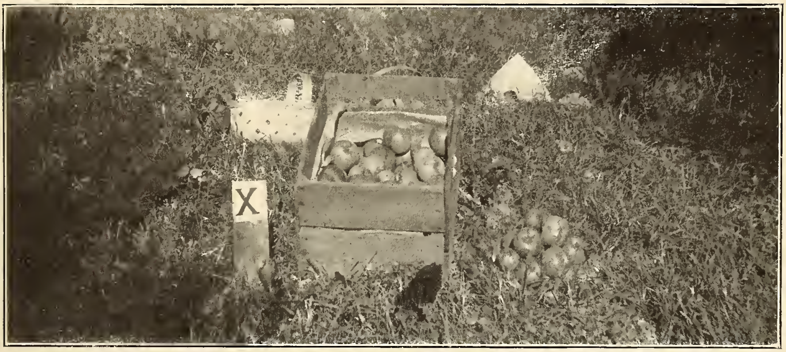
PLATE 3

Codling moth work

Unsprayed or check trees

X Picked fruit: 86 sound, 69 wormy apples
Y Picked fruit: 97 sound, 233 wormy apples

Plate 3



Unsprayed apples

PLATE 4

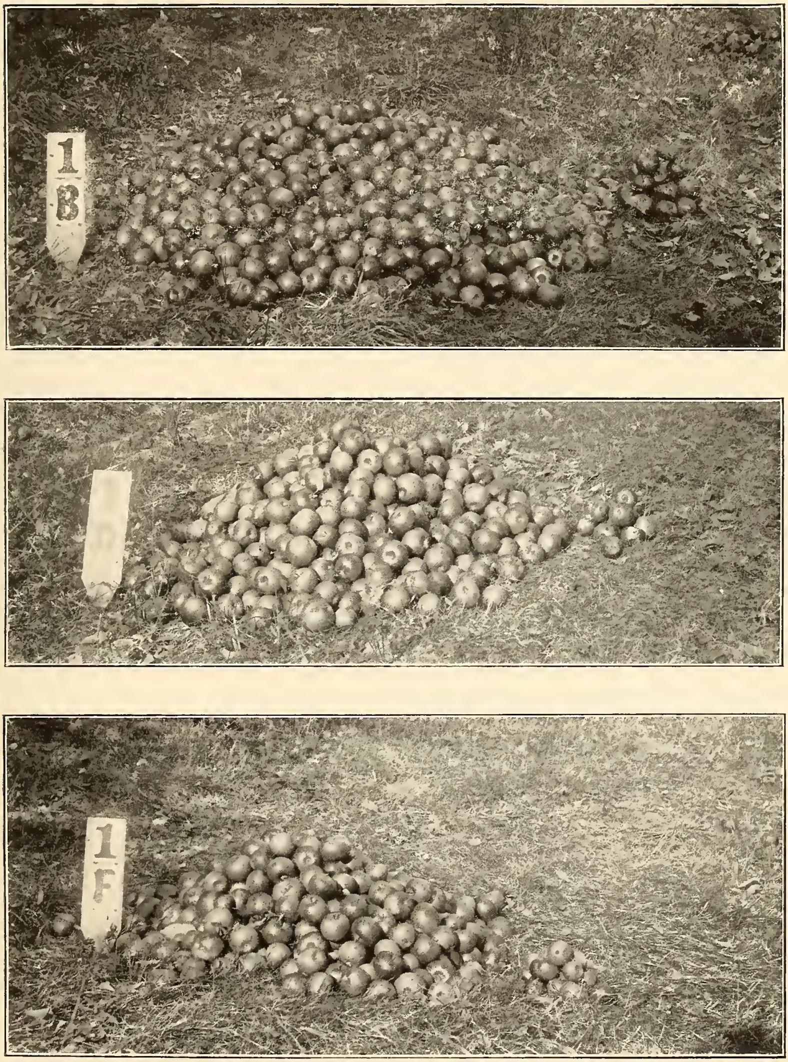
III

Codling moth work

Sprayed but once

1*b* Picked fruit: 1394 sound, 117 wormy apples
1*d* Picked fruit: 703 sound, 82 wormy apples
1*f* Picked fruit: 596 sound, 65 wormy apples

Plate 4



Sprayed apples

PLATE 5

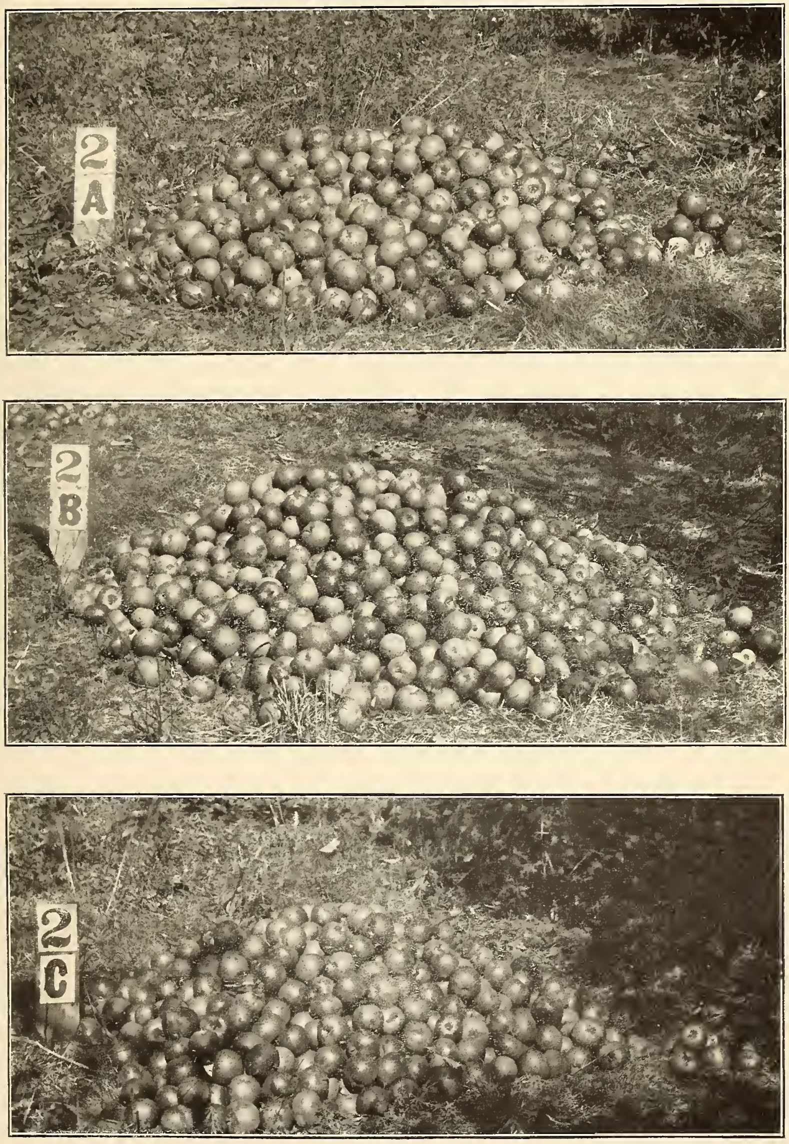
Codling moth work

Sprayed twice

2a Picked fruit: 658 sound, 51 wormy apples
2b Picked fruit: 1501 sound, 88 wormy apples
2c Picked fruit: 760 sound, 52 wormy apples

114

Plate 5



Sprayed apples

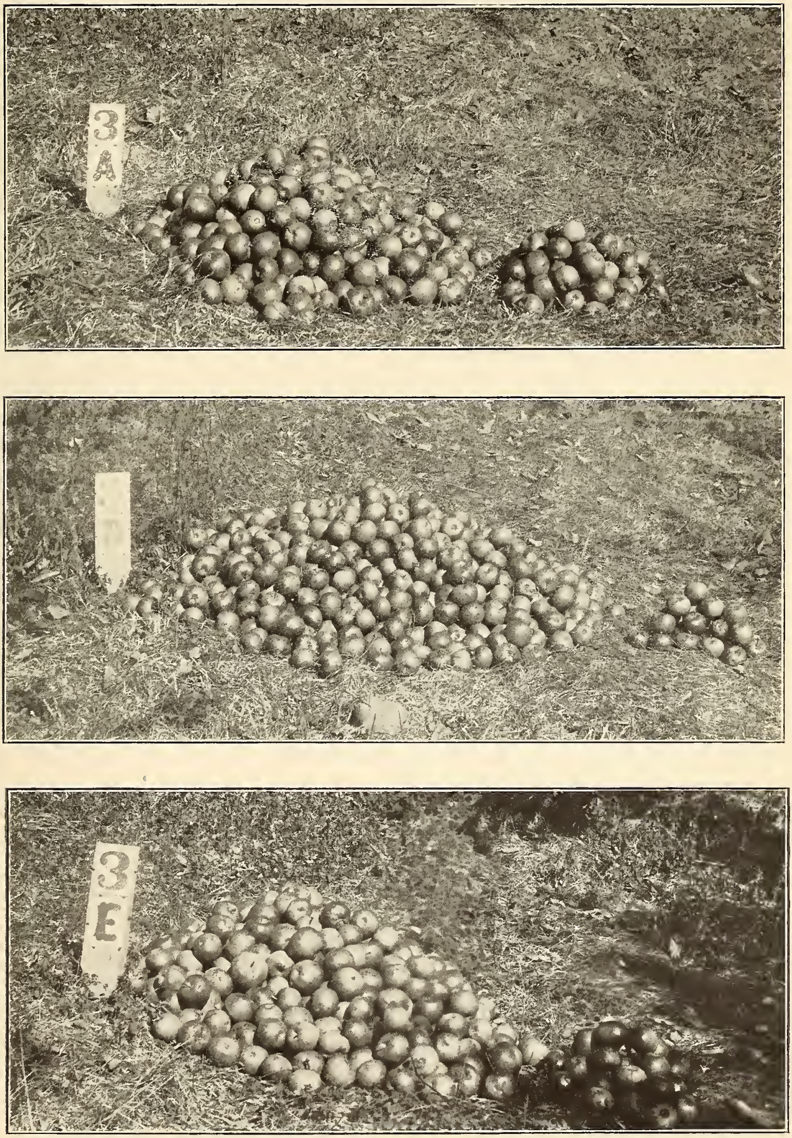
PLATE 6

Codling moth work

One late spraying

3a Picked fruit: 392 sound, 198 wormy apples
3d Picked fruit: 830 sound, 128 wormy apples
3e Picked fruit: 467 sound, 163 wormy apples

Plate 6



Sprayed apples

PLATE 7

Codling moth work

Unsprayed or check trees

X Picked fruit: 120 sound, 47 wormy apples
Y Picked fruit: 317 sound, 325 wormy apples

118

Plate 7

Unsprayed apples

PLATE 8

Codling moth work

Upper figure, Wealthy tree in series 3
Lower figure, Mackintosh tree in series 3, also showing yield of tree 2Y; 125 sound, 250 wormy apples

Plate 8

1

2

Experimental trees

PLATE 9

Codling moth work

Apples showing the characteristic end wormy infestation, also one which has been entered at a slight depression by a larva of the second brood

Plate 9

Wormy apples

PLATE 10

Codling moth work

1 Baldwin showing a moderate amount of bordeaux injury
2 Work of Tortricid followed by codling moth injury

Plate 10

Russeted and wormy fruit

PLATE 11

Codling moth work

Two apples showing work of Tortricid

1 The operations of the insect about the blossom end
2 Its feeding near the end and upon the side of the apple

126

Plate 11

Work of Tortricid on apples

PLATE 12

Codling moth work

1 Baldwin showing a moderate amount of injury by bordeaux mixture
2 Baldwin with more severe injury and incipient cracking, a codling moth entrance in the middle of a crack

Plate 12

Russeting and codling moth injury

PLATE 13

Codling moth work

1 Asymmetrical Ben Davis with one side badly deformed, probably from injury by bordeaux mixture

2 Another apple badly injured though not deformed by bordeaux mixture

Plate 13

Russeted fruit

PLATE 14

Codling moth work

Badly checked apples on unsprayed trees. Such crevices are favorite points for entry by codling moth.

Plate 14

Russeted and checked fruit

PLATE 15

Psyllopsis fraxinicola Först.

Distorted ash leaves, showing work of this species

134

Plate 15

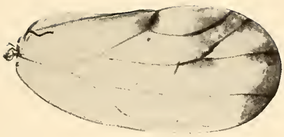
Work of ash psylla

PLATE 16

Psyllopsis fraxinicola Först.

1 Anterior wing, male. x 15
2 Posterior wing, male. x 15
3 Apex of male abdomen, showing genitalia. x 20
4 Apex of female abdomen, showing ovipositor and accessory organs. x 20
5 Head. x 15
6 Antenna, portion of anterior leg and part of rostrum of female. x 30

Plate 16



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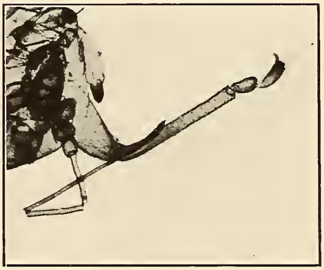


6

Ash psylla

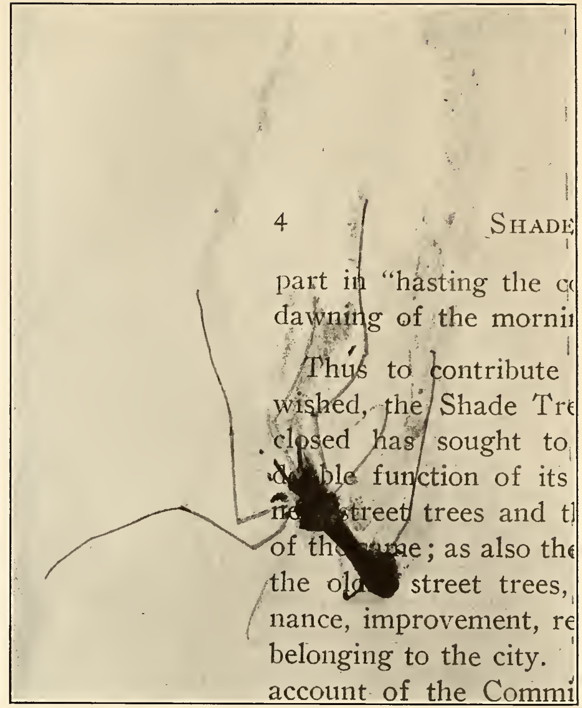
PLATE 17

1 Gall of *Chermes cooleyi* Gill. on blue spruce, natural size

2 A portion of a printed page showing a crane fly which had been pressed into the paper in the calendering process. Natural size

Plate 17

1



2

Spruce gall and crane fly

PLATE 18

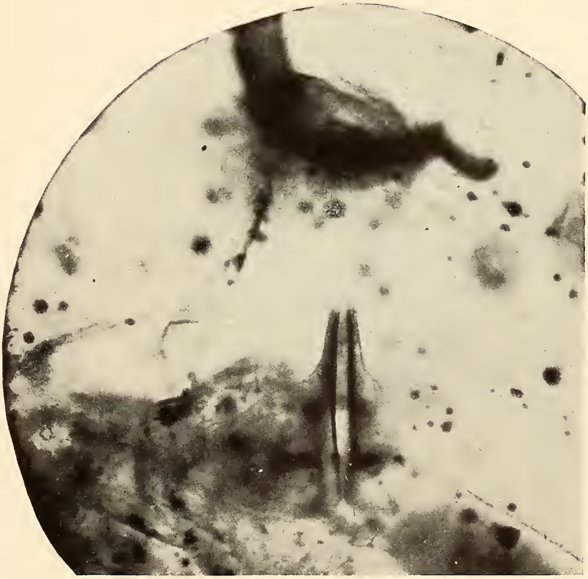
Chermes piceae Ratz.

1 Ventral aspect of female. x 35
2 Posterior extremity showing ovipositor. x 200

140

Plate 18

1



2

Silver fir aphid

PLATE 19

Camponotus herculeanus Linn.

Work of carpenter ant in poplar

142

Plate 19

Work of carpenter ant

PLATE 20

Camponotus herculeanus Linn.

Work of carpenter ant in poplar; another view

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Plate 20

Work of carpenter ant

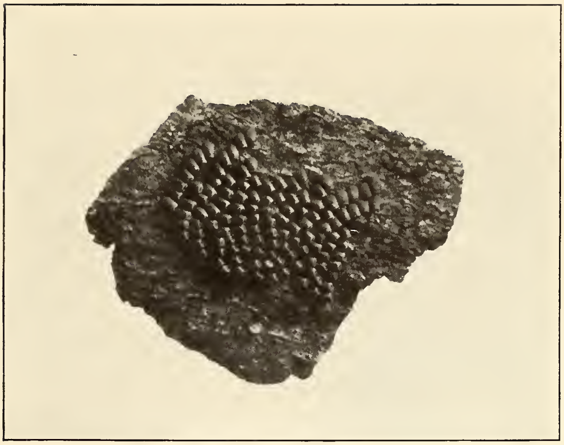
PLATE 21

Snow-white linden moth

1 Snow-white linden moth; eggs, slightly enlarged
2 Adult moths

146

Plate 21



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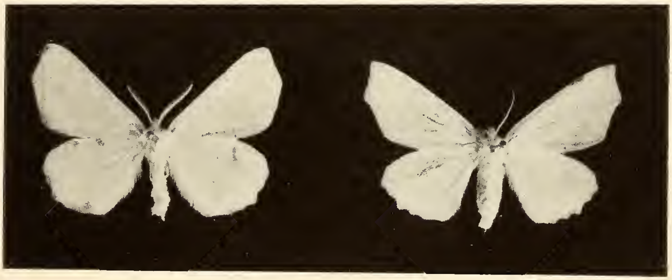


2

Snow-white linden moth

PLATE 22

Miastor ? americana Felt

1 Large, white, living larva chilled. Photographed by reflected light. x 50

Plate 22

Miastor larvae

PLATE 23

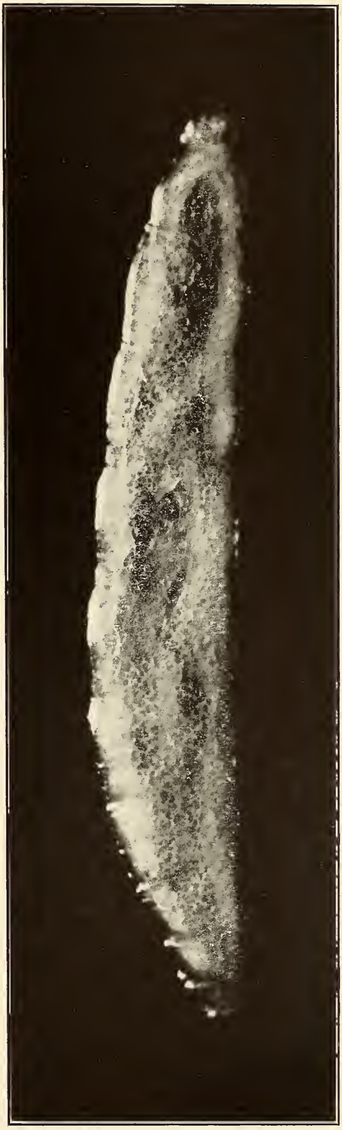
Miastor ? americana Felt

1 Mother larva containing a number of semitransparent embryos. Note cells well filled with adipose tissue. x 50. By reflected light

2 Mother larva containing several semitransparent embryos. Note comparatively few large cells filled with adipose tissue. x 50. By reflected light

Plate 23

1



2

Miastor larvae containing embryos

PLATE 24

Miastor ? americana Felt

1 Mother larva containing several nearly developed embryos. x 50

2 Mother larva containing two nearly developed embryos. Note columns of large cells. x 50

Plate 24

2

1

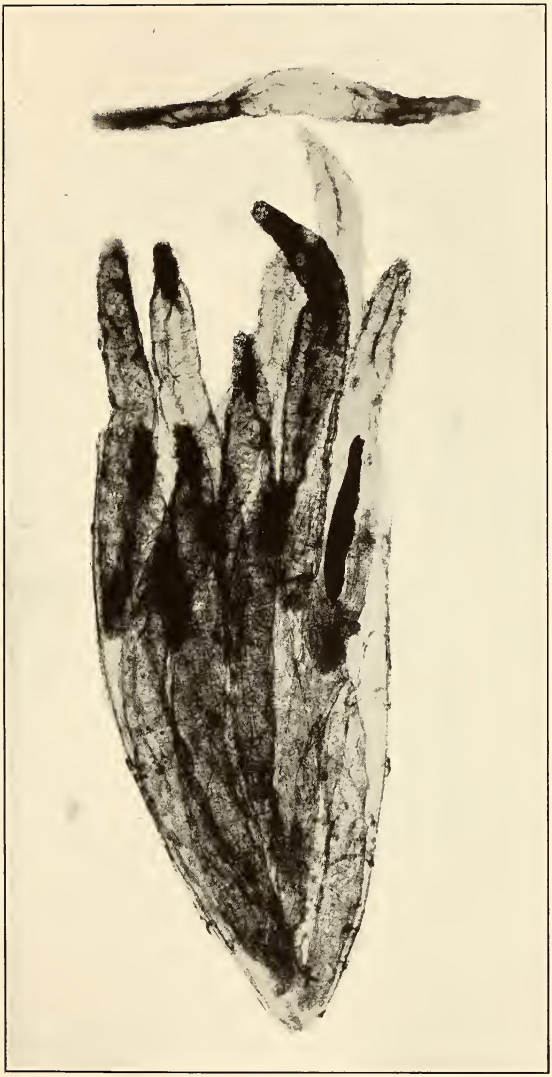
Embryos in Miastor larvae

PLATE 25

Miastor ? americana Felt

Posterior extremity of a large mother larva filled with numerous embryos, one lying free across the broken end. x 100

Plate 25



Miastor embryos

PLATE 26

Miastor ? americana Felt

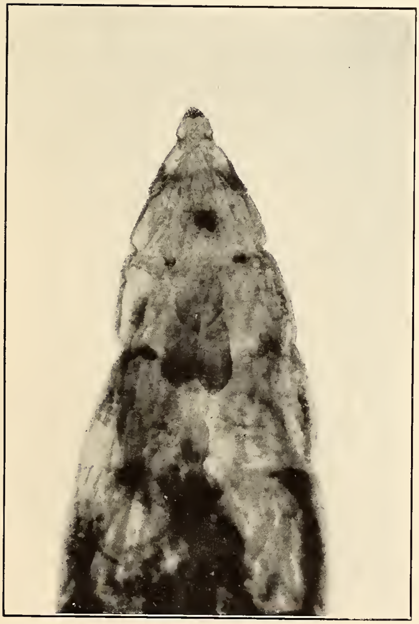
1 Portion of chip showing a number of Miastor larvæ. x 20

2 Head and anterior body segments of larva, showing the shape of the head, with the anterior third fuscous, the short, diverging antennae, the ocular spot and the lobed brain. x 120

3 Posterior extremity of larva, showing cuticular processes at its apex. x 50

Plate 26

1



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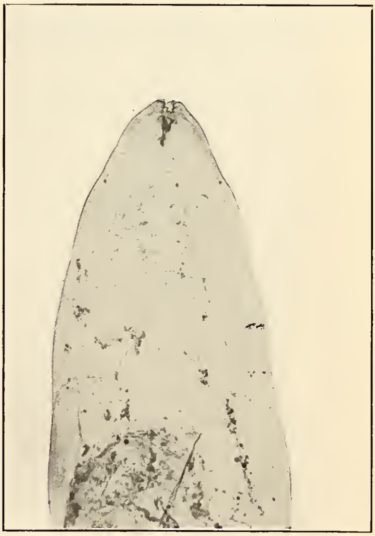


3

Miastor larvae

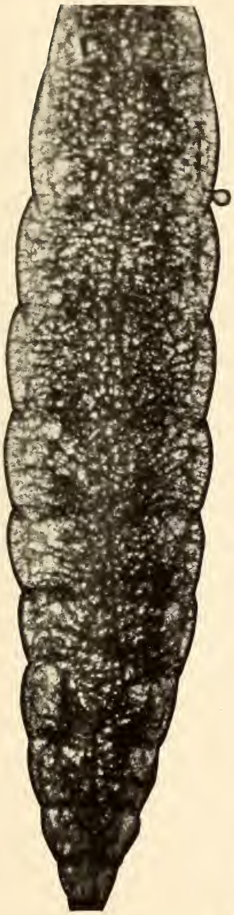
PLATE 27

Miastor ? americana Felt

1 Mother larva filled with partly broken down adipose tissue, the embryos concealed beneath. x 50

2 Embryo in mother larva, showing general outline and an indistinct segmentation along the germinal streak. x 120

Plate 27



1

2

Miastor larvae

PLATE 28

Miastor ? americana Felt

Three segments of a large, white mother larva, showing series of cuboidal cells. x 200

Plate 28

Portion of Miastor larvae

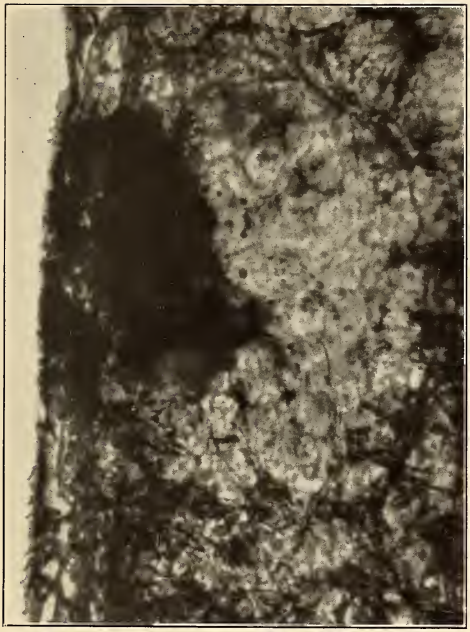
PLATE 29

Miastor ? americana Felt

1 Ovary of mother larva. Note the large-celled, oval mass of tissue near the discolored area. x 325

2 Portion of a band of spines. x 325

Plate 29



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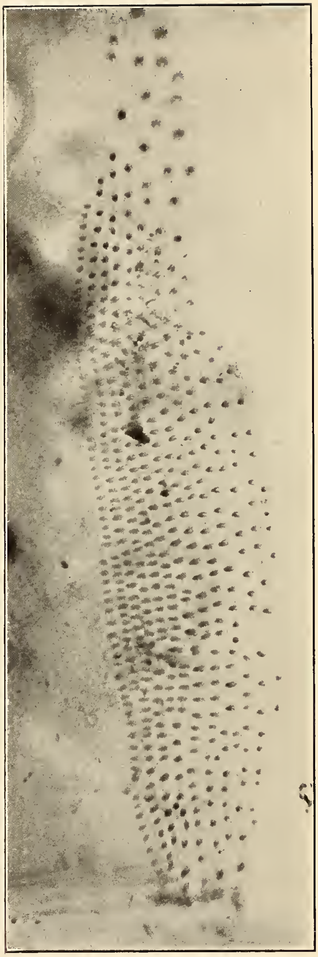


2

Miastor larvae

PLATE 30

163

5

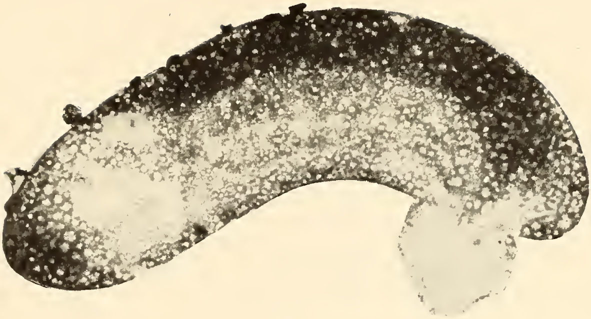
Miastor ? americana Felt

1 Young embryo dissected from a large mother larva and showing a darker strip of ectoderm, a lighter mesodermal area and a dark mass of tissue at the anterior extremity toward the left. x 100

2 Young living embryo lying mostly in the ninth segment of a small, yellowish mother larva. Note the large polar cells at the lower posterior extremity. x 200

3 The same, more enlarged. x 400

Plate 30



1

2

Miastor embryos 3

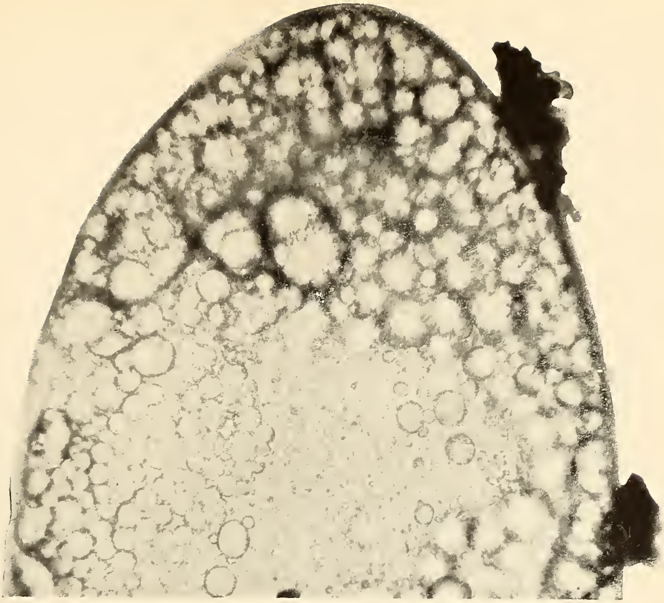
PLATE 31

Miastor ? americana Felt

1 Anterior extremity of embryo illustrated in figure 1 of the preceding plate. x 300

2 Middle portion of same embryo. x 300

Plate 31



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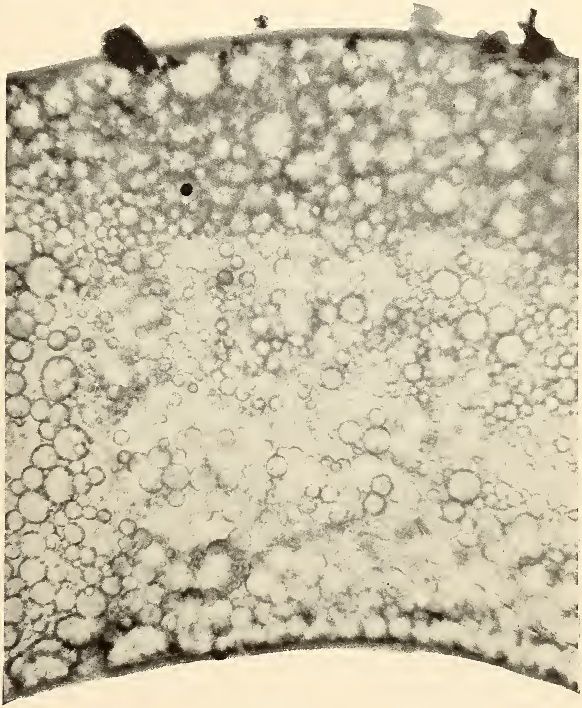


2

Miastor embryos

PLATE 32

Miastor ? americana Felt

1 Living embryo within a small, yellowish larva. Note the distinct germinal streak with its broad projection to one side near the anterior third, and the cephalic cap of fuscous cells. x 100

2 The same embryo photographed 24 hours later and showing some change. This photograph was relatively not as good as the first. x 100

3 The same embryo several days later showing the condition after disintegration has begun. x 100

4 A larger embryo in a small, yellow mother larva extending from her fifth to eighth body segments. Note the great extension of the ectoderm from about the anterior fourth to the posterior fifth, and the cephalic cap of dark cells. x 100

5 Empty skin of a portion of a mother larva. The irregular, dark, longitudinal lines represent tracheae while the transverse fuscous bands are spines on the segments. x 100

Plate 32

1

2

3

4

5

Miastor embryos

PLATE 33

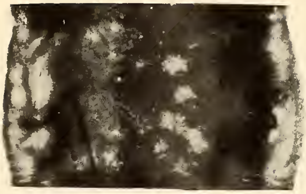
Miastor ? americana Felt

1 A portion of a segment of the larva illustrated on plate 35, figure 1 showing the character of the large-celled median mass of mesoderm. x 200

2 Embryo illustrated on plate 32, figure 1. x 300

3 Enlargement of same embryo from photograph made the following day. x 300

Plate 33



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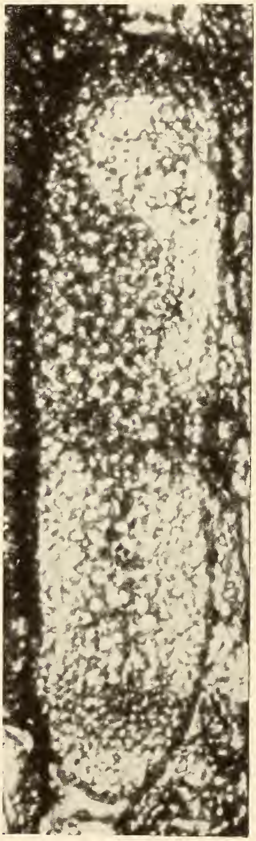


3

2

Miastor embryos

PLATE 34

Miastor ? americana Felt

1 Small, yellowish mother larva containing an embryo extending from the fourth to the eleventh body segments and illustrating an early stage in the development of the mesoderm and adipose tissue. x 75

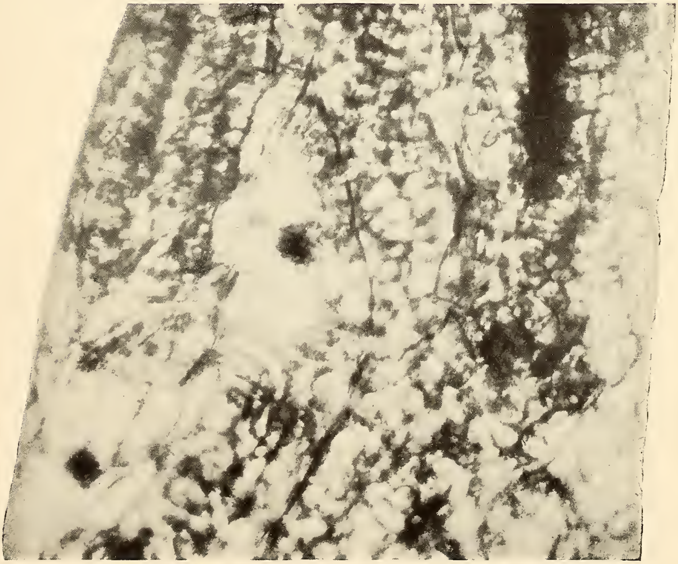
2 Small, somewhat shrunken, yellowish mother larva containing a nearly fully developed embryo, the fuscous anterior portion of the head and the black ocular spot showing distinctly in her posterior (lower) body segments. x 75

3 Portion of a large, white mother larva packed with numerous embryos. The two conspicuous black spots near the middle of lighter areas represent well developed ocular spots of embryos nearly ready to escape. This mother larva contained about 10 such embryos, the heads of three at least, being included in the portion illustrated. x 200

Plate 34

1

2



3

Miastor embryos

PLATE 35

Miastor ? americana Felt

1 Mother larva containing an embryo extending from about the fifth to the tenth body segments and showing an early stage in the development of the mesodermal tissue. x 100. A portion of the latter more enlarged as illustrated on plate 33, figure 1.

2 Small, yellow mother larva containing an embryo extending from the fourth to the twelfth segments and showing in the posterior part of the embryo a conspicuous mass of large-celled mesodermal tissue with distinctly rounded extremities. x 100

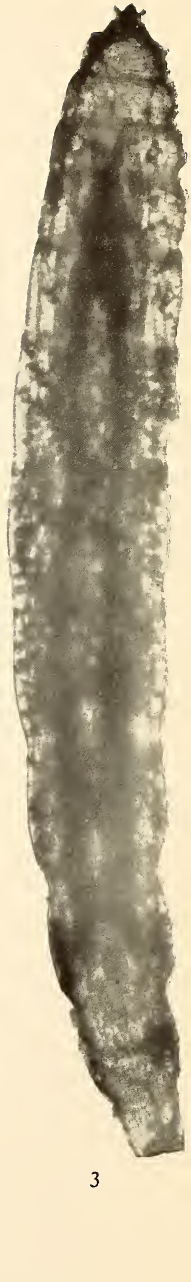
3 Small, yellow mother larva containing a nearly developed embryo showing the three-rowed condition due to an increase in the embryonic adipose tissue and a correlated decrease in the mesoderm. x 100

All on this plate are arranged with the head of the mother larva up, the anterior extremity of the embryo being toward the bottom of the plate.

Plate 35

1

2



3

Miastor embryos

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Appendix 4

Botany

Museum Bulletin 150

150 Report of the State Botanist 1910

Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 495 ALBANY, N. Y. MAY 15, 1911

New York State Museum

JOHN M. CLARKE, Director

CHARLES H. PECK, State Botanist

Museum Bulletin 150

REPORT OF THE STATE BOTANIST 1910

New York State Education Department
Science Division, January 25, 1911

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

SIR: I have the honor to transmit herewith the report of the State Botanist for the fiscal year ending September 30th, 1910, and to recommend the same for publication as a bulletin of the State Museum.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 27th day of January 1911

A. S. Draper

Commissioner of Education

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New York State Museum

JOHN M. CLARKE, Director

CHARLES H. PECK, State Botanist

Museum Bulletin 150

REPORT OF THE STATE BOTANIST 1910

Dr John M. Clarke, Director of State Museum:

I have the honor to submit the following report of work done in the botanical section of the State Museum:

Since the date of my last report specimens of plants for the State herbarium have been collected in the counties of Albany, Chemung, Columbia, Essex, Greene, Livingston, Rensselaer, Saratoga, St Lawrence, Steuben, Ulster and Warren. There have been contributed specimens of plants that were collected in the counties of Albany, Cayuga, Cortland, Delaware, Essex, Franklin, Fulton, Greene, Genesee, Hamilton, Herkimer, Monroe, Nassau, Oneida, Onondaga, Ontario, Orleans, Oswego, Saratoga, Schoharie, St Lawrence, Suffolk, Tompkins, Warren, Washington, Wayne and Wyoming.

There have been received specimens of extralimital species of plants that were collected in Alabama, Colorado, Connecticut, District of Columbia, Florida, Indiana, Kansas, Kentucky, Maine, Massachusetts, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Brunswick, New Jersey, New Mexico, North Carolina, Nova Scotia, Ohio, Ontario, Pennsylvania, Texas, Utah, Washington and Wisconsin.

The number of species of which specimens have been added to the herbarium is 270. This includes contributed and collected specimens. Of this number, 79 species are new to the herbarium and 23 species are believed to be new to science. The new species are all fungi. A list of the added species is marked "Plants added to the herbarium."

The number of those who have contributed specimens is 176. This includes those who sent specimens merely for identification if the specimens were collected in our State and were desirable additions to the herbarium. The number of identifications made of specimens sent or brought to the office by inquirers is 2419. The number of persons for whom identifications were made and the number of identifications made exceed the corresponding numbers, 152 and 1717, for last year. This indicates a gratifying increase in the general desire for botanical information. A list of the names of the contributors and their respective contributions is marked "Contributors and their contributions."

Names and notices of species new to our New York flora and descriptions of new species are given in a chapter marked "Species not before reported."

New localities of rare plants, descriptions of new varieties and any facts of interest that may have been observed are given in a chapter entitled "Remarks and observations."

Species of fungi collected outside our State limits are frequently sent for identification. Sometimes specimens are received that do not correspond to any published description. In such cases the fungus is given a name and a description of it prepared. These names and descriptions make a chapter with the heading "New species and varieties of extralimital fungi."

Specimens of five species of Crataegus, or thorn bushes, have been added to the large number already represented in the herbarium. Four of these have not before been reported and are new to our flora.

Specimens of five species of mushrooms have been collected and their edible qualities tried and approved. These make the whole number of our New York edible species and varieties 205. Three plates have been prepared on which the five added species are represented by colored figures, natural size. Descriptions of these species may be found in a chapter on "Edible fungi." Two other plates have been prepared on which three new species of mushrooms are represented.

One species has been tried which, when eaten freely, causes a profuse perspiration but no other inconvenience. Its flavor, texture and digestibility are faultless, but its effects are such as to place it among medicinal, not edible, mushrooms. My attention was first called to this peculiar character of the mushroom by Mr F. G. Howland and through his kindness in furnishing me samples of it I have been able to verify its sudorific properties. Perhaps experimentation may prove it to be useful in cases of illness where a sudorfic medicine is desirable. An account of my experiment may be found under the name Clitocybe dealbata sudorifica, in the chapter entitled "Remarks and observations."

Having been informed that the raspberry patches of the fruit growers in the vicinity of Marlboro, Ulster county, were suffering from disease and wishing to know the cause of it, a visit was made to that place in July. An examination of the diseased canes showed that they were suffering from an attack of a parasitic fungus whose botanical name is Sphaerella rubina Pk. The fruiting canes develop their leaves and flowers as usual but before the fruit ripens it withers and dries on the branches. The dryness of the season and an attack of "red spider" on the foliage were apparently contributing causes of the failure of the crop and the loss was severe. The diseased canes bore patches of the fungus. It matures its spores early in the season. In the type specimens they were found in May. The young canes showed brown or blackish patches one or two inches long on the lower part. In some cases they were near the ground, thereby indicating a probable infection while they were but a few inches tall. These spots had not yet developed their perithecia or spore cases but doubtless would toward the end of the season and next spring be ready to shed their spores and renew the species in the succeeding crop of young canes. Theoretically the disease should be prevented by spraying the young canes with a good fungicide like Bordeaux mixture or lime sulfur mixture, but it would be necessary to give the first spraying when the young shoots are only three or four inches high. This should be repeated once a week till the canes of the previous year begin to blossom.

While there, my attention was called to a diseased chestnut tree. It was a young tree with sickly looking foliage and a few dead branches. It was suffering from the chestnut bark disease caused by a parasitic bark fungus. Both branches and trunk were affected by the fungus, the latter but a few feet above the ground. It was my first opportunity to see a tree affected by this disease about which much that appears to me to be overdrawn and needlessly alarming has recently been published in magazines and newspapers. Remarks concerning its distribution in our State are given under the name Valsonectria parasitica (Murr.) Rehm in the chapter headed "Remarks and observations."

In 1899 a census of the flowering plants and ferns of Bonaparte swamp was taken and a list of the species was published in the report of the Botanist for that year. The swamp is a large one lying in the northern part of Lewis county a short distance east of Lake Bonaparte. It is about two miles in diameter where the Carthage and Adirondack Railroad crosses it. The number of species of flowering plants and ferns found in it is 128.

The swamps and peat marshes of the State are a part of our natural resources. When cleared, drained, and properly cultivated they constitute some of our most valuable agricultural lands. Their gradual formation from a water surface to a land surface is interesting and due chiefly to the agency of plants. If the original pond or lake is very shallow its whole surface, except the central channel through which the stream flows, is occupied by aquatic plants. These by their annual growth and partial decay form a sedimentary deposit which gradually fills the lake until water-loving mosses, sphagnum, and other marsh plants take possession. When this has taken place we have a sphagnum marsh. If the lake is deep in the center the marsh forms only along the shallow margins. By the yearly growth and decay of the plants of the sphagnum marsh its surface gradually becomes firmer and small shrubs and herbs of wet places take possession. When the shrubs predominate it is called a shrubby marsh; when marsh grasses and sedges are the prevailing vegetation it is a grassy marsh. In due time the surface of the shrubby marsh becomes sufficiently firm to sustain and support certain kinds of trees whose roots do not object to an abundant and constant supply of moisture. When this stage has been reached we have a swamp, a low wet piece of woods covered with trees and tall shrubs. The border of a marsh may be and often is a wooded swamp which is itself merely an older part of the marsh. The grassy marsh appears to be less inviting to the advent of trees than the sphagnum marsh, and prairielike, it often remains open an indefinite time. Among the natural products of our marshes are the two species of cranberries, the large or common cranberry and the small cranberry, the mosses used by florists and nurserymen for packing material and the peat used as an absorbent or bedding in stables and ultimately in this way as a component of the stable manure. The more firm and fibrous peat from bushy marshes is used for various purposes requiring a fibrous material and for heating purposes. The grasses and sedges of the grassy marsh are sometimes cut for hay, but this is rarely done except in cases of scarcity or very high prices of hay of better quality. The sedges of certain species are sometimes utilized in making "crex carpets" and various articles of furniture.

That we may have a more definite knowledge of the species of plants that are most prevalent in our marshes, and consequently the most common agents in transforming our marshes into a more useful condition, a list of the flowering plants and ferns of two of our marshes has been made. This list, with a description of the marshes, will be found in a chapter entitled " Cranberry and Averyville marshes."

In accordance with the plan previously adopted, a revision of our species of Hypholoma and Psathyra has been made. The descriptions have been rewritten and the species arranged in the groups or sections in which they were distributed by Fries, and the usual " keys " prepared. The chapters containing these descriptions are respectively entitled " New York species of Hypholoma " and " New York species of Psathyra."

The coincidence between a plentiful crop of wild mushrooms and good crops of staple agricultural products has been noticed in previous reports. The past season has furnished a noticeable confirmation of the results of previous observations. While the usual summer drouth in the eastern and southeastern parts of the State was quite severe and wild mushrooms correspondingly scarce, in other parts of the State the rainfall has been more abundant and the crop of wild mushrooms has been plentiful. One correspondent writing from Silver Springs, Wyoming county, in speaking of one of his collecting excursions, says, " I am swamped with the number and variety of mushrooms now growing in the woods. It seems that I find a new kind at almost every step. I had a market basket full of specimens which comprised about fifty species." Another correspondent writing from Fourth lake, Herkimer county, says, " Mushroom hunting has been very delightful here this season. I have found so many fine specimens I could not keep pace with them."

The season has been specially favorable to the development of the giant puffball, Calvatia gigantea (Batsch). They have appeared in unusual numbers and, in some cases, of unusual size. A correspondent writing from Pittsford, Monroe county, says, "I am sending you a specimen of Calvatia gigantea weighing seven pounds. They are very plentiful here this season. I have seen thirty-five or more, one weighing twelve pounds." A single one of medium size, that is, eight to ten inches in diameter, is sufficient to afford a meal to a family of ordinary size. The same correspondent says " Puffballs are growing here by the hundred and we are enjoying them very much. Mushrooms in this part of the country are very plentiful." The giant puffball usually grows in open places and but one or two in a place, but in New Lebanon, Columbia county, there is a station shaded by young deciduous trees where I saw about a dozen specimens growing in close proximity to each other.

Mr S. H. Burnham, my assistant, has continued the clerical work of the office, doing all the typewriting of labels, letters and reports, attending to the correspondence of the office during my absence on collecting trips, preparing, disinfecting, labeling and arranging the specimens in their proper places, and aiding in the identification of specimens. He has also aided in the investigation of the pine rust that has been proving injurious to young plantations of white pine.

Respectfully submitted

CHARLES H. PECK

State Botanist

Albany, December 28, 1910

PLANTS ADDED TO THE HERBARIUM

New to the herbarium

Amanita bisporigera *Atk.*
A. floccocephala *Atk.*
A. velatipes *Atk.*
Ascochyta menyanthis *Oud.*
Aulographum ledi *Pk.*
Biatora coarctata (*Sm.*) *Nyl.*
Calvatia craniiformis (*Schw.*)
Camelina sativa (*L.*) *Crantz*
Cercospora phlogina *Pk.*
Cladosporium paeoniae *Pass.*
Climacium kindbergii (*R. & C.*)
Clitocybe biformis *Pk.*
C. maxima *G. & M.*
Cortinarius croceofolius *Pk.*
C. glaucopus (*Schaeff.*)
C. napus *Fr.*
C. triumphans *Fr.*
Crataegus aristata *S.*
C. brainerdi *S.*
C. calvini *S.*
C. longipedunculata *S.*
C. nemorosa *S.*
Crepis setosa *Hall. f.*
Cryptosporium macrospermum *Pk.*
Cycloloma atriplicifolium (*Spreng.*)
Cytospora microspora (*Cd.*) *Rabenh.*
Diplodia linderae *E. & E.*
Eccilia mordax *Atk.*
Eurotium subgriseum *Pk.*
Gloeosporium caryae *E. & D.*
G. divergens *Pk.*
Grindelia squarrosa (*Pursh*) *Dunal*
Helianthus petiolaris *Nutt.*
Heterothecium pezizoideum (*Ach.*)
Hygrophorus caprinus (*Scop.*) *Fr.*
Hypericum prolificum *L.*
Hypholoma delineatum *Pk.*
Hypochnus tristis *Karst.*
Inocybe rimosoides *Pk.*
Lactarius boughtoni *Pk.*
Lentinus piceinus *Pk.*
Lychnis coronaria (*L.*) *Desr.*
Machaeranthera pulverulenta (*Nutt.*)
Macrosporium heteronemum (*Desm.*)
Marasmius contrarius *Pk.*
Myxosporium carpini *Pk.*
Naemospora croceola *Sacc.*
Naucoria sororia *Pk.*
Oidium asteris-punicei *Pk.*
Oxybaphus floribundus *Chois.*
Pertusaria leioplaca (*Ach.*)
Pholiota terrigena *Fr.*
Phoma piceina *Pk.*
P. simillima *Pk.*
P. stictica *B. & Br.*
Phyllosticta betae *Oud.*
P. subtilis *Pk.*
Physcia hispida (*Schreb.*)
Picris hieracioides *L.*
Pilocratera abnormis *Pk.*
Placodium ferrug. discolor *Willey*
Plasmodiophora elaeagni *Schroet.*
Pleurotus approximans *Pk.*
Ramalina rigida (*Pers.*) *Tuck.*
Rhabdospora physostegiae *Pk.*
Scirpus occidentalis (*Wats.*) *Chase*
Sideranthus gracilis (*Nutt.*) *Rydb.*
Sphaeropsis smilacis latispora *Pk.*
Sporotrichum grisellum *Sacc.*
Theloschistes flavicans *Wallr.*
Thlaspi perfoliatum *L.*
Trichothecium subgriseum *Pk.*
Triosteum perfoliatum *L.*
Usnea trichodea *Ach.*
Vermicularia beneficiens *Pk.*
V. pomicola *Pk.*
Verticillium agaricinum (*Lk.*) *Cd.*
Viburnum venosum *Britton*
Vicia villosa *Roth*

Not new to the herbarium

Acalypha virginica *L.*
Agaricus abruptibulbus *Pk.*
A. arvensis *Schaeff.*
Alisma plantago-aquatica *L.*
Ambrosia artemisiifolia *L.*
Amelanchier oblongifolia (*T. & G.*)
Antennaria neglecta *Greene*
Apocynum cannabinum *L.*

Arabis laevigata (*Muhl.*) *Poir*
Arceuthobium pusillum *Pk.*
Aristolochia clematitis *L.*
Artemisia biennis *Willd.*
Asclepias syriaca *L.*
Aspidium thelypteris (*L.*) *Sw.*
Aster laevis *L.*
A. schreberi *Nees*
A. undulatus *L.*
Astragalus neglecta (*T. & G.*) *Sheld.*
Barbarea stricta *Andrz.*
Boletinus paluster *Pk.*
Boletus clintonianus *Pk.*
B. elbensis *Pk.*
B. parasiticus *Bull.*
Brassica arvensis (*L.*) *Ktze.*
Broussonetia papyrifera (*L.*)
Calvatia gigantea (*Batsch*)
Calyptospora goeppertiana *Kuehn*
Camelina microcarpa *Andrz.*
Cantharellus infundibuliformis (*Scop.*)
Cardamine parviflora *L.*
Carex canescens *L.*
C. longirostris *Torr.*
Centaurium umbellatum *Gilib.*
Cerastium viscosum *L.*
Ceratiomyxa fruticulosa (*Muell.*)
Cladosporium carpophilum *Thuem.*
Cinna arundinacea *L.*
C. latifolia (*Trev.*) *Griseb.*
Collybia butyracea (*Bull.*) *Fr.*
Cornus canadensis *L.*
Coronilla varia *L.*
Cortinarius sanguineus *Fr.*
Crataegus apposita *S.*
C. colorata *S.*
C. dissociabilis *S.*
C. dissona *S.*
C. foetida *Ashe*
C. grayana *Eggle.*
C. inopinata *S.*
C. inusitula *S.*
C. leiophylla *S.*
C. pellecta *S.*
C. punctata *Jacq.*
C. recta *S.*
C. spatifolia *S.*
C. succulenta *Lk.*
C. tenuiloba *S.*
Cryptotaenia canadensis (*L.*)
Cynoglossum officinale *L.*
Cynosurus cristatus *L.*
Cyperus grayi *Torr.*
Daphne mezereum L.
Daucus carota *L.*
Desmodium canescens (*L.*) *DC.*
Epilobium hirsutum *L.*
Erechtites hieracifolia (*L.*) *Raf.*
Eriophorum callitrix *Cham.*
E. virginicum *L.*
Erysiphe polygoni *DC.*
Eupatorium hyssopifolium *L.*
E. purpureum *L.*
Euphorbia corollata *L.*
E. peplus *L.*
Fusicladium dendriticum (*Wallr.*)
Galium aparine *L.*
G. palustre *L.*
Gentiana quinquefolia *L.*
Gerardia maritima *Raf.*
G. purpurea *L.*
G. virginica (*L.*) *BSP.*
Gnaphalium uliginosum *L.*
Habenaria dilatata (*Pursh*) *Gray*
Hedeoma hispida *Pursh*
Helvella crispa (*Scop.*) *Fr.*
H. gracilis *Pk.*
Herpotrichia diffusa (*Fckl.*)
Hieracium canadense *Mx.*
H. murorum *L.*
Hordeum jubatum *L.*
H. trifurcatum *Jacq.*
Hydrastis canadensis *L.*
Hygrophorus eburneus (*Bull.*) *Fr.*
Hypholoma appendiculatum (*Bull.*)
Hex verticillata (*L.*) *Gray*
Ilex verticillata (*L.*) *Gray*
Juncus bufonius *L.*
Kalmia polifolia *Wang.*
Lechea racemulosa *Mx.*
Lenzites sepiaria *Fr.*
Leontodon nudicaulis (*L.*) *Banks*
Lepidium campestre (*L.*) *R. Br.*
L. draba *L.*
Lepiota procera (*Scop.*) *Fr.*
L. rubrotincta *Pk.*
Liatris scariosa *Willd.*
Lithospermum arvense *L.*
L. officinale *L.*
Lotus corniculatus *L.*
Luzula spicata (*L.*) *DC.*

Lycoperdon atropurpureum *Vitt.*
Massariella scoriadea (*Fr.*) *Sacc.*
Melissa officinalis *L.*
Mitrula cucullata *Fr.*
Monarda fistulosa *L.*
Monilia crataegi *Diedicke*
Mycogone cerv. subincarnata *Pk.*
Myrica asplenifolia *L.*
Oidium destruens *Pk.*
Onosmodium hispidissimum *Mack.*
Osmorhiza slaytoni (*Mx.*) *Clarke*
Osmunda cinnamomea *L.*
Panax quinquefolium *L.*
Panicum agrostoides *Spreng.*
P. amarum *Ell.*
P. boreale *Nash*
P. scribnerianum *Nash*
P. spretum *Schultes*
Paspalum circulare *Nash*
P. muhlenbergii *Nash*
P. setaceum *Mx.*
Phyllosticta podophylli (*Curt.*)
Picea mariana (*Mill.*) *BSP.*
Plantago elongata *Pursh*
P. media *L.*
Polygonum prolificum (*Small*)
Polypodium vulgare *L.*
Polyporus circinatus *Fr.*
P. frondosus *Fr.*
P. pubescens (*Schum.*) *Fr.*
Potamogeton americanus *C. & S.*
Prunus cuneata *Raf.*
P. pennsylvanicus *L. f.*
Puccinia rubigo-vera (*DC.*) *Wint.*
Ribes prostratum *L'Her.*
Roestelia aurantiaca *Pk.*
Rudbeckia laciniata *L.*
Rumex hastatulus *Baldw.*
Russula brevipes *Pk.*
Sabatia stellaris *Pursh*
Sagina decumbens (*Ell.*) *T. & G.*
Salix petiolaris *Sm.*
S. purpurea *L.*
S. rostrata *Richards.*
S. tristis *Ait.*
Scirpus olneyi *Gray*
Sedum purpureum *Tausch*
Septoria violae *West.*
Serapias helleborine *L.*
Setaria verticillata (*L.*) *Bv.*
Solidago neglecta *T. & G.*
Sparganium minimum *Fr.*
Spartina patens juncea (*Mx.*)
Spergularia marina (*L.*)
Sphaeronema acerinum *Pk.*
Sphaerotheca humuli (*DC.*)
Sphenopholis pallens (*Spreng.*)
Spirea latifolia *Borkh.*
Sporobolus cryptandrus (*Torr.*)
Steironema ciliatum (*L.*) *Raf.*
Stipa avenacea *L.*
Teucrium canadense *L.*
T. occidentale *Gray*
Thaspium barbinode (*Mx.*) *Nutt.*
Thymus serpyllum *L.*
Tilia michauxii *Nutt.*
Tricholoma vaccinum (*Pers.*) *Fr.*
Trichostemma dichotomum *L.*
Tridens flavus (*L.*) *Hitchc.*
Urtica lyalli *Wats.*
Ustilago longissima (*Sow.*)
U. zeae (*Beckm.*) *Ung.*
Vaccinium atrococcum (*Gray*)
V. macrocarpon *Ait.*
V. oxycoccos *L.*
Valsonectria parasitica (*Murr.*)
Veronica anagallis-aquatica *L.*
Viburnum dentatum *L.*
V. pauciflorum *Raf.*
Vicia americana *Muhl.*
V. angustifolia (*L.*) *Reich.*
Viola Blanda *Willd.*
Viola pallens *(Banks) Brain.*

CONTRIBUTORS AND THEIR CONTRIBUTIONS

Miss L. C. Allen, Newtonville, Mass.

Lentinus spretus *Pk.*
Lepiota allenae *Pk.*

Miss H. C. Anderson, Lambertville, N. J.

Boletus albus *Pk.*
Psathyrella graciloides *Pk.*

Miss F. Beckwith, Rochester

Aster laevis *L.*
Helianthus petiolaris *Nutt.*
Leontodon nudicaulis (*L.*) *Banks*
Lotus corniculatus *L.*
Machaeranthera pulverulenta (*Nutt.*)
Sideranthus gracilis (*Nutt.*) *Rydb.*

Mrs E. B. Blackford, Boston, Mass.

Clavaria pulchra *Pk.*
Flammula graveolens *Pk.*
Hebeloma mesophaeum *Fr.*
Naucoria myosotis *Fr.*

Miss E. S. Blunt, Elizabethtown

Ambrosia artemisiifolia *L.*

Miss G. S. Burlingham, New York

Lactarius glyciosmus *Fr.*

Miss M. C. Burns, Middleville

Lepiota procera (Scop.) *Fr.*

Mrs C. F. Davis, Portland, Me.

Peziza aurantia *Pers.*

Mrs E. P. Gardner, Canandaigua

Astragalus neglectus (*T. & G.*)
Cryptataenia canadensis (*L.*) *DC.*
Lychnis coronaria (*L.*) *Desr.*
Melissa officinalis *L.*
Monarda fistulosa *L.*
Steironema ciliatum (*L.*) *Raf.*
Teucrium occidentale *Gray*

Mrs L. L. Goodrich, Syracuse

Centaureum umbellatum *Gilib.*
Daphne mezereum *L.*
Lepidium draba *L.*

Miss A. Hibbard, West Roxbury, Mass.

Entoloma cyaneum *Pk.*
Lactarius colorascens *Pk.*
Naucoria myosotis *Fr.*
Pholiota duroides *Pk.*
Russula bresadolae *Schulz*

Mrs S. Manning, St Paul, Minn.

Flammula flavida *Pers.*

Miss E. W. Mische, Syracuse

Daphne mezereum *L.*

Mrs C. E. Putnam, St Paul, Minn.

Flammula flavida *Pers.*

Mrs S. W. Russell, Glens Falls

Polypodium vulgare *L.*

Mrs F. C. Sherman, Syracuse

Clitocybe maxima *G. & M.*
Stropharia depilata *Pers.*

Miss A. Van Horne, Montreal, Can.

Cantharellus brevipes *Pk.*

Miss E. C. Webster, Canandaigua

Crataegus calvini *S.*
C. gemmosa *S.*
C. longipedunculata *S.*
Cynosurus cristatus *L.*
Hieracium murorum *L.*
Plantago media *L.*
Puccinia rubigo-vera (*DC.*) *Wint.*
Scirpus occidentalis (*Wats.*)
Scrapias helleborine *L.*
Setaria verticillata (*L.*) *Bv.*
Vicia americana *Muhl.*

Miss H. Whalen, Ballston Spa

Agaricus campester hortensis *Cke.*

Mrs M. E. Whetstone, Minneapolis, Minn.

Flammula pulchrifolia *Pk.*
Lentinus tigrinus (*Bull*) *Fr.*
Lepiota rubrotincta *Pk.*
Mycogone cerv. subincarnata *Pk.*
Psathyrella caudata *Fr.*
Tubaria inquilina *Fr.*
Volvaria peckii *Atk.*
V. speciosa *Fr.*

F. H. Ames, Brooklyn

Amanita radicata *Pk.*
Boletus vermiculosus *Pk.*
Lactarius torminosus *Fr.*
Usnea trichodea *Ach.*

G. F. Atkinson, Ithaca

Amanita bisporigera *Atk.*
A. floccocephala *Atk.*
A. velatipes *Atk.*
Bubakia crotonis (*Cke.*) *Arth.*
Collybia familia *Pk.*
Craterellus cornucopioides (*L.*)
Eccilia mordax *Atk.*
Eocronartium typhuloides *Atk.*
Hygrophorus caprinus (*Scop.*) *Fr.*
H. chrysodon (*Batsch*)
H. luridus *B. & C.*
Hypholoma boughtoni *Pk.*
Kuehneola albida (*Kuehn*) *Magn.*
Lactarius camphoratus (*Bull.*)
Naucoria sororia *Pk.*
Panaeolus papilionaceus *Fr.*
Pholiota terrigena *Fr.*
Plasmopara halstedii (*Farl.*)
Polyporus caeruleoporus *Pk.*
Russula crustosa *Pk.*
Sporotrichum grisellum *Sacc.*
Uromyces appendiculatus (*Pers.*)

G. G. Atwood, Albany

Cryptosporium macrospermum *Pk.*
Roestelia aurantiaca *Pk.*
Sphaerotheca humuli (*DC.*) *Burr.*

H. J. Banker, Greencastle, Ind.

Hydnum combinans *Pk.*
H. farinaceum *Pers.*
Hydum populinum *Pk.*
Irpex ambiguus *Pk.*

E. Bartholomew, Stockton, Kan.

Basidiophora kellermanii (*E. & H.*)
B. kell. paupercula *Pk.*
Bertia querceti *Rehm*
Bispora effusa *Pk.*
Cercospora clavata (*Ger.*) *Pk.*
C. verbenae-strictae *Pk.*
Coniosporium arundinis (*Cd.*) *Sacc.*
C. perplexum *Pk.*
Crucibulum vulgare *Tul.*
Cyathus striatus schweinitzii *Tul.*
Cylindrosporium conservans *Pk.*
C. padi cerasina *Pk.*
Daedalea unicolor (*Bull.*) *Fr.*
Dasyscypha bicolor (*Bull.*) *Fckl.*
Diaporthe alnea *Fckl.*
D. callicarpae *Pk.*
Diatrype bullata (*Hoffm.*) *Fr.*
Diplodia alni-rubrae *Pk.*
Eutypella ailanthi *Sacc.*
E. stellulata (*Fr.*) *Sacc.*
Helminthosoporium macrocarpum *Grev.*
H. subapiculatum *Pk.*
Hormiscium ambrosiae *Pk.*
Hymenochaete rubiginosa (*Schrad.*)
H. tabacina (*Sow.*) *Lev.*
Hypochnus sambuci (*Pers.*) *Fr.*
Hypoxylon bartholomaei *Pk.*
Hypoxylon fuscum (*Pers.*) *Fr.*
Leptosphaeria sambuci *Fautr.*
Leptothyrium punctiforme *B. & C.*
Macrosporium sarcinula *Berk.*
Melanconis anomala *Pk.*
Melanconium bicolor candidum *Pk.*
Melanomma pulvis-pyrius (*Pers.*)
Merulius corium *Fr.*
Microdiplodia viciae *Pk.*
Microsphaera alni (*Wallr.*) *Salm.*
Ovularia rigidula *Delac.*
O. stachydis-ciliatae *Pk.*
Phleospora mori (*Lev.*) *Sacc.*
Phyllosticta paupercula *Pk.*
Polystictus abietinus *Fr.*
Ramularia virgaurea *Thuem.*
Septoria aceris-macrophylli *Pk.*
S. ficarioides *Pk.*
S. samarae *Pk.*
Sphaerella gaultheriae *C. & P.*
S. rumicis (*Desm.*) *Cke.*
Sphaeromyces delphinii *Pk.*
Sphaeropsis melanconioides *Pk.*
Trimmatostroma americana *Thuem.*
Uredo quercus *Broud.*
Valsa minutella *Pk.*
V. salicina tetraspora (*Curr.*)
Valsella salicis *Fckl.*

M. S. Baxter, Rochester

Cinna arundinacea *L.*
Epilobium hirsutum *L.*
Euphorbia corollata *L.*
Helianthus petiolaris *Nutt.*
Hieracium canadense *Mx.*
Onosmodium hispidissimum *Mack.*
Panicum boreale *Nash.*
P. scribnerianum *Nash*
Panicum spretum *Schultes*
Paspalum muhlenbergii *Nash*
Rynchospora alba (*L.*) *Vahl*
Sideranthus gracilis (*Nutt.*) *Rydb.*
Solidago neglecta *T. & G.*
Sphenopholis pallens (*Spreng.*)
Tilia michauxii *Nutt.*
Tridens flavus (*L.*) *Hitchc.*

C. E. Bessey, Lincoln, Neb.

Pholiota squarrosa *Muell.*

E. Bethel, Denver, Colo.

Allantonectria yuccae *Earle*
Pholiota comosa *Fr.*
Peridermium harknessiana *Moore*
Septoria samarae *Pk.*

E. F. Bigelow, Sound Beach, Conn.

Calostoma cinnabarinum *Desv.*

E. S. Black, Little Silver, N. J.

Broussonetia papyrifera *(L.) Vent.*

F. S. Boughton, Pittsford

Agaricus silvaticus *Schaeff.*
Boletus albus *Pk.*
Calvatia gigantea *(Batsch)*
Cortinarius napus *Fr.*
Inocybe modesta *Pk.*
Lactarius boughtoni *Pk.*
Lepiota rugoso-reticulata *Lorin.*
Thelephora willeyi *Clinton*
Verticillium agaricinum *(Lk.) Cd.*

E. L. Bradley, Cato

Hydrastis canadensis *L.*

F. J. Braendle, Washington, D. C.

Clitopilus washingtoniensis *Braend.*

S. H. Burnham, Hudson Falls

Acalpha virginica *L.*
Ascochyta menyanthis *Oud.*
Aster undulatus loriformis *Burg.*
Biatora coarctata *(Sm.) Nyl.*
Boletus felleus *Bull.*
Clitocybe candida *Bres.*
Clitopilus caespitosus *Pk.*
Collybia zonata *Pk.*
Cortinarius aureifolius *Pk.*
Cronartium ribicola *F. de W.*
Cycloloma atriplicifolium *(Spreng.)*
Desmodium canescens *(L.) DC.*
Diplodia linderae *E. & E.*
Eupatorium purpureum *L.*
Hedeoma hispida *Pursh*
Heterothecium pezizoideum *(Ach.)*
Hordeum jubatum *L.*
Hygrophorus minutulus *Pk.*
Hypoxylon morsei *B. & C.*
Lepiota clypeolaria *(Bull.) Fr.*
L. rubrotincta *Pk.*
Massariella scoriadea *(Fr.) Sacc.*
Oxybaphus floribundus *Chois.*
Pertusaria leioplaca *(Ach.)*
Placodium cerin. sideritis *Tuck.*
Pleurotus atropellitus *Pk.*
P. ulmarius Fr
Psilocybe camptopoda *Pk.*
Puccinia hieracii *(Schum.) Mart.*
Sedum purpureum *Tausch*
Septoria sedicola *Pk.*
S. violae *West.*
Tricholoma terreum *Schaeff.*
Triosteum perfoliatum *L.*
Veronica anagallis-aquatica *L.*

H. P. Burt, New Bedford, Mass.

Collybia maculata *(A. & S.) Fr.*
Stropharia semiglobata *Batsch*

G. H. Chadwick, Canton

Vicia villosa *Roth*

S. Davis, Boston, Mass.

Boletus chrysen. sphagnorum *Pk.*
Clavaria fusiformis *Sow.*
C. grandis *Pk.*
C. pallescens *Pk.*
C. platyclada *Pk.*
Clitocybe centralis *Pk.*
C. compressipes *Pk.*
C. maculata *Pk.*
Discina leucoxantha *Bres.*
Entoloma cyaneum *Pk.*
Geoglossum difforme *Fr.*
G. glabrum *Pers.*
Gomphidius gracilis *Berk.*
G. vinicolor *Pk.*
Hebeloma discomorbidum *Pk.*
H. parvifructum *Pk.*
Hygrophorus coloratus *Pk.*
H. hypothejus *Fr.*
Inocybe flocculosa (*Berk.*)
I. geophylla (*Sow.*) *Fr.*
I. umboninota *Pk.*
Leptonia longistriata *Pk.*
L. strictipes *Pk.*
Microglossum rufum (*Schw.*)
Naucoria myosotis *Fr.*
Nolanea delicatulus *Pk.*
Pholiota autumnalis *Pk.*
Tricholoma ustale *Fr.*

B. O. Dodge, Madison, Wis.

Boletus elbensis *Pk.*
Collybia lacunosa *Pk.*
Discina orbicularis *Pk.*
Lactarius zonarius (*Bull.*) *Fr.*
Lycoperdon cepiforme (*Wallr.*) *Bon.*
Marasmius minutus *Pk.*
Polyporus guttulatus *Pk.*
P. lentus *Berk.*
Steccherinum adustulum *Banker*

J. Dunbar, Rochester

Aster schreberi *Nees*
Sporobolus cryptandrus (*Torr.*) *Gray*

J. Dearness, London, Can.

Cladosporium triostei *Pk.*
Discosia artocreas (*Tode*) *Fr.*
Hypoxylon perforatum (*Schw.*)
Lachnella fraxinicola (*B. & Br.*)
Lophiostoma triseptatum *Pk.*
Ombrophila thujina *Pk.*
Pezicula acericola *Pk.*

C. E. Fairman, Lyndonville

Aleurodiscus oakesii (*B. & C.*) *Cke.*
Cytospora microspora (*Cd.*) *Rabenh.*
Dinemasporium acerinum *Pk.*
Gloeosporium caryae *E. & D.*
Hymenula olivacea *Pk.*
Naemospora croceola *Sacc.*
Peziza griseo-rosea *Ger.*
Plasmodiophora elaeagni *Schroet.*
Polyporus adustus (*Willd.*) *Fr.*
P. adus. carpineus *Sow.*
P. resinosus (*Schrad.*)
Poria aurea *Pk.*
Rhabdospora physostegiae *Pk.*
Sphaeronema acerinum *Pk.*
Sphaeropsis smil. latispora *Pk.*
Stereum complicatum *Fr.*

W. G. Farlow, Cambridge, Mass.

Polyporus sulphureus semialbinus *Pk.*

G. C. Fisher, DeFuniak Spa., Fla.

Agaricus floridanus *Pk.*

M. J. French, Utica

Boletus parasiticus *Bull.*
Hygrophorus chlorophanus *Fr.*
Polyporus radicatus *Schw.*
Lentinus lepideus *Fr.*
Stropharia bilamellata *Pk.*
Thelephora willeyi *Clinton*

H. Garman, Lexington, Ky.

Macrophoma suspecta *Pk.*

A. O. Garrett, Salt Lake City, Utah

Discula runcinata *E. & E.*
Lophodermium pinastri (*Schrad.*)

N. M. Glatfelter, St Louis, Mo.

Helvella macropus brevis *Pk.*
Panaeolus retirugis *Fr.*
Psathyra umbonata *Pk.*
Russula eccentrica *Pk.*

G. S. Graves, Newport

Fuligo ovata *(Schaeff.) Macbr.*

S. J. Greenfield, Ilion

Clavaria coralloides *L.*

J. G. Grossenbacher, Geneva

Myxosporium carpini *Pk.*

C. C. Hanmer, East Hartford, Conn.

Lepiota densifolia *Gill.*

F. D. Heald, Austin, Tex.

Cercospora kaki *E. & E.*

G. T. Howell, Rockville, Ind.

Merulius tremellosus *Schrad.*
Nolanea howellii *Pk.*
Polyporus radicatus *Schw.*
Trichia scabra *Rost.*

F. G. Howland, Saratoga Spa

Clitocybe dealbata sudorifica *Pk.*

M. E. Jones, Salt Lake City, Utah

Aecidium psoraleae *Pk.*
Cystopus candidus (*Pers.*) *Lev.*
Hyalospora polypodii (*DC.*) *Magn.*
Melampsoropsis pyrolae (*DC.*) *Arth.*
Phyllosticta arnicae *Fckl.*
Puccinia aberrans *Pk.*
P. asteris *Duby.*
P. balsamorrhizae *Pk.*
P. circaeae *Pers.*
Puccinia clarkiae *Pk.*
P. gayophyti *Billings*
P. gentianae (*Str.*) *Link.*
P. jonesii *Pk.*
Septoria lacustris *S. & T.*
Thecaphora deformans *D. & M.*
Uredo bigelowii *Thuem.*
Uromyces astragali (*Opiz*) *Sacc.*
U. borealis *Pk.*

C. H. Kauffman, Ann Arbor, Mich.

Pilocratera abnormis *Pk.*

F. D. Kern, Lafayette, Ind.

Septoria angustissima *Pk.*

L. C. C. Krieger, Cambridge, Mass.

Boletinus castanellus *Pk.*

W. T. Lakin, Cumberland, Md.

Boletus caespitosus *Pk.*
Boletus subtomentosus *L.*

H. Lansing, Albany

Agaricus placomyces *Pk.*

R. Latham, Orient Point

Apocynum cannab. pubescens (*R. Br.*)
Asclepias syriaca *L.*
Buellia myriocarpa (*DC.*) *Mudd*
Calvatia craniiformis (*Schw.*) *Morg.*
Camelina sativa (*L.*) *Crantz*
Cardamine parviflora *L.*
Carex canescens disjuncta *Fernald*
Carya alba (*L.*) *Koch*
Cinna latifolia (*Trev.*) *Griseb.*
Cladonia boryi *Tuck.*
Climacium kindbergii (*R. & C.*) *Grout*
Coronilla varia *L.*
Crepis setosa *Hall. f.*
Cyperus grayi *Torr.*
Erechtites hieracifolia (*L.*) *Raf.*
Fomes annosus *Fr.*
Gerardia maritima *Raf.*
G. purpurea *L.*
Glonium parvulum (*Ger.*) *Sacc.*
Gymnosporangium macropus *Link*
Herpotrichia diffusa (*Fckl.*) *E. & E.*
Hysterium pulicare *Pers.*
Juncus bufonius *L.*
Lecanidion indigoticum (*C. & P.*)
Lecanora varia saepicola *Fr.*
Lechea racemulosa *Mx.*
Lenzites betulina (*L.*) *Fr.*
Liatris scariosa *Willd.*
Osmorhiza claytoni (*Mx.*) *Clarke*
Panicum agrostoides *Spreng.*
P. amarum *Ell.*
Parmelia borreri rudecta *Tuck.*
P. borr. hypomela *Tuck.*
P. cetrata *Ach.*
P. colopodes (*Ach.*) *Nyl.*
P. perforata (*Jacq.*) *Ach.*
P. perfor. hypotropa *Nyl.*
Parmelia saxatilis sulcata *Nyl.*
Paspalum circulare *Nash*
P. setaceum *Mx.*
Phaeangella deformata (*Pk.*)
Physcia granulifera (*Ach.*) *Tuck.*
P. hispida (*Schreb.*) *Tuck.*
P. stellaris (*L.*) *Tuck.*
Physma luridum (*Mont.*) *Tuck.*
Picris hieracioides *L.*
Placodium cerinum (*Hoffm.*) *N. & H.*
P. ferrug. discolor *Willey*
Plantago elongata *Pursh*
Pleospora herbarum (*Pers.*) *Rabenh.*
Polygonum prolificum (*Small*)
Polyporus giganteus (*Pers.*) *Fr.*
Poria subacida vesiculosa (*B. & C.*)
Ramalina calicaris fraxinea *Fr.*
R. rigida (*Pers.*) *Tuck.*
Sabatia stellaris *Pursh*
Sagina decumbens (*Ell.*) *T. & G.*
Salix purpurea *L.*
Scirpus olneyi *Gray.*
Scleroderma flavidum *E. & E.*
Smilacina racemosa (*L.*) *Desf.*
Spartina patens juncea (*Mx.*)
Spergularia marina (*L.*) *Griseb.*
Sporobolus cryptandrus (*Torr.*)
Stipa avenacea *L.*
Teucrium canadense *L.*
Theloschistes conc. effusus *Tuck.*
T. flavicans *Wallr.*
Trametes pini (*Brot.*) *Fr.*
Trichostemma dichotomum *L.*
Usnea trichodea *Ach.*
Viburnum dentatum *L.*
V. venosum *Britton*
Vicia angust. segetalis (*Thuill.*)

C. E. Lewis, Orono, Me.

Phoma mali Schulz. & Sacc.

C. A. Mabie, Holley

Clitocybe multiceps tricholoma *Pk.*
Flammula flavida *Pers.*
Hypholoma sublateritium *Schaeff.*
Lepiota rhacodes *(Vitt.) Fr.*
Pholiota squarrosa *Muell.*
Pleurotus terrestris *Pk.*
Polyporus radicatus *Schw.*

A. H. Mackay, Halifax, Can.

Armillaria ventricosa *Pk.*
Clitocybe vilescens *Pk.*
Helvella sulcata *Afzel.*

J. A. Maney, Geneva

Peridermium pyriforme *Pk.*

E. R. Memminger, Flat Rock, N. C.

Craterellus cornucopioides *(L.) Pers.*

G. E. Morris, Waltham, Mass.

Boletus parasiticus *Bull.*
Lepiota rubrotincta *Pk.*
Pholiota autumnalis *Pk.*

M. V. Munger, Malone

Specimen of fruit of English walnut, Juglans regia *L.*, with 3-valved shell and 3-lobed seed.

J. B. S. Norton, College Park, Md.

Psathyrella disseminata (*Pers.*) *Fr.*

J. F. Peck, Rexford Flats

Two connected trunks of Ostrya virginiana *(Mill.) Koch*

F. T. Pember, Granville

Alisma plantago-aquatica *L.*
Grindelia squarrosa *(Pursh) Dunal*

L. H. Pennington, Syracuse

Fomes fraxineus *(Bull.) Fr.*
Guepinia palmiceps *Berk.*
Irpex mollis *B. & C.*
Poria floccosa *Fr.*
P. mutans *Pk.*
P. obducens *Pers.*

D. Reddick, Ithaca

Lysurus borealis *(Burt) C. G. Lloyd*

L. D. Rhind, Gloversville

Peridermium pyriforme *Pk.*

W. H. Ropes, Salem, Mass.

Agaricus campester *L.*
Cortinarius intrusus *Pk.*
Flammula pulchrifolia *Pk.*
Ornithogalum nutans *L.*

L. L. Shaff, Hannibal

Hypericum prolificum *L.*

P. Spaulding, Washington, D. C.

Cryptosphaeria populina *(Pers.)*
Cryptosporium macrospermum *Pk.*

F. C. Stewart, Geneva

Fusarium roseum *Link*
Gymnosporangium globosum *Farl.*
Hordeum trifurcatum *Jacq.*
Myxosporium castan. quercus *Pk.*
Phoma simillima *Pk.*
P. stictica *B. & Br.*
Phyllosticta betae *Oud.*
Stereum complicatum *Fr.*
Thlaspi perfoliatum *L.*

W. G. Stover, Columbus, Ohio

Marasmius delectans *Morg.*
Pleurotus corticatus *Fr.*

D. R. Sumstine, Pittsburg, Pa.

Hebeloma flexuosipes *Pk.*

K. F. Symonds, Utica.

Panus torulosus *Fr.*
Stropharia bilamellata *Pk.*

R. Thaxter, Cambridge, Mass.

Chaetomium indicum *Cd.*

C. Thom, Storrs, Conn.

Boletus subluteus *Pk.*

J. A. Thompson, Rochester

Roestelia aurantiaca *Pk.*

H. L. True, McConnelsville, Ohio

Gyromitra brunnea *Underw.*

L. Tucker & Son, Albany

Vermicularia beneficiens *Pk.*

D. B. Van Buren, Albany

Cladosporium paeoniae *Pass.* Roestelia aurantiaca *Pk.*

J. M. Van Hook, Bloomington, Ind.

Sporotrichum chryseum *Pk.* Stropharia thrausta *Kalchb.*

H. L. Wells, New Haven, Conn.

Boletus gertrudiae *Pk.* Pholiota dura *Bolt.*

H. H. Whetzel, Ithaca

Phoma simillima *Pk.*

T. E. Wilcox, Washington, D. C.

Boletus bicolor *Pk.* Boletus gracilis *Pk.*
Melanogaster durissimus *Cke.*

C. L. Williams, Glens Falls

Fusicladium dendriticum *(Wallr.)* Polypodium vulgare *L.*

D. B. Young, Albany

Cytospora salicis *(Cd.) Rabenh.* Eurotium subgriseum *Pk.*
Phoma piceina *Pk.*

SPECIES NOT BEFORE REPORTED

Amanita bisporigera Atk.

Ithaca. G. F. Atkinson. Collected by C. H. Kauffman. This appears like a dwarf white form of A. phalloides Fr.

Amanita floccocephala Atk.

Ithaca. G. F. Atkinson.

Amanita velatipes Atk.

Cortland. July. G. F. Atkinson.

Ascochyta menyanthis Oud.

Living leaves of buckbean, Menyanthes trifoliata L. Near Clemons, Washington co. August. S. H. Burnham.

Aulographum ledi n. sp.

Spots orbicular, grayish white, surrounded by a brown or purplish brown border; perithecia epiphyllous, few on a spot, elliptic or oblong, often substellately lobed by confluence, erumpent, black, context whitish; asci obovate or subglobose; spores ovate or oblong, continuous, at length uniseptate, hyaline, 12–15 μ long, 6–8 μ thick.

Upper surface of leaves of Labrador tea, Ledum groenlandicum Oeder. Fine, St Lawrence co. August.

Remarkable and very distinct by its subglobose asci.

Maculae orbiculares, griseo-albidae, margine brunneo vel purpureo-brunneo circumdatae; perithecia epiphylla, pauca, elliptica oblongave, saepe confluentia et substellatim lobata, erumpentia, atra, contexta albida; asci obovati subglobosive; sporae ovatae oblongaeve, continuae, demum uniseptatae, hyalinae, 12–15 x 6–8 μ.

Biatora coarctata (Sm.) Nyl.

On nodules in drifting sand. Karner, Albany co. November. S. H. Burnham.

Calvatia craniiformis (Schw.) Morg.

Ground. Orient Point, Suffolk co. November. R. Latham.

Camelina microcarpa Andrz.

Grain fields. Bergen, Genesee co. June. This plant was erroneously reported as Camelina sativa (L.) Crantz. Specimens of the true C. sativa with broader seed vessels have been collected in oat fields near Orient Point by R. Latham and contributed by him to the herbarium.

Cercospora phlogina n. sp.

Spots orbicular or nearly so, .5–1 cm broad, sometimes confluent, blackish brown, usually with a small grayish center on the upper surface; hyphae epiphyllous, densely tufted, flexuous or irregular, 30–40 μ long, commonly aseptate, slightly colored; spores oblong or slightly narrowed toward the apex, 2–4-septate, 35–60 μ long, 3–4 μ thick.

Leaves of cultivated phlox. Floral Park, Nassau co. June. F. C. Stewart.

This species is related to C. omphacodes E. & H., but it differs in the characters of the spots, the position of the fungus and the thicker spores with fewer septa.

Maculae suborbiculars, .5–1 cm latae, aliquando confluentes, fuscoatrae, in centro supra griseae; hyphae epiphyllae, dense caes pitosae, flexuosae vel irregulares, 30–40 μ longae, vulgo aseptatae, leviter coloratae; sporae oblongae vel ad apicem attenuatae, 2–4–septatae, 35–60 x 3–4 μ.

Cladosporium paeoniae Pass.

Living leaves of paeonia. Batavia. August. D. B. VanBuren. Collected by Alice G. Fisher. The fungus forms large brown spots on the leaves. It sometimes occupies the entire leaf and kills it

Climacium kindbergii (R. & C.) Grout

Roots of trees in swampy places. Orient Point. December R. Latham.

Clitocybe biformis n. sp.

Plate VI, figures 9–15

Pileus fleshy, thin, firm, broadly convex or nearly plane, becoming centrally depressed, subumbilicate or broadly infundibuliform, glabrous, even or slightly striate on the margin, pale buff, sometimes more brightly colored in the center, flesh white or whitish, margin at first involute; lamellae thin, close, narrow, decurrent, whitish, becoming pallid or subcinnamon with age or in drying; stem equal or nearly so, firm, solid or stuffed, often curved, sometimes eccentric, tomentose at the base, colored like the pileus; spores subglobose or broadly elliptic, 5–6 μ long, 4–5 μ broad.

Pileus 2.5–7.5 cm broad; stem 2.5–3.5 cm long, 4–8 mm thick.

In mixed woods. Growing in arcs of circles. North Elba. Essex co. September.

When young the pileus is convex, when old it is centrally depressed or sometimes broadly infundibuliform. This change of shape has suggested the specific name. The change in the color of the lamellae is more remarkable. The species is closely allied to Clitocybe gilva (Pers.) Fr. from which it may be separated by the whitish color of the flesh and the peculiar change of color in the lamellae. This passes from whitish to fawn color or pale cinnamon. Its habit of growing in circles is also peculiar. The mycelium binds together a mass of dirt and decaying vegetable matter. These adhere closely to the base of the stem when the mushroom is pulled from its place of growth, and make the stem appear as if bulbous.

Pileus carneus, tenuis, firmus, late convexus vel subplanus, deinde centro depressus, subumbilicatus vel late infundibuliformis, glaber, margine levis vel striatulus, pallide luteolus, in centro aliquando luteus, carne alba albidave; lamellae tenues, confertae, angustae, decurrentes, in senectute siccitateve pallide cinnamomeae; stipes subaequalis, firmus, solidus, farctusve, aliquando curvus vel eccentricus, basi tomentosus, in colore pileo similis; sporae subglobosae vel late ellipsoideae, 5–6 x 4–5 μ.

Clitocybe maxima G. & M.

Catskill mountains. September. Mrs F. C. Sherman. North Elba. C. H. Peck. This is a large and rare species, appearing as if it might be a luxuriant development of Clitocybe infundibuliformis (Schaeff.) Fr.

Cortinarius croceofolius n. sp.

Plate VI, figures 1–8

Pileus fleshy, thin, broadly convex or nearly plane, obtuse or obtusely umbonate, dry, slightly fibrillose specially on the margin, brownish cinnamon, often paler or saffron yellow on the margin, flesh pale yellow, grayish or dingy when dry; lamellae thin, close, saffron yellow verging to orange, then brownish cinnamon, often yellow crenulate on the margin; stem equal or slightly thickened at the base, fibrillose above, saffron yellow, hollow, veil similarly colored; spores broadly ellipsoid, 6–7 μ long, 4–5 μ broad.

Pileus 2.5–5 cm broad; stem 2.5–4 cm long, 4–6 mm thick.

Mossy ground in or on the borders of woods of spruce and balsam fir trees. North Elba. September.

This species belongs to the section Dermocybe and is closely related to Cortinarius cinnamomeus (L.) Fr. and C. semisanguineus (Fr.) Kauffm. but in the color of the lamellae it is intermediate between them and from both it is readily separated by its smaller spores. From C. croceocolor Kauffm., of which I have seen no specimens, it may be separated by the darker color of the pileus and the different colors of the lamellae.

Pileus carneus, tenuis, late convexus vel subplanus, obtusus vel obtuse umbonatus, siccus, leviter fibrillosus, fusco-cinnamomeus, saepe margine pallidior vel croceus, carne flava, in siccitate grisea; lamellae tenues, confertae, croceae aurantiacaeve, demum fusco-cinnamomeae, saepe acie flavo-crenulatae; stipes aequalis vel leviter basi incrassatus, supra fibrillosus, cavus, croceus, velo croceo; sporae late ellipsoideae, 6–7 x 4–5 μ.

Cortinarius glaucopus (Schaeff.) Fr.

Woods. North Elba. September.

Cortinarius napus Fr.

Pittsford, Monroe co. September. F. S. Boughton.

Cortinarius triumphans Fr.

In groves of young deciduous trees. New Lebanon, Columbia co. September. The pileus in our specimens was viscid but glabrous.

Crataegus aristata n. sp. Sarg.

(Pruinosae)

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. Leaves ovate to oval, long-pointed and acuminate at the apex, cuneate at the entire base, finely often doubly serrate above, with straight glandular teeth and slightly divided into 4 or 5 pairs of small acuminate lobes; more than half-grown when the flowers open early in June and then yellow green, smooth and furnished with a few hairs on the midribs above, and pale below, and at maturity thick, bluish green, paler on the lower surface than on the upper surface, 4.5–6 cm long and 3–5 cm wide, with thin midribs and primary veins; petioles slender, narrowly wing-margined at the apex, slightly hairy on the upper side early in the season, soon becoming glabrous, 1–1.2 cm in length; leaves on vigorous shoots broadly ovate to slightly obovate, rounded or cuneate at the base, more coarsely serrate, conspicuously lobed, and often 7–8 cm long and 5.5–6 cm wide, with stout rose-colored midribs and petioles. Flowers 1.8–2 cm in diameter, on long slender pedicels, in 6–15-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually contracted from the base, short, broad, acuminate, glandular-serrate near the middle, slightly hairy on the inner surface, reflexed after anthesis; stamens 20; filaments persistent on the fruit; anthers pink; styles 3 or 4. Fruit ripening early in October, on long slender drooping pedicels, in few-fruited clusters, subglobose, slightly 5-angled, pruinose, bright red, marked by occasional pale dots, about 1 cm in diameter; calyx prominent with a long tube, a deep broad cavity wide and tomentose in the bottom, and spreading and reflexed lobes; flesh thick, yellow, dry and mealy; nutlets 3–5, narrowed and rounded at the apex, broader and rounded at the base, 5.5–6 mm long and 4–4.5 mm wide, the narrow hypostyle extending to below the middle of the nutlet.

A shrub 3–4 m high, with numerous wide spreading branches and slender zigzag branchlets dark orange green and marked by pale lenticels when they first appear, becoming pale orange brown in their first season and light brown the following year, and armed with numerous stout straight or slightly curved purple spines 3.5–4.5 cm long.

Roadsides near Rossie, St Lawrence co. C. H. Peck (✕ 12 Re), June 12 and September 29, 1909.

Crataegus brainerdi Sarg.

Rocky places. Rossie. June. The plant reported under this name in Bulletin 75, page 12, was later decided by Professor Sargent to be a distinct species and was described and reported under the name C r a t a e g u s m e l l i t a Sarg.

Crataegus longipedunculata Sarg.

Near Canandaigua. June and October. Miss E. C. Webster.

Crataegus nemorosa n. sp. Sarg.

(Medioximae)

Glabrous. Leaves ovate, acuminate, rounded or abruptly cuneate at the base, sharply often doubly serrate with straight glandular teeth and deeply divided into 3 or 4 pairs of slender acuminate lobes usually pointing toward the apex of the leaf; about one-half grown when the flowers open at the end of May or early in June and then very thin and yellow green, and at maturity thin, blue green and lustrous on the upper surface, pale on the lower surface, 4.5–5 cm long and 3–3.5 cm wide, with thin midribs and primary veins, turning deep vinous red in the autumn on the upper side and remaining pale below; petioles slender, slightly wing-margined at the apex, glandular, with minute persistent glands, 1.5–2 cm in length; leaves on vigorous shoots broadly ovate, acute, long-pointed at the apex, rounded or truncate at the entire base, coarsely serrate, deeply lobed and often 8–9 cm long and broad. Flowers 1.5–1.8 cm in diameter, on long slender pedicels, in small 5–8-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from a wide base, short, acuminate, entire or furnished near the middle with 1 or 2 minute glandular teeth, reflexed after anthesis, stamens 5–10; anthers pink; styles 3 or 4. Fruit on slender drooping pedicels, in few-fruited clusters, short-oblong to obovate, crimson, slightly pruinose, marked by dark dots, about 1 cm in diameter; calyx little enlarged, with a wide shallow cavity pointed in the bottom and spreading and appressed persistent lobes; flesh thin, dry and hard, green tinged with red; nutlets 2–4, broad and rounded at the apex, acute at the base, rounded and only slightly ridged on the back, 5.5–6 mm long and 3–3.5 mm wide.

A shrub 2–3 m high, with small stems covered with dark gray bark and numerous ascending and spreading branches, and slender slightly zigzag branchlets dark orange green and marked by pale lenticels when they first appear, becoming bright chestnut brown and lustrous in their first season and dark reddish brown the following year, and armed with numerous slender straight chestnut brown spines 3.5–6 cm long.

Hillsides near Painted Post, Steuben co., G. D. Cornell (# 119 type), September 22, 1907, May 26, 1908; C. H. Peck, June 2 and September 21, 1909; G. D. Cornell (# 119 A with 6–10 stamens and larger short-oblong fruit a little if at all narrowed at the base), Painted Post, September 22, 1907, May 28, 1908.

Crepis setosa Hall. f.

Orient Point. September. R. Latham.

Cryptosporium macrospermum n. sp.

Heaps scattered, at first covered by the epidermis, then erumpent through orbicular or elliptic apertures, about 1 mm broad, black, sometimes capped by a whitish or greenish white globule of spores, the spore mass enlarged and softened when moist; spores slender, fusiform, falcate or rarely sigmoid, generally subulate at one end, acute or subacute at the other, hyaline and often 2–6 nucleate, 60–80 μ long, 5–6 μ broad.

Dead bark of balsam fir, Abies balsamea (L.) Mill. Adirondack mountains, Franklin co. May. G. G. Atwood and P. Spaulding.

The fungus has so far developed only where the bark is dead and it is therefore uncertain that it causes the death of the bark and the wood beneath.

Acervuli sparsi, primus epidermide tecti, deinde per aperturas orbiculares ellipticasve erumpentes, 1 mm lati, nigri, aliquando sporarum globulum albidum exudantes; sporae graciles, fusiformes, falcatae, rare sigmatoideae, vulgo apice subulatae, basi acutae subacutaeve, hyalinae, saepe 2–6-nucleatae, 60–90 x 5–6 μ.

Cycloloma atriplicifolium (Spreng.) Coult.

Waste places. Albany. September. S. H. Burnham.

Cytospora microspora (Cd.) Rabenh.

Dead branches of thorn bush. Medina, Orleans co. October. C. E. Fairman.

Diplodia linderae E. & E.

Dead branches of spice bush, Benzoin aestivale (L.) Nees. Tripoli, Washington co. April. S. H. Burnham.

Eccilia mordax Atk.

Near Ithaca. July. G. F. Atkinson. Collected by C. O. Smith.

Eurotium subgriseum n. sp.

Perithecia minute, 100–125 μ in diameter, densely clustered, globose or subglobose, pale yellow; spores globose, greenish yellow in mass, 6–8 μ in diameter.

Dead wood and bark of sycamore branches, Platanus occidentalis L. Brooklyn. March. D. B. Young.

This is found growing with and among the conidial form, Aspergillus subgriseus Pk. Torrey Bot. Club Bul. 22:210. The color of this mold varies from whitish to grayish or bluish gray. The fertile hyphae are erect, continuous, 100–125 μ long and 7–8 μ thick, terminating in a subglobose vesicle 30–40 μ in diameter, on which strings of globose hyaline spores or conidia are borne. These conidia are 3.5–4 μ broad. They are smaller than those of the Aspergillus glaucus (L.) Link, the conidial form of Eurotium herbariorum (Wigg.) Link. The branches were collected in Brooklyn by J. J. Levison, May 12, 1909 but were kept in a moist atmosphere under cover for several months and the fungus probably developed during this time.

Perithecia minuta, 100–125 μ in diam., dense caespitosa, globosa subglobosave, flava; sporae globosae, flavido-virides, 6–8 μ in diam.

Gloeosporium caryae E. & D.

Leaves of hickory. Lyndonville, Orleans co. October. C. E. Fairman.

Gloeosporium divergens n. sp.

Spots large, irregular, commonly occupying the lobes and margin of the leaves, definite, pale brown, either with or without a slight inconspicuous reddish brown margin on the upper surface; heaps mostly hypophyllous, rarely epiphyllous and then chiefly along the veinlets, 120–160 μ broad, darker colored than the spots; spores narrowly elliptic or oblong, often 2-nucleate, hyaline, 10–15 μ long, 4–6 μ broad.

Living leaves of white oak, Quercus alba L. Menands, Albany co. July.

Maculae magnae, irregulares, foliorum lobas marginemque occupantes, definitae, pallide brunneae, interdum supra margine angusto inconspicuo, rufescento-brunneo; acervuli vulgo hypophylli, rare epiphylli et tunc ad venulas, 120–160 μ lati, maculis brunniores; sporae anguste ellipsoideae oblongaeve, saepe 2-nucleatae, hyalinae, 10–15 x 4–6 μ.

Grindelia squarrosa (Pursh) Dunal

Dry pastures on hillsides. Granville, Washington co. September. F. T. Pember. A showy introduced plant.

Mr Pember remarks concerning it, "I can only suggest that it may have been introduced in western grass seed. It is scattered about over two acres, and in some places constitutes nearly all the vegetation. There must be several thousand plants of it."

Helianthus petiolaris Nutt.

In a lawn. Rochester. July. M. S. Baxter. Introduced from the West. Determined by Dr P. A. Rydberg. Possibly not permanently established.

Heterothecium pezizoideum (Ach.) Flot.

Spruce bark. Black mountain, Washington co. August. S. H. Burnham.

Hygrophorus caprinus (Scop.) Fr.

Near Ithaca. November. G. F. Atkinson. Collected by C. H. Kauffman.

Hypericum prolificum L.

Hannibal, Oswego co. August. L. L. Shaff.

This is a large shrubby plant and it seems strange that it should so long have escaped detection in our State unless it is very local.

The station is on or near its northern limits. Mr Shaff writes that he first discovered the plant about 25 years ago. At that time and for 8 years after he kept sheep and the plant did not spread much. For 17 years he has kept no sheep and during this time it has spread over his pastures and now occupies about five acres.

Hypochnus tristis Karst.

On the base of young spruce trees. North Elba. September. The specimens are sterile and to this extent are doubtful. Professor E. A. Burt, specialist in this group of fungi, decides that it is probably this species.

Inocybe rimosoides n. sp.

Pileus thin, broadly campanulate or expanded, umbonate, glabrous, shining, substriate, radiately cracked, pale yellow; lamellae close, sinuate, adnexed or nearly free, pallid becoming brownish ferruginous; stem equal, glabrous, hollow, pallid; spores even, 8–10 μ long, 5–6 μ broad, cystidia none.

Pileus 2–3.5 cm broad; stem 2.5–4.5 cm long, 2–3 mm thick.

Grassy ground. Menands. August.

Related to Inocybe rimosa (Bull.) Fr. from which it may be distinguished by its paler and more acutely umbonate pileus, its hollow stem, smaller spores and the absence of cystidia.

Pileus tenuis, late campanulatus expansusve, umbonatus, glaber, nitidus, substriatus, radiate rimosus, luteolus; lamellae confertae sinuatae, adnexae vel subliberae, pallidae deinde brunneo-ferrugineae; stipes aequalis, glaber, fistulosus, pallidus; sporae leves, 8–10 x 5–6 μ cystidia nulla.

Lactarius boughtoni n. sp.

Plate VI, figures 1–7

Pileus fleshy, firm, becoming fragile with age, broadly convex nearly plane or centrally depressed, often deflexed on the margin, dark brownish red (walnut brown), flesh whitish, subconcolorous when moist, milk white very scanty or sometimes none, taste acrid; lamellae thin, close, adnate or slightly decurrent, whitish becoming pale buff or darker with age; stem firm, nearly equal, hollow, glabrous, colored like but often paler than the pileus, generally paler at the top than below and there slightly pruinose; spores subglobose, 8–9 μ long, 7–8 μ broad.

Pileus 5–10 cm broad; stem 4–10 cm long, 6–12 mm thick.

Ground in woods and in swamps. Old Forge, Herkimer co. August. F. S. Boughton. North Elba. September. C. H. Peck.

Closely allied to Lactarius rufus (Scop.) Fr. but separated by its paler lamellae, hollow stem, absence of an umbo and very scanty milk. The stem is often pointed at the base. Edible according to F. S. Boughton, who says it "entirely lost its acridity in cooking and was very fine in flavor." I have not tried it.

Pileus carneus, firmus, senectute fragilis, late convexus subplanus vel centro depressus, saepe margine deflexus, lateritius, carne albida, lacte albo, parco vel nullo, sapore acri; lamellae tenues, confertae, adnatae vel subdecurrentes, albidae vel lutescentes; stipes firmus, subaequalis, cavus, glaber, pileo in colore similis vel pallidior; sporae subglobosae, 8–9 x 7–8 μ.

Lentinus piceinus n. sp.

Pileus thin, dimidiate, sessile or with a very short stem, broadly convex or nearly plane, glabrous, pale alutaceous; lamellae few, distant, unequal, serrate-dentate, pallid; stem when present very short; spores minute, subglobose, 4–5 μ in diameter.

Pileus 8–12 mm broad; stem about 2 mm long.

Bark of red spruce, Picea rubra (DuRoi) Dietr. Long Lake, Hamilton co. July.

A small and rare species. Found but once.

Pileus tenuis, dimidiatus, sessilis vel breviter stipitus, late convexus subplanusve, glaber, subalutaceus; stipes brevissimus; sporae minutae, subglobosae, 4–5 μ in diam.

Lychnis coronaria (L.) Desr.

Canandaigua. July. Mrs E. P. Gardner. An introduced plant cultivated for ornament but sometimes escaping from cultivation.

Machaeranthera pulverulenta (Nutt.) Greene

Cobbs hill near Rochester. July. Miss F. Beckwith. Introduced from the West. Determined by Dr P. A. Rydberg.

Macrosporium heteronemum pantophaeum Sacc.

In gardens on young decaying summer crookneck squashes. Menands. August.

Marasmius contrarius n. sp.

Pileus submembraneous, broadly convex or nearly plane, often slightly uneven, glabrous, whitish or white with a brown center becoming grayish or subalutaceous in drying; lamellae thin, subdistant, sometimes branched or irregular, adnate or slightly decurrent, whitish, the interspaces slightly venose; stem slender, solid, downy, grayish-tawny, with tawny tomentum at the base, white within; spores 7–9 μ long, 4–5 μ broad.

Pileus 4–10 mm broad; stem 2–3 cm long, 1–1.5 mm thick.

Gregarious. Damp mossy places under spruce and balsam fir trees to the fallen leaves of which the stem is commonly attached. North Elba. June.

The texture of both pileus and stem is tough. The brown center often disappears in drying. This, and the whitish color changing to pale tan in drying, are such an unusual occurrence as to suggest the specific name. Related to M. ramulinus Pk. but at once separated from it by its pileus changing color in drying, its longer solid stem being more downy and tawny with a distinctly tomentose base and by its habitat.

Pileus submembraneus, late convexus subplanusve, saepe subrugosus, glaber, albus albidusve in centro brunneus, in siccitate griseus vel subalutaceus; lamellae tenues, subdistantes, aliquando irregulares vel ramosae, adnatae vel leviter decurrentes, albidae, interstitiis venosis; stipes gracilis, solidus, pubescens, fulvo-griseus, basi fulvo-tomentosus, intra alba; sporae 7–9 x 4–5 μ.

Myxosporium carpini n. sp.

Heaps minute, greenish black, nestling in the bark, covered by the epidermis; spores oblong or elliptic oblong, exuding in pale yellow tendrils, binucleate, hyaline, 8–12 μ long, 3.5–4 μ broad.

On bark of water beech, Carpinus caroliniana Walt. Geneva. June. J. G. Grossenbacher.

Acervuli minuti, in cortice nidulantes, epidermide tecti, olivaceo-nigri; sporae oblongae vel oblongo-ellipsoideae, binucleatae, hyalinae, 8–12 x 3.5–4 μ, in cirrhis exudantes.

Naemospora croceola Sacc.

Oak bark. Lyndonville. October. C. E. Fairman.

Naucoria sororia Pk.

Growing on manure. McLean, Tompkins co. September. G. F. Atkinson. This species is doubtless often confused with

Naucoria suborbicularis (Bull.) Fr. from which it is separated by its farinaceous odor and taste, its fragile character, lacunose or pitted pileus and its stem striated at the top.

Oidium asteris-punicei n. sp.

Amphigenous indeterminate, widely and thinly effused, whitish; fertile hyphae suberect, hyaline, septate, simple; spores terminal catenulate, ellipsoid or oblong, rounded or subtruncate at the ends, hyaline, 30–60 μ long, 15–20 μ broad.

Living or languishing leaves of red stemmed aster, Aster puniceus L. Letchworth Park, Wyoming co. September.

Related to Oidium erysiphoides Fr., but I find no rosy tinted tufts and the hyphae are nearly as broad as the spores. Perhaps it is the conidial stage of Erysiphe cichoracearum DC.

Amphigenum, indeterminatum, late et tenuiter effusum, albidum; hyphae fertiles suberectae, hyalinae, septatae, simplices; sporae catenulatae, acrogenae, ellipsoideae oblongaeve, utrinque obtusae subtruncataeve, hyalinae, 30–60 x 15–20 μ.

Oxybaphus floribundus Chois.

Waste places. Albany. September. S. H. Burnham. Introduced from the West but apparently well established.

Pertusaria leioplaca (Ach.) Schaer.

Bark of hop hornbeam. Ostrya virginiana (Mill.) Koch. Helderberg mountains, Albany co. May. S. H. Burnham.

Pholiota terrigena Fr.

Grassy ground. Utica. October. G. F. Atkinson. In drying, this mushroom is said to emit an odor similar to that of mice.

Phoma piceina n. sp.

Perithecia few, scattered, prominent but minute, black; spores ellipsoid or oblong, hyaline, 8–12 μ long, 4–5 μ broad.

On leaves of red spruce Picea rubra (DuRoi) Dietr. Adirondack mountains near Lake Pleasant, Hamilton co. May. D. B. Young.

In these specimens the leaves have been injured by some insect which has caused a swelling at the base and may have been the primary cause of the death of the leaves.

Perithecia pauca, sparsa, prominentia, minuta, atra; sporae ellipsoideae oblongaeve, hyalinae, 8–12 x 4–5 μ.

Phoma simillima n. sp.

Perithecia densely gregarious, slightly prominent, at first covered by the epidermis, then erumpent, convex or depressed, minute, black; spores ellipsoid, hyaline, 8–12 long, 5–8 μ broad.

Dead bark of pear trees, Pyrus communis L. Ithaca. H. H. Whetzel. Rochester. April. F. C. Stewart.

This differs from Cytospora piri Fckl., which inhabits branches of pear trees, by its much smaller spores. The perithecia commonly burst through transverse apertures in the epidermis.

Perthecia dense gregaria, leviter prominentia, primus epidermide tecta, deinde erumpentia, convexa vel depressa, minuta, atra; sporae ellipsoidea, hyalinae, 8–12 x 5–8 μ.

Phoma stictica B. & Br.

On leaves of common box tree, Buxus sempervirens L. Geneva. January. F. C. Stewart. Collected by S. M. McMurran. This Phoma is said to be the spermogonium of Diaporthe retecta (F. & N.) Sacc.

Phyllosticta betae Oud.

Living leaves of beet, Beta vulgaris L. Flint, Ontario co. August. F. C. Stewart.

Phyllosticta subtilis n. sp.

Spots suborbicular, .5–3 cm broad, sometimes confluent, indefinite, reddish brown; perithecia numerous, densely gregarious, hypophyllous, minute, 80–120 μ broad, blackish; spores minute, oblong, straight or curved, hyaline, 8–12 μ long, 1.5–2 μ broad.

Leaves of Carya. Painted Post. September.

This species departs from the ordinary character of the genus in its narrow spores.

Maculae suborbiculares, .5–3 cm latae, aliquando confluentes, indeterminatae, fuscae; perithecia numerosa, dense gregaria, hypophylla, minuta, 80–120 μ lata, nigra; sporae minutae, oblongae, rectae curvaeve, hyalinae, 8–12 x 1.5–2 μ.

Physcia hispida (Schreb.) Tuck.

On red cedar wood, Juniperus virginiana L. Orient Point. April. Sterile form. R. Latham.

Picris hieracioides L.

Orient Point. August and September. R. Latham. An introduced plant.

Pilocratera abnormis n. sp.

Cups scattered, stipitate, small, 1–4 mm broad, obconic or saucer-shaped, pale grayish, obscurely pubescent; stem 1–3 mm long, inserted or swollen at the base into a minute hairy bulb, colored and adorned like the cup; asci subcylindric, 160–200 μ long, 10–12 μ broad, spores oblong or subfusiform, straight or slightly curved, slightly narrowed toward each end, commonly containing a single large central nucleus, 25–40 μ long, 8–10 μ broad, paraphyses filiform.

Decorticated wood of yellow birch, Betula lutea Mx. Fine. August. Found also on decaying wood at Ishpeming, Michigan. August. C. H. Kauffman.

The minute pubescence is somewhat compacted into tufts on the margin but the tufts are not long enough to give a fimbriate or ciliate appearance to the margin.

Cupulae sparsae, stipitatae, parvae, 1–4 mm latae, obconicae vel acetabuliformes, pallido-griseae, minute pubescentes; stipes 1–3 mm longus, insititius vel basi bulbillosus, hirtus, cupulae in colore similís; asci subcylindracei, 160–200 x 10–12 μ; sporae oblongae subfusiformesve, rectae vel leviter curvatae, utrinque leviter angustatae, vulgo uninucleatae, 25–40 x 8–10 μ, paraphyses filiformes.

Placodium ferrugineum discolor Willey

On bark of red cedar, Juniperus virginiana L. Orient Point. April. R. Latham.

Plasmodiophora elaeagni Schroeter

On roots of Elaeagnus longipes Gray. Lyndonville. November. C. E. Fairman.

Pleurotus approximans n. sp.

Pileus thin, tough, subgelatinous, dimidiate or subflabelliform or with a short stemlike base, at first involute on the margin and more or less strigulose hairy, specially toward the base, becoming pruinose or subglabrous with the thin even margin expanded or slightly recurved, pallid, grayish brown or smoky brown, 6–12 mm broad; lamellae narrow, close, tapering toward each end, converging to a basal point, creamy yellow, minutely bristly on the edge and sides with the projecting hyaline pointed cystidia which are 60–80 μ long, 15–20 μ broad.

On decaying wood and bark, apparently of red maple, Acer rubrum L. Sylvan Beach, Oneida co. July.

This species is closely related to Pleurotus spiculifer Berk., a species founded on specimens collected on decaying wood on New Ireland island in the Pacific ocean, and described as having the pileus very glabrous membranous and pellucidly striate, characters not applicable to our specimens. For this reason we have considered our mushroom distinct, though in other respects the characters are very similar. Our specimens revive on the application of moisture and then the flesh is colored like the surface of the pileus and subgelatinous, .4–.5 mm thick. When dry it is white, slightly thinner, and appearing to have a thin upper gelatinous layer. The spores are not known in our specimens nor described in P. spiculifer.

Pileus tenuis, lentus, subgelatinous, dimidiatus aut subflabelliformis, sessilis vel substipitatus, primo margine involutus, hirtus praesertim ad basem, demum pruinosus vel subglaber, margine tenue expanso vel leviter recurvato pallidus, griseo-brunneus vel fumoso-brunneus, 6–12 mm latus; lamellae angustae, acie lateribusque cystidiis minute setulosus; cystidia hyalina lageniformia, 60–80 x 15–20 μ.

Ramalina rigida (Pers.) Tuck.

On red cedar, Juniperus virginiana L. Orient Point. December. R. Latham.

Rhabdospora physostegiae n. sp.

Perithecia caulicolous, scattered or seriate, erumpent, globose-depressed, black; spores filiform, hyaline, nearly or quite straight, 25–30 μ long, 1–1.5 μ broad.

Dead stems of Physostegia virginiana (L.) Benth. Lyndonville. May. C. E. Fairman.

Perithecia sparsa vel seriatim posita, erumpentia, globosa depressave, atra; sporae filiformes, hyalinae, subrectae, 25–30 x 1–1.5 μ.

Sideranthus gracilis (Nutt.) Rydb.

In a lawn. Rochester. July. M. S. Baxter. Near the reservoir on Cobbs hill. Miss F. Beckwith. Introduced from the West and possibly not permanently established.

Sphaeropsis smilacis latispora n. var.

Dead branches of hispid greenbrier, S m i l a x h i s p i d a Muhl. Yates, Orleans co. March. C. E. Fairman.

This variety differs from the typical form in its broader spores. Spores 17–20 μ long, 11–13 μ broad. In the type they are 15–20 long, 6–8 μ broad.

Sporae 17–20 x 11–13 μ.

Sporotrichum grisellum Sacc.

Dead bark. Ithaca. G. F. Atkinson. Collected by C. O. Smith.

Theloschistes flavicans Wallr.

On red cedar, J u n i p e r u s v i r g i n i a n a L. Orient Point. April. R. Latham. This is a beautiful lichen but the specimens are sterile.

Thlaspi perfoliatum L.

Geneva. May. F. C. Stewart. A rare plant introduced from Europe.

Trichothecium subgriseum n. sp.

Hyphae thinly effused, covering the matrix with a very thin grayish buff subvelvety stratum, sparsely branched, septate, hyaline, 6–8 μ thick; spores obovate or oblong-elliptic, simple or obscurely uniseptate, hyaline, 16–24 μ long, 8–10 μ broad.

Decaying wood of yellow birch, B e t u l a l u t e a Mx. and sugar maple, A c e r s a c c h a r u m Marsh. Fine. August.

Apparently related to T r i c h o t h e c i u m g r i s e u m Speg. but differing in its branching hyphae and more narrow and often simple spores.

Hyphae tenuiter effusae, matricem strato tenue, griseo-luteolo subvelutino obducentes, sparse ramosae, septatae, hyalinae, 6–8 μ latae; sporae obovatae oblongae vel ellipsoideae, continuae vel obscure uniseptatae, hyalinae, 16–24 x 8–10 μ.

Triosteum perfoliatum L.

Glenmont, Albany co. June. S. H. Burnham. The specimens formerly attributed to this species are now referred to T r i o s t e u m a u r a n t i a c u m Bickn. which is the more common species in the northern part of the State.

Usnea trichodea Ach.

Orient Point. December. R. Latham. The specimens are sterile.

Vermicularia beneficiens n. sp.

Perithecia thin, depressed, orbicular or ellipsoid, .3–.5 mm broad, densely gregarious, at first covered by the epidermis, then erumpent, black, adorned with numerous black setae, sometimes paler at the top, 80–240 μ long, 4–6 μ broad; spores cylindric, straight or slightly curved, acute at one or both ends, sometimes pseudouniseptate, hyaline, 20–30 μ long, 4–4.5 μ broad; sporophores cylindric or subclavate, obtuse, crowded, 12–15 μ long.

On living stems of live-forever, Sedum purpureum Tausch. Davenport, Delaware co. July. Luther Tucker & Son. Collected by W. Gillander.

The fungus attacks the stem at or near the base which soon turns brown both without and within and becomes hollow in the affected part. The leaves, being deprived of their necessary nourishment, gradually wither, fade and drop, beginning at the lower part of the stem and gradually advancing upward until the stem is nearly or wholly denuded and finally dies. The root also early becomes discolored and must necessarily cease to perform its natural functions.

The species is similar to Vermicularia herbarum West. and may possibly have been previously confused with it, since that species has been reported as occurring on Sedum acre L., S. album L., S. maximum Suter and S. reflexum L. Our plant, however, differs not only in its host plant, but also differs from the characters assigned to V. herbarum in having the perithecia larger and densly gregarious and in having the spores longer, acute at the ends, and often spuriously septate. It also appears to be specially distinct in its parasitic character. On this account it has been announced as a beneficial fungus because of its availability as a destructive agent in destroying a weed so tenacious of life as the live-forever. This character of the fungus has suggested the specific name here assigned to it.

Perithecia tenua, depressa, orbicularia vel ellipsoidea, .3–.5 mm lata, dense gregaria, circumambientia, primum epidermide tecta, deinde erumpentia, atra, setis numerosis, rigidis, erectis vel divergentibus, acutis, atris ornata, quae aliquando apice pallescentes, 80–240 x 4–6 μ ; sporae cylindraceae, rectae vel leviter curvatae, vulgo utrinque acutae, aliquando pseudouniseptatae, hyalinae, 20–30 x 4–5 μ, basidia cylindracea subclavatave, obtusa, conferta, 12–15 μ longa.

Vermicularia pomicola n. sp.

Perithecia gregarious, hemispheric or subglobose, bristly with numerous subulate black erect or divergent setae, 120–280 μ long, 7–8 μ broad; spores straight or slightly curved, pointed at each end, 25–35 μ long, 4–5 μ broad.

On apples lying on the ground. New Lebanon. September.

Spores longer than in Vermicularia pomona Sacc. which occurs on appletree leaves and is considered a variety of V. trichella Fr.

Perithecia gregaria, hemisphaerica subglobosave, setis numerosis subulatis, atris, erectis divergentibusve ornata, 120–280 x 7–8 μ; sporae rectae vel leviter curvae, utrinque acutae, 25–35 x 4–5 μ.

Verticillium agaricinum (Lk.) Cd.

On Flammula squalida Pk. Thompsons lake, Albany co. September. The parasite forms a thin whitish pruinosity on the surface of the deformed pileus. It occurs also on the pileus of Tricholoma russula (Schaeff.) Fr. at Pittsford, Monroe co. September. F. S. Boughton. The spores of the parasite are very variable, 6–12 μ long and 4–5 μ broad. The mycelium causes the pileus to become enlarged, irregular or deformed and the lamellae to become irregular and sometimes branched or even anastomosing and discolored. It is perhaps the conidial stage of some species of Hypomyces.

Viburnum venosum Britton

Orient Point. July. R. Latham. The species is well named, the veins of the leaves being very prominent and conspicuous on the lower surface.

Vicia villosa Roth

Canton, St Lawrence co. June. G. H. Chadwick. Introduced and cultivated for fodder, but escaping from cultivation and manifesting a tendency to become naturalized. The flowers are commonly blue and resemble those of Vicia cracca L. but a white flowered form occurs.

REMARKS AND OBSERVATIONS

Aster laevis L.

A very noticeable form or possibly a variety of this species occurs on Pinnacle hill near Rochester. November. Miss F. Beckwith. It differs from the common forms in its late flowering and in its long narrow panicle the branches of which are suberect, 2.5–5 cm long.

Aster undulatus loriformis Burg.

West Fort Ann, Washington co. October. S. H. Burnham.

Boletinus paluster Pk.

This beautiful small species often grows on decaying wood and the mossy bases of trees. It has a white mycelium and pale yellow flesh. Wounds of the flesh often become red after long exposure. The flavor is tardily but sharply acrid.

Brassica arvensis (L.) Ktze.

A white flowered form occurs occasionally. Menands. July.

Cantharellus infundibuliformis nigricans n. var.

Pileus blackish; hymenium very decurrent, the decurrent part destitute of lamellae. Otherwise as in the common form with which it grows.

Among mosses in swamps. North Elba. September.

Pileus nigricans; hymenium valde decurrens, pars decurrens lamellis carens.

Ceratiomyxa fruticulosa (Muell.) Macbr.

Decaying wood. Edwards, St Lawrence co. June. A yellow form occurs growing with the common white form and sometimes confluent with it.

Clitocybe multiceps tricholoma n. var.

Flesh of the pileus rather thin, taste mild; lamellae rounded behind, slightly adnexed, otherwise like the type. Holley, Orleans co. September. C. A. Mabie.

This variety, by the attachment of the lamellae, connects the species with the genus Tricholoma, to which at first sight it is likely to be referred. The naked margin of the pileus and its close agreement in general characters with Clitocybe multiceps Pk. lead me to refer it to this species. Like it, it is edible but scarcely first quality.

Pileus tenuior, sapor mitis; lamellae adnexae.

Clitocybe dealbata sudorifica n. var.

Pileus whitish, not shining, sudorific when eaten freely. Otherwise like the typical form. Grassy ground. Saratoga Springs. November. F. G. Howland.

Pileus albidus, non nitens; sudorificus.

Mr F. G. Howland recently reported to me that the white washed mushroom, Clitocybe dealbata Sow. when eaten freely caused profuse perspiration. I, with others, had eaten sparingly of this mushroom several years ago without experiencing any ill effects. At my request he kindly sent me a good supply of the fresh mushrooms that I might try them myself. Eight caps of average size were fried slightly in butter with a little milk and flour added. These were eaten at supper time. In texture and flavor no fault could be found with them. In about half an hour perspiration began to appear on my forehead, and gradually spread over the whole body. It lasted about five hours. It was unaccompanied by any pain or distress of any kind. There seemed to be a slight acceleration of the pulse, an unusual catarrhal discharge from the nostrils, a little stimulation of the salivary glands and an occasional hiccup. At the end of five hours the perspiration ceased, I fell asleep and slept till morning when I arose feeling as well as usual. This peculiar action of the mushroom suggested the thought that possibly I had erroneously referred our mushroom to C. dealbata; that it must be some other closely related species for no record of such effects had been attributed to the white washed mushroom by those writers who have published it as edible. A careful comparison of our specimens with the published descriptions of the white washed mushrooms revealed no well-marked characters by which to separate them. In the color of the cap alone does there appear to be any available mark of distinction. This, in the white washed mushroom, is described as white and rather shining, or as one writer expresses it, "exceedingly like ivory." In our plant it is better described as whitish, or dull white, not at all shining. So close is the morphologic relationship that it appears to me to be better to separate the mushroom under consideration as a mere variety of the white washed mushroom and not as a distinct species. I would not class it as an edible mushroom but rather as a medicinal one. Its physiologic effects apparently separate it more decidedly than any of its external characters.

Clitocybe morbifera Pk., collected by F. J. Braendle near Washington, D. C., is a closely related species. Its name was suggested by the fact that those eating it had been made sick. In the dried state it is scarcely distinguishable from our sudorific mushroom in external appearance, but its stem is hollow. When fresh its pileus is tinged with grayish brown, but it becomes paler in drying. This has also been collected near Minneapolis, Minn., whence it was sent by Mrs M. E. Whetstone with an account of a case of short illness caused by it in one who ate freely of it for breakfast. Dr O. E. Fisher has sent specimens of it from Detroit, Mich., with an account of the sickness it produces and the accompanying symptoms. From these cases it appears that the ill effects of the sickening mushroom are much more serious and uncomfortable than those of the sudorific mushroom.

Cornus canadensis elongata n. f.

Stem elongated, bearing a pair of opposite leaves at each of three or four nearly equidistant nodes, or bearing a whorl of four leaves near the base and two or three pairs of opposite leaves above, instead of the usual peduncle and flower cluster. Cranberry marsh, Sand Lake, Rensselaer co. and Averyville marsh, North Elba. July and September. Sterile.

This peculiar form has the appearance of Cornus suecica L., the northern dwarf cornel, but its leaves have the venation of the common dwarf cornel. No flowering or fruiting specimens were seen.

Crataegus grayana Eggleston

This rare thorn bush occurs in a single clump on Crown Point west of the ruins of Fort Frederick. At Rossie it is represented by several clumps near the Laidlaw house and a single outlying clump about two miles south of the village.

Cronartium ribicola F. de W.

Leaves of red currant, Ribes vulgare Lam. West Fort Ann. October, 1909. S. H. Burnham. This is an interesting discovery of a new locality for this fungus of which the uredo form is the white pine rust Peridermium strobi Kleb., a pernicious pest destructive to young white pines. This station is far removed from the one originally discovered at Geneva. Fortunately it is apparently very scarce in this new locality. In neither instance was any white pine found to be affected by the rust. The question arises in each case. Whence came the spores that infected the currant leaves? Can the fungus perpetuate itself without the intervention of the white pine rust?

Daphne mezereum L.

This early spring flowering shrub is quite hardy and escaping from cultivation it becomes established in pastures and waste places. It is beautiful both in flower and in fruit. Fine specimens were contributed by Miss E. W. Mische and Mrs L. L. Goodrich. They were collected near Homer, Cortland co. and were so abundant on a hillside near the cemetery that they were cut with a scythe as if they were noxious weeds.

Euphorbia corollata L.

Sandy barrens near Bushnells Basin and Perinton, Monroe co. July and August. M. S. Baxter. This rare plant is apparently limited to the western part of the State.

Fuligo ovata (Schaeff.) Macbr.

This is one of our largest slime molds and one of the most variable in external color. A specimen found near Newport, Herkimer co. by G. S. Graves was 25 cm long, 20 cm broad and about 6 cm thick.

Glonium parvulum (Ger.) Sacc.

Decorticated wood. Orient Point. January. R. Latham. Rare.

Herpotrichia diffusa (Schw.) Ellis

In Sylloge this species stands under the name Herpotrichia rhodomphala (Berk.) Sacc. Under this name it was recorded in the Annual Report of the State Botanist for 1889, page 34. Specimens found at Orient Point in March by R. Latham have some of the perithecia wholly red, others partly so. They were growing on decaying wood of locust, Robinia pseudacacia L.

Hordeum trifurcatum Jacq.

Cultivated specimens from Medina were contributed by F. C. Stewart. It is cultivated under the name of beardless barley and is said to be very productive. It sometimes springs up spontaneously. Such specimens were erroneously reported under the name Hordeum hexastichon L.

Hydrastis canadensis L.

This valuable medicinal plant has become exceedingly rare in our State. It is therefore very gratifying to know that it still exists in Cayuga co., whence fruiting specimens were sent by E. L. Bradley.

Lecanora varia saepicola Fr.

On fence rails. Orient Point. April. R. Latham.

Lepidium draba L.

Waste ground in Syracuse near Onondaga creek. June. Mrs L. L. Goodrich. Collected by Miss Belle Douglass. This introduced plant was found many years ago near Astoria, Queens co. by Prof. D. C. Eaton, but that station for it has since been reported as destroyed.

Mycogone cervina subincarnata Pk.

In State Museum Report 32, page 44 this fungus was reported as a Sepedonium. It should be referred to the genus Mycogone and is a mere variety of Mycogone cervina Ditm. differing only in its smaller spores and more pinkish color. Its habitat is the same as that of the typical form. The spores are 20–28 μ long, 12–20 μ broad in the widest part. The upper cell is globose, verrucose, and much larger than the smooth lower cell.

Sporae subincarnatae, 20–28 x 12–20 μ.

Myxosporium castaneum quercus n. var.

Heaps slightly prominent, orbicular or oblong, erumpent through transverse chinks of the epidermis. Otherwise like the type.

Branches of chestnut oak, Quercus prinus L. Riverhead, Suffolk co. October. F. C. Stewart.

Acervuli minuti, orbiculares oblongive, per rimulas transversas in epidermide erumpentes.

Oidium destruens Pk.

This destructive parasitic fungus begins its work early in the season. Young leaves of the shad bush Amelanchier oblongifolia (T. & G.) Roem. were found near Albany affected by it the last week in April.

Parmelia borreri hypomela Tuck.

Bark of red cedar, Juniperus virginiana L. Orient Point. April. R. Latham.

Parmelia perforata hypotropa Nyl.

Bark of red cedar, Juniperus virginiana L. Orient Point. April. R. Latham.

Peronospora ficariae Tul.

Living leaves of buttercup, Ranunculus acris L. Menands. May.

Plantago media L.

Near Canandaigua. August. Miss E. C. Webster. This introduced plantain is rare. Its spikes resemble those of the English plantain but it is easily distinguished from that species by the broad, hoary pubescent leaves.

Polypodium vulgare L.

A singular small sterile fern which, on account of its venation has been referred to this species, was collected near Lake George and specimens were contributed by C. L. Williams and Mrs S. W. Russell.

The fronds are 5–12 cm long, 1–2 cm broad, sinuate lobed or irregularly pinnatifid, the lobes being broad, obtuse and unequal.

Ramalina calicaris fraxinea Fr.

Orient Point. November. R. Latham.

Roestelia aurantiaca Pk.

The orange colored rust occurs on various species of shad bush, Amelanchier, and of thorn bushes and trees, Crataegus. Also on quince trees. It attacks the leaves, fruit and sometimes the twigs. Its alternate form is Gymnosporangium clavipes

C. & P. which lives on red cedar, Juniperus virginiana L. and the common juniper, J. communis depressa Pursh. The spores of the Gymnosporangium are produced in spring and serve to infect species of shad bushes, thorn bushes and quince bushes or trees, but instead of reproducing the Gymnosporangium in them, they develop into the orange rust or Roestelia, whose spores are carried back to the red cedar or common juniper and produce in them the Gymnosporangium. The Roestelia frequently causes great loss to quince growers by attacking the young quinces and rendering them worthless. Fine specimens of it were contributed by Messrs J. A. Thomson, D. B. VanBuren, and G. G. Atwood. Quince fruits from 1–1.5 inches in diameter were practically covered by the cups of the fungus filled with their orange colored spores. In some cases even the twigs bearing the fruit had been invaded and were swollen by the fungus. This rust appears to have been unusually abundant the past season, in the western part of the State. Mr D. B. Van Buren found quince orchards there badly infested by it, even in localities where no red cedar trees were known to exist within many miles. This would indicate that the orange rust has some way of reproducing itself without the intervention of the red cedar or that some unnoticed juniper trees may exist in the vicinity of these orchards and furnish the Gymnosporangium spores. Experiments should be made by which the fact can be ascertained if the orange rust can reproduce itself in the quince either the same or the following year. Also if the mycelium may live in the twigs during the winter and renew the development of the rust in the leaves and fruit developing from the infested twigs.

Sagina decumbens (Ell.) T. & G.

Orient Point. June. R. Latham. This is a rare and delicate little plant.

Scirpus occidentalis (Wats.) Chase

Canandaigua. August. Miss E. C. Webster. The longer spikes separate this species from its near relative Scirpus validus Vahl. The plant previously reported under this name proves to be a mere form of S. validus Vahl.

Sphaerotheca humuli (DC.) Burr.

Living leaves and aments of hop vines. Middleburg, Schoharie co. G. G. Atwood. The fungus attacks the leaves, diminishing their vigor; also the aments or fruit, arresting their proper development and causing partial or sometimes serious failure of the crop.

Sporobolus cryptandrus (Torr.) Gray

Sandy soil. Webster, Monroe co. September. J. Dunbar. Orient Point. September. R. Latham. Not common.

Thaspium barbinode (Mx.) Nutt.

Rocky places near Corning. May. Rare or wanting in the eastern part of the State.

Theloschistes concolor effusus Tuck.

On bark of trees. Orient Point. January. R. Latham.

Valsonectria parasitica (Murrill) Rehm

Bark of chestnut, Castanea dentata (Marsh.) Borkh. Marlboro, Ulster co. July.

This fungus was described under the name Diaporthe parasitica, but it does not well agree with the character of that genus, inasmuch as it has a bright colored perithecium instead of a black one. It agrees much better in this respect with the genus Valsonectria. The locality here mentioned is the most northern, with one exception, of any known to me. It is also the first one in which I have seen a tree affected by this fungus, though I have looked for it for three seasons whenever I have been where chestnut trees are common. Specimens have been seen that were collected at Visher Ferry, Saratoga co. This is the most northern station for it known to me. It has been reported to have been found at Cooperstown but no specimens from that locality have been seen by me.

Viburnum dentatum L.

A form with leaves decidedly acuminate was found at Orient Point in July by R. Latham.

Vicia angustifolia segetalis (Thuill.) Koch

Orient Point. July. R. Latham.

Viola pallens (Banks) Brainerd

In woods. Edwards. May. This violet was formerly confused with Viola blanda Willd. It is separated from it by the dull reddish spots of the petioles and scapes, the bearded lateral petals and the broader upper petals. In our specimens the capsules are subglobose and about twice as long as the sagittate sepals.

NEW SPECIES AND VARIETIES OF EXTRALIMITAL FUNGI

Agaricus floridanus

Pileus hemispheric or campanulate, becoming nearly plane rimosely areolate or slightly strigose, becoming glabrous, whitish with a yellow or yellowish center; lamellae at first white, then pink, finally dark brown or blackish; stem easily separable from the pileus, equal or slightly thickened at the base, solid, becoming fibrous when old, whitish, annulus small; spores globose or broadly elliptic, 5–6 μ long, 4–5 μ broad.

Pileus 9–15 cm broad; stem 5–10 cm long, 1.5–3 cm thick.

Single or subcespitose. Grassy fields of sandy soil. DeFuniak Springs, Florida. March. G. Clyde Fisher.

The mycelium often binds the particles of sand into a globose mass which adheres to the base of the stem. This gives the stem a bulbous appearance, though it is not strictly bulbous. This species is apparently closely allied to Agaricus campester americanus Speg. a South American species. It may be separated from that variety by its rimosely areolate pileus, its stem easily separating from the pileus, solid and not bulbous, and by its smaller annulus. The spores are the same size in both and smaller than in the common mushroom. In both the lamellae are at first white.

Pileus hemisphericus campanulatusve, deinde subplanus, rimose areolatus substrigosus, demum glaber, albidus, in centro luteus vel flavidus; lamellae primo albae, deinde incarnatae, postremo atro-brunneae vel nigricantes; stipes ex pileo facile separabilis, aequalis vel basi subincrassatus, solidus, in senectute fibrosus, albidus, annulus parvus; sporae globosae vel late ellipsoideae, 5–6 x .4–5 μ.

Boletus gertrudiae

Pileus fleshy, broadly convex, glabrous, soft, dry or nearly so, orange yellow or brownish yellow, rarely bright yellow, flesh white, unchangeable; tubes long, bright yellow when young, brownish yellow when mature, adnate or but slightly rounded at the stem, the mouths minute; stem rather long, equal or nearly so, solid, glabrous, yellow above, white below, white within or sometimes more or less yellow within the upper part; spores oblong fusiform, 15–20 μ long, 5–6 μ broad.

Pileus 5–12 cm broad; stem 10–15 cm long, 12–24 mm thick.

Ground in woods. Old Lyme, Connecticut. August. H. L. Wells.

This is a fine large species with a beautifully colored stem, the upper half usually bright yellow, the lower half white. The two colors sometimes blend into each other and sometimes are quite definitely terminated. They grow scattered but sometimes two with stems united at the base. The pileus is apt to be badly infested by insect larvae. This species may well commemorate Miss Gertrude Wells who, though young in years, has already manifested a remarkable interest in mushrooms and a wonderful proficiency in the knowledge of them.

Pileus carneus, late convexus, glaber, mollis, siccus, aurantiaco-luteus vel brunneo-luteus, rare flavidus, carne alba, immutabile; tubuli longi, primus flavidi, deinde fulvo-ochraecei, adnati vel circum stipitem leviter depressi, pori minuti; stipes longus, subaequalis, solidus, glaber, supra flavidus, infra albus, carne intra alba, vel supra flavida; sporae oblongae vel fusiformes, 15–20 x 5–6 µ.

Cercospora verbenae-strictae

Spots numerous, small, angular, yellowish green; hyphae hypophyllous, tufted, short, simple, slightly colored, 20–40 µ long, 4–5 µ broad; spores slender, commonly tapering upward, obscurely 3–6-septate, hyaline, 20–100 µ long, 3–4 µ broad.

Lower surface of living or languishing leaves of Verbena stricta Vent. Stockton, Kansas. August. E. Bartholomew and W. T. Swingle.

Maculae numerosae, parvae, angulares, luteo-virides; hyphae hypophyllae, caespitosae, breves, simplices, leviter coloratae, 20–40 x 4–5 µ; sporae graciles, vulgo sursum attenuatae, obscure 3–6-septatae, hyalinae, 20–100 x 3–4 µ.

Clitocybe subnigricans

Pileus fleshy in the center, thin toward the margin, convex becoming nearly plane, glabrous, whitish or smoky white, flesh whitish, slowly changing to grayish on exposure to the air, taste slightly and tardily acrid, odor earthy, slightly pungent and disagreeable, persistent, lamellae thin, narrow, close, slightly or in some specimens very much decurrent, whitish becoming blackish where bruised and in drying; stem solid, slightly fibrous striate, somewhat thickened or distinctly bulbous at the base, colored like the pileus but becoming blackish in drying; spores white, 6–7 μ long, 4–6 μ broad.

Pileus 2.5–5 cm broad; stem 4–7.5 cm long, 6–12 mm thick.

Subcespitose or gregarious. Rye Beach, New Hampshire. G. B. Fessenden.

A fine species easily distinguished by its strong odor and the blackening of the lamellae and stem where bruised and in drying.

Pileus carneus, ad marginem tenuis, convexus, demum subplanus, glaber, albidus vel fumoso-albus, caro albida, vulnera ad griseum tarde mutantia, sapor leviter et tarde acris, odor terrenus, ingratus, persistens; lamellae tenues, angustae, confertae, leviter vel valde decurrentes, albidae, ubi vulneratae nigricantes et in siccitate; stipes solidus, leviter fibroso-striatus, basi incrassatus vel bulbosus, albidus, in siccitate nigricans; sporae albae, 6–7 x 4–6 μ.

Clitopilus washingtoniensis Braend. in lit.

Pileus thin, broadly convex, nearly plane or centrally depressed, sometimes undulate on the margin, glabrous, at first bluish, soon pale purple or mauve, flesh white, taste mild; lamellae narrow, close, decurrent, slightly tinged with pink; stem short, central, eccentric or almost lateral, equal or tapering downward, fibrillose and longitudinally rimulose, solid, brownish; spores elliptic, 6–7 μ long, 4–5 μ broad.

Pileus 1.6–2.5 cm broad; stem 1–2 cm long, 2–4 mm thick.

Gregarious or cespitose. Washington, D. C. June. F. J. Braendle.

Remarkable for the peculiar colors of the pileus and for its variable attachment to the stem.

Pileus tenuis, late convexus subplanus vel in centro depressus, glaber, aliquando margine undatus, primus subcaeruleus deinde pallide purpureus, carne alba, sapore miti; lamellae angustae, confertae, decurrentes, subincarnatae; stipes brevis, centralis, eccentricus vel sublateralis, aequalis vel infra attenuatus, fibrillosus, in longum rimulosus, solidus, brunneus; sporae ellipsoideae, 6–7 x 4–5 μ.

Coniothecium perplexum

Effused, forming a thin black crust; hyphae inconspicuous, short, continuous, creeping, colored, 3–4 μ in diameter; spores minute, subglobose or irregular, colored, 4–6 μ in diameter, persistently adhering and forming subglobose, irregular or oblong opaque masses, 20–40 μ in diameter or 20–35 μ long, 40–60 μ broad.

Decaying wood of ash posts below the surface of the ground. Stockton, Kansas. December. E. Bartholomew.

Effusum, stratum tenue nigrum formans; hyphae inconspicuae, breves, continuae, repentes, fuscae, 3–4 μ crassae; sporae minutae, subglobosae vel irregulares, fuscae, 4–6 μ in diam., persistenter adherentes, acervulosque subglobosos, irregulares vel oblongos nigricantes formantes, 20–40 μ in diam. vel 20–35 x 40–60 μ.

Cylindrosporium conservans

Spots numerous, amphigenous, suborbicular, sometimes confluent, 1–3 mm broad, green; acervuli epiphyllous, commonly 1–6 on a spot; spores filiform, curved, 40–75 μ long, 3–4 μ broad, oozing out and forming persistent whitish or honey colored masses or tendrils.

Leaves of Scouler's willow, Salix scouleriana Barr Rolling Bay, Washington. August. E. Bartholomew.

The spots are surrounded by the yellow or greenish yellow tissue of the leaves, the fungus apparently preventing the discoloration of the tissues in proximity to it. This character is suggestive of the specific name. The center of the spots appears paler on the upper surface because of the spore masses.

Maculae numerosae, amphigenae, suborbiculares, aliquando confluentes, 1–3 mm latae, virides; acervuli epiphylli, vulgo 1–6 in quavis macula; sporae filiformes, 40–75 x 3–4 μ, curvatae, exundantes et massas aut claviculas persistentes albidas melleasve formantes.

Diaporthe callicarpae

Stroma effused, thin, blackening the surface of the wood; perithecia immersed in the wood, commonly 2–6, depressed-globose, .3–.5 mm broad, black, ostiola minute, barely emerging from the blackened surface of the wood and rupturing the epidermis; asci very slender, narrowed at each end, 60–80 μ long, 6–8 μ broad, spores distichous, 4-nucleate, 12–15 μ long, 3–4 μ broad.

Dead stems of Sambucus callicarpa Greene. Rolling Bay, Washington. August. E. Bartholomew.

This species belongs to the section Euporthe. The spores and asci are very slender and the septum of the former is scarcely perceptible.

Stroma effusum, tenue, ligni superficiem nigricans; perithecia in ligno immersa, vulgo 2–6, depresso-globosa, .3–.5 mm lata, nigra, ostiola minuta ligni superficiem vix superantia; asci graciles, utrinque attenuati, 60–80 x 6–8 μ; sporae distichae, 4-nucleatae, 12–15 x 3–4 μ.

Diplodia alni-rubrae

Perithecia densely gregarious, sunk in the bark, covered by the slightly elevated epidermis, .3–.5 μ broad; spores ellipsoid or broadly ellipsoid, oozing out and staining the matrix black, 16–20 μ long, 10–14 μ broad.

Rolling Bay, Washington. August. E. Bartholomew.

The dead bark of Alnus rubra Bong. Closely related to Diplodia alni Fckl., but with shorter and broader spores which emerge and stain the matrix black.

Perithecia dense gregaria, in cortice insculpta, epidermide leviter elevata tecta, .3–.5 μ lata; sporae ellipsoideae vel late ellipsoidae, exudantes matricemque inquinantes, 16–20 x 10–14 μ.

Flammula graveolens

Pileus fleshy, broadly convex or nearly plane, sometimes slightly depressed in the center, viscid, glabrous or very obscurely innately fibrillose, reddish brown or yellowish brown, at first paler on the margin, the thin pellicle subseparable, flesh pale yellow, odor strong, earthy; lamellae thin, moderately close, adnate or slightly decurrent, pale yellow becoming subferruginous; stem equal or tapering at the base, solid or with a very narrow cavity, silky fibrillose, pale yellow without and within, becoming brownish at the base, veil floccose or webby, pale yellow, visible in the young plant, soon disappearing; spores brownish ferruginous, elliptic, 6–8 μ long, 4–5 μ broad.

Pileus 2.5–7 cm broad; stem 5–7 cm long, 5–10 mm thick.

Under pine trees. West Gloucester, Massachusetts. October. Mrs E. B. Blackford.

A species well marked by its pale yellow flesh veil and stem, its viscid pileus, brownish ferruginous spores and strong odor. It is sometimes cespitose.

Pileus carneus, late convexus vel subplanus, aliquando in centro depressus, viscidus, glaber aut obscure fibrillosus, rufo-brunneus vel flavo-brunneus, primus margine pallidior, pellicula tenue subseparabile, carne flavida, odore grave, terraneo; lamellae tenues subconfertae, adnatae, vel subdecurrentes, flavidae, deinde subferrugineae; stipes aequalis vel basi attenuatus, solidus vel leviter cavus, sericeo-fibrillosus, extra intraque flavidus, demum basi brunneus, velum floccosum arachnoideumve, flavidum, evanescens; sporae brunneo-ferruginosae, ellipsoideae, 6–8 x 4–5 μ.

Hebeloma flexuosipes

Pileus thin, convex, glabrous, slightly viscid when moist, dingy buff or clay brown, flesh white; lamellae close, adnate, brownish ferruginous; stem fibrous, equal or slightly thickened at the base, flexuous, solid or stuffed, pruinose-pubescent and minutely glandular at the top, pallid or similar to the pileus in color, with an abundant white fibrillose mycelium at the base, veil none; spores subellipsoid, brownish ferruginous, 12–16 μ long, 7–9 μ broad.

Pileus 2.5–6 cm broad; stem 3.5–7.5 cm long, 4–8 mm thick.

Ground. Schenley park, Pittsburg, Pennsylvania. July. D. R. Sumstine. Said to be edible.

Pileus tenuis, convexus, glaber, viscidulus, luteolus vel argillaceo-brunneus, carne alba; lamellae confertae, adnatae, brunneo-ferrugineae; stipes fibrosus aequalis vel leviter basi incrassatus, flexuosus, solidus farctusve, ad apicem pruinoso-pubescens et minute glandulosus, pallidus vel pileo in colore similis, velo nullo, mycelio fibrilloso, abundante, candido; sporae subellipsoideae, brunneo-ferruginosae, 12–16 x 7–9 μ.

Helminthosporium subapiculatum

Tufts effused, black; hyphae erect, rigid, subflexuous, often nodulose and irregular above, obscurely septate, variable in length, 8–10 μ thick; spores variable, oblong or subfusiform, 6–7-septate, 35–80 μ long, 12–16 μ broad.

Dead wood of Sambucus callicarpa Greene. Rolling Bay, Washington. August. E. Bartholomew.

It is related to Helminthosporium apiculatum Cd. but differs in its longer oblong spores without an apiculus.

Caespites effusi, atri; hyphae erectae, rigidae, subflexuosae, saepe superne nodulosae et irregulares, obscure septatae, 8–10 μ crassae; sporae variables, oblongae vel subfusiformes, 6–7-septatae, 35–80 x 12–16 μ.

Hormiscium ambrosiae

Tufts commonly effused, black; chains of spores persistent, straight or slightly curved, commonly tapering toward the apex or broader in the middle and tapering toward each end, 40–100 μ long;

spores subglobose, commonly broader than long, colored, smooth, 4–16 in a chain, 6–10 μ long, 8–18 μ broad.

On dead stems of Ambrosia trifida L. Louisville, Kansas. September. E. Bartholomew.

Caespites vulgo effusi, atri; catenae sporarum simplices persistentes, rectae vel leviter curvatae, vulgo ad apicem attenuatae vel in parte media latiores utrinque angustatae, 40–100 μ longae; sporae subglobosae, leves, fuscae, 4–16 in quavis catena, 6–10 x 8–18 μ.

Hypoxylon bartholomaei

Stroma effused, thin, about 1 mm thick, 2–3 cm long, .5–1 cm broad, subelliptic, sometimes with a slight narrow sterile black margin, even, black, opaque; perithecia monostichous, subglobose, .5 mm broad, the ostiola scarcely visible; asci cylindric, 160–200 μ long, 8–12 μ broad; spores monostichous, ellipsoid, at first pale and 1–2-nucleate, then colored, 16–24 μ long, 8–12 μ broad; paraphyses filiform.

On decorticated wood of red alder, Alnus rubra Bong. Rolling Bay, Washington. August. E. Bartholomew.

The distinguishing characters of this species are the thin subelliptic stroma and its dull even black surface. The ostiola are not visible to the naked eye. The young conidial state not seen.

Stroma effusum, tenue, circiter 1 mm thick, 2–3 cm longum, .5–1 cm latum, subellipticum, leve, atrum, opacum; perithecia monosticha, subglobosa, .5 mm lata, ostiola vix visibilia; asci cylindracei, 160–200 x 8–12 μ; sporae monostichae, ellipsoideae, primo pallidae, uninucleatae vel binucleatae, deinde coloratae, 16–24 x 8–12 μ; paraphyses filiformes.

Lepiota allenae

Pileus thin, conic, convex or campanulate, widely striate on the margin, unpolished, whitish or tinged with pale yellow, often yellowish brown in the center; lamellae thin, 1–2 mm broad, free, close, whitish or tinged with pale yellow; stem slightly tapering upward, glabrous, hollow, colored like the pileus, the annulus slight, persistent or evanescent; spores broadly ellipsoid or subglobose, 5–7 μ long, 4–6 μ broad.

Pileus 8–15 mm broad; stem 12–20 mm long, 1–2 mm thick.

Cespitose. In a greenhouse. Newtonville, Massachusetts. August. Miss L. C. Allen.

This is a small delicate, beautiful, and nearly uniformly colored species. The small smooth disk is sometimes brown or yellowish brown and in very young plants looks like a cap on the apex of the small undeveloped pileus. It may possibly be an introduced species. It is respectfully dedicated to its discoverer.

Pileus tenuis, conicus, convexus campanulatusve, margine late striatus, impolitus, albidus flavidusve, saepe in centro flavido-brunneus; lamellae tenues, 1–2 mm latae, liberae, confertae, albidae flavidaeve; stipes supra leviter attenuatus, glaber, cavus, pileo in colore similis, annulus parvus, persistens vel evanescens; sporae late ellipsoideae, vel subglobosae, 5–7 x 4–6 μ.

Leptonia longistriata

Pileus conic or convex, submembranous, fragile, umbilicate, subhygrophanous, squamulose, striatulate nearly or quite to the umbilicus both when moist and when dry, grayish brown; lamellae thin, fragile, subdistant, eroded or wavy on the edge, whitish becoming flesh color; stem straight, slender, tough, glabrous, shining when dry, hollow, colored like the pileus with a white mycelium at the base; spores irregular or angular, uninucleate, 12–16 μ long, 8–10 μ broad.

Pileus 1–1.5 cm broad; stem 3–5 cm long, 1–2 mm thick.

Ground by roadsides. Stow, Massachusetts. August. S. Davis.

The distinguishing character of this species is the widely striated margin which is suggestive of the specific name.

Pileus conicus convexusve, submembranaceus, fragilis, umbilicatus, subhygrophanus, squamulosus, fere ad umbilicum striatulatus, griseo-brunneus; lamellae tenues, fragiles, subdistantes, acie erosae undulataeve, albidae deinde incarnatae; stipes strictus, gracilis, lentus, glaber, in siccitate nitens, cavus, in colore pileo similis, basi mycelio albido; sporae irregulares angularesve, uninucleatae, 12–16 x 8–10 μ.

Leptonia strictipes

Pileus thin, campanulate or convex, obtuse or slightly umbilicate, even or striatulate on the thin margin, yellow brown or dark brown; lamellae thin, narrow, close, adnate or slightly sinuate with a decurrent tooth, dusted and subincarnate by the spores; stem long, slender, straight, glabrous, hollow, equal or slightly tapering upward, with a whitish mycelium at the base; spores angular, uninucleate, commonly with an oblique apiculus at one end, 10–14 μ long, 7–9 μ broad.

Pileus 1.5–2.5 cm broad; stem 6–8 cm long; 2–3 mm thick.

Among sphagnum. Taylor's swamp, Stow, Massachusetts. August. S. Davis.

Known by its variously colored pileus and long straight stem. It is a larger species than Leptonia longistriata Pk. to which it is closely related, and has a different habit and habitat and smaller spores.

Pileus tenuis, campanulatus convexusve, obtusus vel leviter umbilicatus margine tenue levis striatulatusve, flavo-brunneus vel nigro-brunneus; lamellae tenues, angustae, confertae, adnatae vel leviter sinuatae dente decurrente; sporis pulverulentae, subincarnatae; stipes longus, gracilis, rectus, glaber, cavus, aequalis vel sursum leviter attenuatus, basi mycelio albido; sporae angulares, uninucleatae, vulgo oblique apiculatae, 10–14 x 7–9 μ.

Macrophoma suspecta

Perithecia minute, 120–160 μ broad, gregarious or scattered, occupying large areas on the upper surface of the lower leaves, at first covered by the epidermis, then erumpent, thin, convex, orbicular, opening by a pore, black; spores oblong or cylindric, obtuse, hyaline, continuous, 2–4-nucleate, 12–18 μ long, 4–5 μ broad.

Dead basal leaves of winter wheat, Triticum vulgare Vill. Lexington, Kentucky. May and June. H. Garman.

Related to Phoma hennebergii J. Kuehn but differing in its place of growth and in its broader spores and perithecia. It is suspected of killing the host plant, hence the specific name. This is very distinct from Colletotrichum cereale Manns, which is parasitic on wheat, rye, oats, barley and various grasses in Ohio.

This species is a good illustration of the difficulty sometimes encountered in assigning definite limits to a genus. The genus Macrophoma was first suggested by Professor Saccardo as one that might be instituted for the reception of species of Phoma having rather thick perithecia and spores. Berlese and Voglino, acting on this suggestion, instituted the genus Macrophoma and included in it species whose spores should equal 15 μ or more in length. The spores in the species here described vary in length from 12–18 μ. It therefore stands on the border line between Phoma and Macrophoma and so far as this character goes might be placed in either genus. Because some of the spores exceed the limiting dimension we have placed the species in Macrophoma.

thought it might be possible to find an occasional perithecium in which no spores would be 15 μ long.

Perithecia minuta, 120–160 μ in diam., gregaria sparsave, foliorum basalium areas magnas occupantia, primum epidermide tecta, tenua, convexa, orbicularia, poro aperientia, atra; sporae oblongae vel cylindraceae, utrinque rotundatae, hyalinae, continuae, 2–4-nucleatae, 12–18 x 4–5 μ.

Microdiplodia viciae

Perithecia hypophyllous, sometimes amphigenous, thin, covered by the epidermis, erumpent, black, 80–120 μ in diameter; spores at first hyaline, then colored, ellipsoid or oblong, 8–12 μ long, 4–5 μ broad, not at all or but slightly constricted at the septum.

Dead leaves of linear leaved vetch, Vicia linearis (Nutt.) Greene. Stockton, Kansas. May. E. Bartholomew.

The spores are similar in size and shape to those of Microdiplodia mori Allesch., but the habitat is so distinct it is scarcely probable that the two can be the same.

Perithecia hypophylla, aliquando amphigena, tenua, epidermide tecta, erumpentia, nigra, 80–120 μ in diam.; sporae primo hyalinae, demum fuscae, ellipsoideae oblongaeve, 8–12 x 4–5 μ, non aut vix constrictae ad septum.

Nolanea howellii

Pileus thin, conic or convex, minutely tomentulose, intensely blue; lamellae broad, adnate, subdistant, pale yellow or straw color, becoming flesh color; stem slender, equal, hollow, glabrous, but covered with white silky fibrils at the base, colored like the pileus; spores oblong or subglobose, angular, with an oblique apiculus at the base, 10–12 μ long, 7–8 μ broad.

Pileus 1–2 cm broad; stem 4–6 cm long, 1–2 mm thick.

Among fallen leaves in damp places in thick woods. Rockville, Indiana. September. G. T. Howell.

Colored much like Nolanea atrocyanea Clem. but a much larger species. From N. caelestina Fr. it scarcely differs except in the yellowish color of the young lamellae, the uniform deep blue color of the pileus and the longer stem with white silky fibrils at the base. Respectfully dedicated to its discoverer.

Pileus tenuis, conicus convexusve, minute tomentosulus, intense caeruleus; lamellae latae, adnatae, subdistantes, stramineae, deinde incarnatae; stipes gracilis, aequalis, cavus, glaber, basi fibrillis albis sericeis tectus, pileo in colore similis; sporae oblongae subglobosaeve, angulares, oblique apiculatae, 10–12 x 7–8 μ.

Ombrophila thujina

Cups minute, .5–.75 mm broad, scattered or subcespitose, sessile or subsessile; hymenium plane or convex, not or scarcely margined, pale orange; asci oblong or subclavate, 90–100 μ long, 15–20 μ broad; spores crowded or distichous in the asci, oblong or subfusiform, rounded at the ends, hyaline, 18–22 μ long, 6–8 μ broad; paraphyses filiform, free at the tips.

Smooth bark of the branches of white cedar, Thuja occidentalis L. Near London, Ontario. J. Dearness.

This differs from Ombrophila enterochroma (Pk.) Sacc. in being less distinctly stipitate or sessile, in retaining its color in drying, in its less fusiform spores and in the free, not agglutinate, apices of its asci and paraphyses.

Ascomata minuta, .5–.75 mm lata, sparsa vel subcaespitosa, sessilia vel subsessilia; hymenium planum vel convexum, submarginatum, pallide aurantiacum; asci oblongi vel subclavati, 90–100 x 15–20 μ; sporae in ascis confertae vel subdistchae, oblongae vel subfusiformes, utrinque rotundae, hyalinae, 18–22 x 6–8 μ; paraphyses filiformes, apicibus liberis.

Ovularia stachydis-ciliatae

Spots angular, 2–5 mm broad, limited by the veinlets, subconfluent, pale yellowish green, sometimes becoming brownish or reddish brown; hyphae hypophyllous, very short, hyaline; spores very variable, globose, obovate or ellipsoid, hyaline, 6–16 μ long, 6–12 μ broad.

Living leaves of Stachys ciliata Dougl. Alki Point, Washington. August. E. Bartholomew.

The hyphae and spores form a thin inconspicuous grayish covering on the spots beneath.

Maculae angulares, 2–5 mm latae, venulis limitatae, subconfluentes, pallide flavo-virides, aliquando brunnescentes vel rufobrunneae; hyphae hypophyllae, brevissimae, hyalinae; sporae variabiles, globosae, obovatae vel ellipsoideae, hyalinae, 6–16 x 6–12 μ.

Phyllosticta paupercula

Spots very small, .5–1 mm broad, numerous, sometimes confluent, angular or suborbicular, reddish brown or whitish, scarcely visible on the lower surface of the leaf; perithecia minute, epiphyllous, one or two on a spot, black; spores ellipsoid, 4–6 μ long, 3–3.5 μ broad.

Living leaves of cultivated Amelanchier alnifolia Nutt. Stockton, Kansas. September. E. Bartholomew.

Closely related to Phyllosticta prunicola (Op.) Sacc., P. mahaleb Thuem. and P. mespili Sacc. but easily distinguished by the peculiarly colored and very small spots and by the small number of the perithecia on a spot.

Maculae minutae, .5–1 mm latae, numerosae quandoque confluentes, angulares aut suborbiculares, rufo-brunneae vel albidae, infra vix visibiles; perithecia minuta, epiphylla, in aliqua macula unum duove, atra; sporae ellipsoideae, 4–6 x 3–3.5 μ.

Russula eccentrica

Pileus fleshy but thin, firm, eccentric or deformed, at first centrally depressed, with even incurved margin, becoming nearly plane, dry, glabrous, brownish or brownish gray, faintly reddish brown when dry, flesh white, odor disagreeable; lamellae thin, subdistant, broad, adnate or adnexed, pallid or tinged with pink, becoming reddish where wounded, reddish brown and subpruinose with age or in drying; stem smooth, equal, spongy within, white; spores subglobose, even or nearly so, 6–7 μ in diameter.

Pileus 5–10 cm broad; stem 4–6 cm long, 1.5–3 cm thick.

Grassy ravine in open oak woods. Near St Louis, Missouri. August. Rare and local. N. M. Glatfelter.

This is the third species known in which wounds assume a reddish color. From Russula nigricans (Bull.) Fr. it differs in its dry and eccentric pileus not becoming blackish and from R. densifolia Secr. in its eccentric pileus and subdistant pinkish tinted lamellae. It belongs to the section Compactae.

Pileus carneus, tenuis, firmus, eccentricus vel deformatus, primus centro depressus, margine leve incurvato, deinde subplanus, siccus, glaber, brunneus vel brunneo-griseus, siccitate leviter rufo-brunneus, carne alba, odore ingrato; lamellae tenues, subdistantes, latae, adnatae vel adnexae, pallidae vel subincarnatae, rufescentes ubi vulneratae, in aetate vel siccitate rufo-brunneae et subpruinosae; stipes aequalis, levis, intus spongiosus, albus; sporae subglobosae, subleves, 6–7 μ in diam.

Septoria aceris-macrophylli

Spots distinct, orbicular, 3–8 mm broad, amphigenous, pale reddish, slightly paler in the center; perithecia minute, 1/6 mm broad, on the upper surface of the leaf, central, few, black; spores filiform, curved, 20–40 μ long, 1.5–2 μ broad.

Living leaves of A c e r m a c r o p h y l l u m Pursh. Port Madison, Washington. August. E. Bartholomew.

Maculae distinctae, suborbiculares, 3–8 mm latae, amphigenae, pallide rufescentes, centro leviter pallidiores; perithecia minuta, 1/6 mm lata, in pagina folii superiore, centralia, pauca, nigra; sporae filiformes, curvae, 20–40 x 1.5–2 μ.

Septoria angustissima

Spots amphigenous, .5–1.5 cm broad, sometimes confluent and occupying half the leaf or more, reddish brown above, paler beneath, not brown margined; perithecia mostly epiphyllous, densely gregarious, orbicular, about .5 mm broad, depressed or broadly conic, opening by a central pore, black; spores filiform, extremely slender, curved or straight, continuous, eguttulate, hyaline, 18–30 μ long, scarcely 1 μ broad; sporophores shorter and thicker.

On leaves of osage orange, M a c l u r a p o m i f e r a (Raf.) Schneider. Aberdeen, Mississippi. August. F. D. Kern. Collected by T. C. Frye.

Remarkable for its very narrow spores.

Maculae amphigenae, .5–1.5 cm latae, aliquando confluentes foliique partem dimidian occupantes, supra rufo-brunneae, infra pallidiores; perithecia vulgo epiphylla, dense gregaria, orbicularia depressa vel late conica, poro aperientia, nigra; sporae filiformes, pergraciles, curvatae rectaeve, hyalinae, eguttulatae, 18–30 x 1 μ; sporophori breviores et crassiores.

Septoria ficarioides

Spots amphigenous, suborbicular, usually only one or two on a leaf, pallid; perithecia few, epiphyllous, 100–150 μ in diameter, black; spores filiform, straight or slightly curved, hyaline, 25–40 long, 1–2 μ broad.

Leaves of R a n u n c u l u s c y m b a l a r i a Pursh. Wood River, Nebraska. July. E. Bartholomew. Collected by J. M. Bates.

Closely related to Septoria ficariae Desm. but differing in the color of its spots and in its larger and black perithecia, fewer on a spot, and in its different host plant.

Maculae amphigenae, suborbiculares, in folio quoque vulgo unus vel duo, pallidae; perithecia, pauca, epiphylla, 100–150 μ in diam., atra; sporae filiformes, rectae vel curvulae, hyalinae, 25–40 x 1–2 μ.

Septoria samarae

Perithecia minute, 80–120 μ in diameter, numerous, amphigenous, occupying the whole wing of the fruit, superficial, black; spores filiform, curved or rarely flexuous, hyaline, 22–44 μ long, 1.5–2 broad.

Wing of the fruit of box elder, Acer negundo L. and the dwarf mountain maple, Acer glabrum Torr. Morrison, Colorado. September. E. Bartholomew. Collected by E. Bethel. Golden, Colorado. E. Bethel.

The wings have lost their green color, but the covering of the seed is still green.

Perithecia minuta, 80–120 μ in diam., numerosa, amphigena omnino fructus alam occupantia, superficialia, atra; sporae filiformes curvatae vel rare flexuosae hyalinae 22–44 x 1.5–2 μ.

Sphaeromyces delphinii

Subiculum of few radiating branched colored hyphae; sporophores short, very dense; spores catenulate, oblong or subfusiform, forming a dense subglobose brown or black mass, subhyaline by transmitted light, 8–12 μ long, 1.5–2 μ broad.

Dead stems of western larkspur, Delphinium occidentale Wats. August. Salt Lake co., Utah. E. Bartholomew. Collected by A. O. Garrett.

In the spore character this species does not agree well with the character of the genus to which it is here referred, but it seems better to place it here than to make a new genus for its reception. Both it and the species on which the genus was founded are manifestly very rare. In some of the specimens the sporodochium appears to sit upon a gelatinous film which at length becomes blackened by a layer of the fallen spores.

Subiculum hyphis paucis, radiantibus, fuscis, sparse ramosis compositum; sporophori breves, densissimi; sporae catenulatae oblongae vel subfusiformes, massam subglobosam densam fuscam nigramve formantes, subhyalinae sub lente, 8–12 x 1.5–2 μ.

Sphaeropsis melanconioides

Perithecia membranous, orbicular or discoid, 1–2 mm broad, wanting or scarcely developed above, numerous, nestling in the bark to which it is adnate at the base, erumpent, black; spores compact, ellipsoid or oblong, 16–24 long, 10–12 μ broad, supported on more or less slender filiform hyaline sporophores.

Dead branches of Ailanthus glandulosus Desf. Stockton, Kansas. September. E. Bartholomew.

The perithecia are so imperfectly developed that the fungus might easily be mistaken for a species of Melanconium. Hence the specific name.

Perithecia membranacea, orbicularia discoideave, 1–2 mm lata, parte superiore carentia, numerosa, in cortice nidulantia, basi adnata, erumpentia, atra; sporae compactae, ellipsoideae oblongaeve, 16–24 x 10–12 μ, sporophoris hyalinis gracilibus vel filiformibus suffultae.

Sporotrichum chryseum

Hyphae slender, 3–4 μ thick, continuous, long, intricate, hyaline, forming a soft thin subrosy separable membrane, golden yellow beneath; spores abundant, minute, globose, 2.5–3 μ in diameter.

On the hymenium of a resupinate form of Fomes conchatus (Pers.) Fr. Bloomington, Indiana. J. M. VanHook.

The spores appear to give the yellow color to the under surface.

Hyphae graciles, 3–4 μ crassae, continuae, longae, intricatae, hyalinae, membranam mollen tenuem subroseam separabilem subter aureum formanies; sporae abundantes, minutae, globosae, 2.5–3 μ in diam.

Basidiophora kellermanii paupercula

Spots few, small, more scattered, snowy white; oospores globose, smaller, 20–24 μ in diameter.

Living leaves of Iva xanthifolia Nutt. Chama, New Mexico. August. E. Bartholomew. Collected by W. T. Swingle.

Maculae paucae, parvae, sparsiores, candidae; oosporae globosae, minores, 20–24 μ in diam.

Boletus chrysenteron sphagnorum

Pileus hemispheric or very convex, reddish brown, the extreme margin thin, slightly surpassing the hymenium, incurved, flesh white or whitish; tubes longer than the thickness of the flesh.

Pileus 2–3 cm broad; stem 2–4 cm long, 5–8 mm thick.

Among sphagnum. Stow, Massachusetts. September. S. Davis.

The peculiar habitat, deeply convex reddish brown pileus with its slightly extended incurved margin and white flesh are distinguishing features of this variety. In the last mentioned character it resembles Boletus albocarneus Pk.

Pileus hemisphaericus convexissimusve, badius, praeter lamellas margine tenue incurvo extentus, carne alba albidave; tubuli pilei carnis carassitate longiores.

Melanconium bicolor candidum

This differs from the typical form in having the stroma pure white and the spores obovate or narrowed toward one end.

Bark of red mulberry, Morus rubra L. Rolling Bay, Washington. July. E. Bartholomew.

Stroma candidum; sporae obovatae vel basi angustatae.

EDIBLE FUNGI

Boletus albus Pk.

WHITE BOLETUS

Plate 121, figures 1–5

Pileus convex, viscid when moist, white, flesh white or yellowish; tubes small or medium, subrotund, adnate, whitish becoming yellow or ochraceous; stem short, equal or slightly tapering downward, glandular dotted, white; spores ochraceous, subfusiform, 8–9 μ long, 4–4.5 μ broad.

The white boletus is easily distinguished from all our other species by its white viscid cap and its glandular dotted stem. Its cap varies in its horizontal diameter from 1.5–3.5 inches. It is generally convex, but in large plants it is often expanded until it is nearly or quite plane. Its white color is not well retained in drying. It is therefore important to see fresh specimens in order to identify the species satisfactorily. The flesh is white or barely tinged with yellow. Sometimes the fresh plant emits a peculiar, somewhat fetid or strong, odor.

The tubes in the young plant are whitish or but slightly tinged with yellow, but when mature they are ochraceous and the mouths are dotted with dark reddish brown glands. The stem is short, generally less than the diameter of the cap, cylindric or slightly narrowed at the base, solid, without any collar, dotted with reddish brown glands and white or sometimes tinged with pink at the base. It occurs in the vicinity of pine and hemlock trees during July and August. It is not very common. It has an agreeable flavor, is tender and harmless.

Cantharellus aurantiacus (Wulf.) Fr.

ORANGE CHANTARELLE FALSE CHANTARELLE

Plate 122, figures 8–16

Pileus fleshy, soft, minutely tomentose, plane or centrally depressed, yellowish orange, sometimes tinged with smoky brown or brownish in the center only, flesh whitish or yellowish; lamellae narrow, close, decurrent, repeatedly forked, reddish orange, sometimes yellowish orange; stem equal or slightly tapering upward, solid, glabrous, colored like or paler than the pileus; spores subellipsoid, 6–8 μ long, 4–5 μ broad.

The orange chantarelle is sharply separated from the other species by its usually bright orange gills which are regularly and repeatedly forked. The cap varies from 1–3 inches broad and its upper surfaces may be convex, nearly flat or centrally depressed. It is soft in texture and covered with a minute scarcely visible tomentum. Its color is commonly a pale yellowish orange or tawny orange more or less suffused with a dull smoky tint. Sometimes the center is more distinctly brownish than the margin. The extreme margin is frequently decurved or involute. The flesh is soft, whitish or slightly yellowish.

The gills are very pretty by reason of their commonly bright orange color and regular forking.

The stem is 1–3 inches long and 2–5 lines thick. It is solid, equal in diameter throughout its length or sometimes slightly narrowed upward. In color it is generally similar to the cap, though usually paler and sometimes even darker or blackened toward the base.

There is a rare form in which the cap is white or nearly so. There is also a variety p a l l i d u s Pk. in which both cap and gills are pale yellow or whitish yellow. It occurs in swamps.

The orange chantarelle occurs most often in woods and uncultivated places in hilly and mountainous regions from July to October. It was formerly reputed poisonous or dangerous and credited with having a disagreeable flavor. In my own experiments with it the flavor has been found to be agreeable and fair trials of eating it have shown it to be perfectly harmless. I therefore have no hesitation in adding it to our list of edible species.

Lactarius camphoratus (Bull.) Fr.

CAMPHORY LACTARIUS

Plate 126, figures 1–7

Pileus thin, convex, nearly plane or centrally depressed, often with a small umbo, glabrous, dry, bay red or brownish red, flesh tinged with the color of the pileus, milk white, taste mild; lamellae thin, narrow, close, adnate or slightly decurrent, dull reddish or similar to the pileus; stem subequal, glabrous, stuffed or hollow, colored like or a little paler than the pileus; spores globose, white, 8–9 μ in diameter.

The camphory lactarius is closely related to the sweetish lactarius, Lactarius subdulcis (Bull.) Fr. from which it is separated by its darker red color and its agreeable odor. In color it approaches Lactarius rufus (Scop.) Fr. from which its smaller size and mild taste easily separate it. Its umbo, when present, is very small and its margin is sometimes wavy. The color is generally bay red, but occasionally it approaches the color of the cap of the sweetish lactarius from which the odor is then the most available character for the separation of these species.

The gills also are occasionally paler than usual and thereby tend to the confusion of these two species. The odor is less pronounced in the fresh plant than in the dry. It becomes more distinct in drying and persists a long time. It is not like that of camphor as the name would suggest, but resembles more the odor of dried melilot. It is not always wholly dispelled by cooking, but the flavor is not in our opinion a serious objection to the edibility of this mushroom. It occurs in swamps, wet places and in woods from July to September.

Lactarius lignyotus Fr.

SOOTY LACTARIUS

Plate 123, figures 1–6

Pileus convex, plane or slightly depressed, dry, with or without a small umbo, often radiately wrinkled in the center, pruinosely velvety, even on the margin or crenately lobed and distantly but briefly plicate striate, sooty brown, flesh white, milk white, taste mild or tardily and slightly acrid; lamellae subdistant, adnate or slightly decurrent, white or creamy yellow, assuming reddish tints where wounded; stem equal or tapering upward, stuffed, rather long, colored like the pileus; spores globose, echinulate, 8–10 μ in diameter.

The sooty lactarius is a very noticeable species, well marked by its dark brown color, velvety appearance, long stem and wounds of the gills and flesh slowly assuming reddish hues.

The cap varies from 1–4 inches broad, and is usually marked in the center by slight radiating rugosities or wrinkles. It is often marked by a small central prominence. Its dark sooty color and soft velvety appearance are attractive features. The margin is sometimes even, sometimes scalloped and marked with short parallel striations.

The gills are moderately distant from each other, and vary in color from white to creamy yellow or pale ochraceous. Where cut or broken the wounds slowly assume a reddish tint. The milk is scanty, white and mild.

The stem is generally from 2–4 inches long and 2–4 lines thick, but sometimes these dimensions are exceeded. It is often abruptly narrowed at the top and there slightly striate. Its color is like that of the cap.

It occurs most often in hilly or mountainous places, growing in shaded, mossy or damp places in woods and swamps. It is an excellent edible species, and occurs from July to September.

Variety tenuipes Pk. has the pileus about 1 inch broad, and the stem 2–3 inches long and about 2 lines thick.

Lycoperdon atropurpureum Vitt.

PURPLE SPORED PUFF BALL

Plate 121, figures 6–10

Peridium variable in size and shape, 1–2 inches broad, globose, subglobose or obovoid, clothed with slender hairs or spinules which are longer and convergent on the upper part of the peridium, shorter or wanting on the lower part, grayish, brownish or blackish above, paler below, easily rubbed off, commonly disappearing from the mature peridium, the young peridium is whitish below, tinged with gray or brown above, the whole becoming at last smooth, shining and brown, the interior at first fleshy, white, becoming olivaceous with age and finally purplish brown, dry and dusty; the threads of the capillitium are branched, the main stem is about equal in thickness to the diameter of the spores; spores purplish brown, globose, warted, 5–7 μ in diameter.

Ground in woods or in bushy places. August to September. Common.

This, like other puff balls, is edible only while the flesh is clear white. When it assumes a yellow hue it is no longer palatable and when it becomes dry and dusty with the mature spores no one would think of eating it. In the edible state the texture and color of the flesh of this species may be compared to those of a very fine grained soft cottage cheese.

CRANBERRY AND AVERYVILLE MARSHES

Cranberry marsh is in the eastern part of the town of Sand Lake, Rensselaer county. It is an irregular oblong marsh apparently about a half mile long and one-fifth mile broad in its widest part. A sluggish stream flows centrally through its longest diameter. Sphagnum moss is plentiful and forms a soft carpet over most of its surface. Cranberries were formerly produced on it in great abundance, but now these plants are limited to the banks of the stream and a few of the more wet and boggy places. The surface of the marsh is mostly much more firm than it was sixty years ago. Shrubs are more numerous and widespread and small coniferous trees have sprung up in some of the older parts. Some of the orchids that beautified the marsh less than twenty-five years ago have now nearly or quite disappeared. The purple fringed orchis is no longer found there, and of the white fringed orchis only a single flowering specimen was seen in my recent visits. The bladder-fruited or bottle sedge, which formerly bore seed freely there, has now become smaller, less vigorous and completely sterile. The changed conditions induced by the destruction of the surrounding forests and the often recurring summer drouths are gradually exterminating those plants that require a more uniform temperature and constant moisture. The advancing shrubs crowd out or overpower the weaker and less persistent herbaceous plants. This marsh is steadily approaching the shrubby stage in which sphagnum and marsh herbs will scarcely be able to maintain their existence. The number of species of flowering plants and ferns found in this marsh is 76.

Averyville marsh is in the town of North Elba, Essex county. It is about three miles south of Lake Placid. It is apparently about one mile long and one-third mile broad in its widest part. Near the middle it is much more narrow than toward either end by reason of the encroachment of the forest on both sides. This contraction in width divides it into two nearly equal parts, the northern and southern. Chub river runs through its longest diameter from south to north. At the contracted part and for a short distance north of it the river runs close to the margin of the forest on the eastern side, leaving most of the marsh here on the west side of the river. In the rest of the marsh the river is more central. This marsh is peculiar in having the two parts wholly unlike in character and representative of two different kinds of marsh. The northern part is a shrubby marsh. Low shrubs like Labrador tea, sheep laurel, pale laurel, bog rosemary and leather leaf have taken almost complete possession. The usual marsh herbs are nearly exterminated except along the banks of the river and in a few low places. The sphagnum has a dwarf, starved appearance and is evidently struggling for existence. A few dwarf, unthrifty black spruce and tamarack trees are scattered here and there over this part of the marsh. The balsam fir is strangely absent from the open space, but it occurs sparingly along the margin. It is apparently less fitted to endure the unfavorable conditions of the marsh than either the black spruce or the tamarack.

The southern part is a grassy marsh. It is locally known as a "beaver meadow." It is mostly occupied by grasses and sedges. Blue joint grass, Calamagrostis canadensis (Mx.) Bv. and slender sedge, Carex filiformis L. are the prevailing species. They are so abundant that in past times it was customary to mow this part of the marsh and stack the hay till winter when it would be possible to draw it away and make use of it. The scaffoldings of the stacks are still in place, but as this marsh hay is of inferior quality it is not now gathered, other hay of better quality being available. It is remarkable that not a single example of the slender sedge gave any evidence of having borne fruit this season. My visit was too late in the season to find fruit on the plant, but a careful search for old fruit-bearing stems was vain. Possibly the previous cuttings of the plants weakened their fruiting capacity till now they depend entirely on offshoots or stolons for propagation. On the contrary, the blue joint grass was fruiting freely.

The grassy marsh, like the open prairie, appears to be unfavorable to the production of trees. No spruce or tamarack trees were seen in this part of the marsh. Even the shrubs that are so abundant in the northern part are mostly wanting here. Those that do appear are chiefly along or near the river.

The number of species of flowering plants and ferns found in this marsh is 57. This is considerably less than the number found in Cranberry marsh, though the area of the marsh is apparently more than twice as large. On the other hand, but one visit was made here and that so late in the season that probably some early flowering herbaceous species were overlooked.

A list of the names of the species found in each marsh is given below. It will be seen that 33 species are common to both marshes. This is more than half the number of species found in Averyville marsh. These are species likely to be found in most of our larger cold sphagnum bogs and marshes. They are the active agents in the formation of peat beds and in preparing the marsh for the habitation of the larger shrubs and trees. In other words, they are the forerunners of swamps, the trees and shrubs of which, in turn, prepare the way for productive lowland meadows and truck gardens. Of the 33 species common to the two marshes 15, or nearly half, are trees or shrubs. This indicates an advanced stage of the marshes toward a wooded swamp. In Bonaparte swamp the number of trees and shrubs is 29, in Cranberry marsh 20, in Averyville marsh 21. The number of species common to the three marshes is 19. In the following list of species will be found the names of the species of each of the two marshes and those common to the three marshes.

Plants of Cranberry marsh, Sand Lake, Rensselaer co.

Abies balsamea *(L.) Mill.*
Acer rubrum *L.*
Alnus incana *(L.) Moench*
Andromeda glaucophylla *Lk.*
Arisaema triphyllum *(L.) Schott*
Aspidium cristatum *(L.) Sw.*
A. noveboracense *(L.) Sw.*
Aster puniceus *L.*
Calamagrostis canadensis *(Mx.)*
Calla palustris *L.*
Calopogon pulchellus *(Sw.) R. Br.*
Carex canescens *L.*
C. filiformis *L.*
C. folliculata *L.*
C. intumescens *Rudge*
C. leptalea *Wahl.*
C. limosa *L.*
C. magellanica *Lam.*
C. pauciflora *Lightf.*
Carex stell. angustata *Carey*
C. trisperma *Dew.*
C. utriculata *Boott*
Chamaedaphne calyculata *(L.)*
Chelone glabra *L.*
Cinna latifolia *(Trev.) Griseb.*
Cornus canadensis elongata *Pk.*
Drosera longifolia *L.*
D. rotundifolia *L.*
Dulichium arundinaceum *L.*
Epilobium palustre *L.*
Eriophorum callitrix *Cham.*
E. virginicum *L.*
Galium palustre *L.*
Gaultheria procumbens *L.*
Glyceria canadensis *(Mx.) Trin.*
G. pallida *(Torr.) Trin.*
G. torreyana *(Spreng.)*
Habenaria blephariglottis *(Willd.)*

Habenaria clavellata *(Mx.)*
Hypericum virginicum *L.*
Impatiens biflora *Walt.*
Iris versicolor *L.*
Kalmia angustifolia *L.*
K. polifolia *Wang.*
Larix laricina *(DuRoi) Koch*
Ledum groenlandicum *Oeder*
Lycopodium inundatum *L.*
Lycopus virginicus *L.*
Lysimachia terrestris *(L.) BSP.*
Menyanthes trifoliata *L.*
Nemopanthes mucronata *(L.) Trel.*
Nymphaea advena *Ait.*
Picea mariana *(Mill.) BSP.*
P. rubra *(DuRoi) Dietr.*
Pinus strobus L.
Pogonia ophioglossoides *(L.)*
Polygonum sagittatum *L.*
Potomogeton epihydrus *Raf.*
Pyrus melanocarpa *(Mx.) Willd.*
Rosa blanda *Ait.*
Rubus hispidus *L.*
R. triflorus *Richards.*
Rynchospora alba *(L.) Vahl*
Sarracenia purpurea *L.*
Scheuchzeria palustris *L.*
Scutellaria lateriflora *L.*
Sparganium minimum *Fr.*
Spiraea latifolia *Borkh.*
Trientalis americana *Pers.*
Utricularia cornuta *Mx.*
Vaccinium canadense *Kalm*
V. corymbosum *L.*
V. macrocarpon *Ait.*
V. oxycoccos *L.*
V. pennsylvanicum *Lam.*
Viburnum cassinoides *L.*

Plants of Averyville marsh, North Elba, Essex co.

Abies balsamea *(L.) Mill.*
Agrostis hyemalis *(Walt.) BSP.*
Alnus incana *(L.) Moench*
Andromeda glaucophylla *Lk.*
Aspidium cristatum *(L.) Sw.*
Aster puniceus *L.*
A. umbellatus *Mill.*
Bromus altissimus *Pursh*
Calamagrostis canadensis *(Mx.)*
Campanula aparinoides *Pursh*
Carex filiformis *L.*
C. leptalea *Wahl.*
C. pauciflora *Lightf.*
Chamaedaphne calyculata *(L.)*
Cicuta bulbifera *L.*
Cirsium muticum *Mx.*
Cornus canadensis elongata *Pk.*
C. stolonifera *Mx.*
Dalibarda repens *L.*
Epilobium palustre *L.*
Eriophorum callitrix *Cham.*
E. virginicum *L.*
Eupatorium purpureum *L.*
Galium asprellum *Mx.*
Gaultheria procumbens *L.*
Gentiana linearis *Froel.*
Glyceria canadensis *(Mx.) Trin.*
Hippuris vulgaris *L.*
Hypericum ellipticum *Hook.*
Hypericum virginicum *L.*
Iris versicolor *L.*
Juncus brevicaudatus *(Engelm.)*
Kalmia angustifolia *L.*
K. polifolia *Wang.*
Larix laricina *(DuRoi) Koch*
Ledum groenlandicum *Oeder*
Lysimachia terrestris *(L.) BSP.*
Nemopanthes mucronata *(L.) Trel.*
Nymphaea hybrida *(Pk.)*
Picea mariana *(Mill.) BSP.*
Potamogeton epihydrus *Raf.*
Pyrus americana *(Marsh.) DC.*
P. melanocarpa *(Mx.) Willd.*
Rubus triflorus *Richards.*
Salix rostrata *Richards.*
Sambucus canadensis *L.*
Senecio robbinsii *Oakes*
Solidago altissima *L.*
S. serotina *Ait.*
S. uliginosa *Nutt.*
Spiraea latifolia *Borkh.*
Thalictrum polygamum *Muhl.*
Thuja occidentalis *L.*
Vaccinium canadense *Kalm*
V. oxycoccos *L.*
V. pennsylvanicum *Lam.*
Viburnum cassinoides *L.*

Common to the two marshes

Abies balsamea *(L.) Mill.*
Alnus incana *(L.) Moench*
Andromeda glaucophylla *Lk.*
Aspidium cristatum *(L.) Sw.*
Aster puniceus *L.*
Calamagrostis canadensis *(Mx.)*
Carex filiformis *L.*
C. leptalea *Wahl.*
C. pauciflora *Lightf.*
Chamaedaphne calyculata *(L.)*
Cornus canadensis elongata *Pk.*
Epilobium palustre *L.*
Eriophorum callitrix *Cham.*
E. virginicum *L.*
Gaultheria procumbens *L.*
Glyceria canadensis *(Mx.) Trin.*
Hypericum virginicum *L.*
Iris versicolor *L.*
Kalmia angustifolia *L.*
K. polifolia *Wang.*
Larix laricina *(DuRoi) Koch*
Ledum groenlandicum *Oeder*
Lysimachia terrestris *(L.) BSP.*
Nemopanthes mucronata *(L.) Trel.*
Picea mariana *(Mill.) BSP.*
Potamogeton epihydrus *Raf.*
Pyrus melanocarpa *(Mx.) Willd.*
Rubus triflorus *Richards.*
Spiraea latifolia *Borkh.*
Vaccinium canadense *Kalm*
V. oxycoccos *L.*
V. pennsylvanicum *Lam.*
Viburnum cassinoides *L.*

Common to the two marshes and Bonaparte swamp

Abies balsamea *(L.) Mill.*
Alnus incana *(L.) Moench*
Andromeda glaucophylla *Lk.*
Aster puniceus *L*
Calamagrostis canadensis *(Mx.)*
Chamaedaphne calyculata *(L.)*
Carex filiformis *L.*
C. leptalea *Wahl.*
Epilobium palustre *L.*
Eriophorum callitrix *Cham.*
E. virginicum *L.*
Glyceria canadensis *(Mx.) Trin.*
Hypericum virginicum *L.*
Iris versicolor *L.*
Ledum groenlandicum *Oeder*
Nemopanthes mucronata *(L.) Trel.*
Picea mariana *(Mill.) BSP.*
Rubus triflorus *Richards*
Vaccinium oxycoccos *L.*

NEW YORK SPECIES OF HYPHOLOMA

Hypholoma Fr.

Pileus more or less fleshy, the margin at first incurved; lamellae adnate or sinuate and adnexed; veil interwoven, adhering in fragments to the margin of the pileus, not forming a distinct membranous annulus on the stem; spores brown or purplish brown.

The appendiculate character of the margin of the young pileus is a distinguishing feature of the genus and is suggestive of its name. Many of the species grow on wood and are cespitose in their mode of growth. The spore color is brown or purplish brown, but in a few species the spore print on white paper is almost black. The genus corresponds in structure to the white spored genus Tricholoma, the pink spored Entoloma and the ochraceous spored

Hebeloma. Species with a luxuriant development of the veil must be carefully distinguished from Stropharia on one hand, and those with a scanty development of it, from Psilocybe on the other. The species are not in all cases sharply limited and connecting forms are not always satisfactorily located. They have been distributed in five sections, one of which, the Viscida, is yet unrepresented in our flora. The following synoptical key gives the distinguishing characters of the sections.

KEY TO THE SECTIONS

Pileus hygrophanous ....Appendiculata
Pileus not hygrophanous..................................1
1 Pileus glabrous red or yellow its prevailing colors........Fascicularia
1 Pileus not wholly glabrous and with other prevailing colors.............2
2 Pileus silky or floccose when young........................Floccosa
2 Pileus hairy or fibrillose, brown or brownish...............Velutina

Appendiculata

Pileus hygrophanous, glabrous when mature.

The species are commonly small, the pileus rarely exceeding two inches in diameter. They inhabit decaying wood or ground rich in humus and are gregarious or cespitose. The color of the pileus in some species is greatly changed by the escape of its moisture, in others but slightly. This may be regarded as a difficult section because of the variability of the species and their close resemblance to each other.

KEY TO THE SPECIES

Pileus at first whitish or yellowish..........................incertum
Pileus at first some other color..................................1
1 Young lamellae violaceous..............................candolleanum
1 Young lamellae not violaceous....................................2
2 Moisture of fresh pileus escaping first from the margin...madeodiscum
2 Moisture of fresh pileus escaping first from the center............3
3 Plants gregarious, terrestrial..........................hymenocephalum
3 Plants commonly cespitose and lignatile................appendiculatum

Hypholoma incertum Pk.

UNCERTAIN HYPHOLOMA

N. Y. State Mus. Rep't 29, p.40. Mus. Mem. 4, p.165, pl.60, fig.1-9

Pileus thin, fragile, ovate or subcampanulate becoming yellow, especially in the center, commonly white when dry, even or radiately wrinkled, the thin margin sometimes wavy or irregular and when young adorned with fragments of the white fugacious veil, flesh white; lamellae thin, close, narrow, adnate, whitish then rosy brown, finally purplish brown; stem equal, hollow, easily splitting, white or whitish; spores 8–10 μ long, 4–6 μ broad.

Pileus 2–6 cm broad; stem 2.5–7 cm long, 2–6 mm thick.

Gregarious or sparingly cespitose in lawns, pastures, grassy and bushy places and by roadsides in showery weather. May to September. Common. Edible and of excellent flavor.

This species differs from the next following species in its paler young pileus, its adnate lamellae which also are not at first violaceous and in its stem which is not striate at the top. It differs also from the appendiculate hypholoma, Hypholoma appendiculatum (Bull.) Fr. by its paler pileus, its larger spores, its more gregarious habit and in its habitat. It occasionally has the pileus radiately and areolately rimose.

Hypholoma candolleanum Fr.

CANDOLLE HYPHOLOMA

Sylloge V, p.1038

Pileus fleshy but thin, convex or subcampanulate, becoming expanded, obtuse, glabrous, hygrophanous, bay when young and moist, white with a yellowish center when dry, flesh white; lamellae rounded behind, adnexed, close, at first violaceous, then cinnamon brown; stem fragile, subfibrillose, hollow, striate at the apex, white; spores 8–9 μ long, 4–5 μ broad.

Pileus 5–10 cm broad; stem 5–7 cm long, 3–6 mm thick.

Cespitose. Growing on the ground. Silver Springs, Wyoming co. August. Rare.

We have not seen young and fresh specimens of this plant and doubtfully admit it on the strength of specimens which, in this case as in others so referred, do not show young lamellae with a violaceous color, though in other respects they appear to belong to it. Even the figures of it given in Mycological Illustrations and in Illustrations of British Fungi do not show this color to the lamellae, though the description of the species requires it.

Hypholoma madeodiscum Pk.

MOIST DISK HYPHOLOMA

N. Y. State Mus. Rep't 38, p.88

Pileus thin, convex becoming nearly plane, hygrophanous, reddish brown when moist, grayish, tawny or ochraceous and rugose in the center when dry, the moisture escaping first from the margin, slightly silky fibrillose on the margin when young; lamellae close, slightly sinuate, adnexed, whitish becoming brown or purplish brown; stem equal or slightly thickened at the base, hollow, slightly silky fibrillose, obscurely striate at the apex, white; spores 8–10 μ long, 5–6 μ broad.

Pileus 2.5–5 cm broad, stem 4–7 cm long, 4–6 mm thick.

Single or gregarious. Decaying wood. Adirondack mountains. June. Rare. Found but once.

Remarkable for the persistency of the moisture in the center of the pileus. This character is suggestive of the specific name and separates it from allied species. It has some points of agreement with the candolle hypholoma, Hypholoma candolleanum Fr., but differs from it in its mode of growth and in the color of the young lamellae.

Hypholoma hymenocephalum Pk.

THIN CAP HYPHOLOMA

N. Y. State Mus. Rep't 31, p.34

Pileus very thin and fragile, campanulate or convex becoming expanded, sometimes umbonate, hygrophanous, brown and striatulate when moist, pallid or whitish and radiately rugulose when dry, subatomate, the whitish appendiculate veil soon evanescent; lamellae thin, narrow, close, dingy white becoming purplish brown; stem slender, fragile, hollow, striate, slightly mealy at the top, white; spores 8 μ long, 4 μ broad.

Pileus 2.5–5 cm broad; stem 5–10 cm long, 2–3 mm thick.

Gregarious. Damp ground among fallen leaves, especially under shrubs or small trees. Occasional. July and August.

The species is remarkable for its very thin and fragile pileus and for its fragile striate stem. The margin of the pileus is sometimes deeply split, forming radiating lobes and giving a stellate appearance to the cap.

Hypholoma appendiculatum (Bull.) Fr.

APPENDICULATE HYPHOLOMA

Sylloge V, p.1039

Pileus thin, fleshy, ovoid or convex becoming expanded, glabrous, hygrophanous, bay brown or tawny brown when moist, ochraceous or pale ochraceous and rugose after the escape of the moisture;

lamellae close, narrow, adnate, whitish or creamy white becoming purplish brown; stem slender, equal, hollow, glabrous, pruinose at the top, white, the veil webby, white or whitish attached to the margin of the pileus when young, quickly disappearing; spores 5–7 μ long, 3–4 μ broad.

Pileus 2–6 cm broad; stem 5–7 cm long, 4–6 mm thick.

Densely cespitose. Decaying wood chiefly in woods of hilly or mountainous districts. August to October.

This name as used by Bulliard appears to have been applied to at least two species and on this account some confusion has resulted. In the Outlines of British Fungology, plate 11, figures 3 and 4, two species are evidently included under this name. In Sylloge V, page 1039, the name is limited to the species represented by figure 3. In our treatment of this species we have limited it to those specimens which best agree with the characters ascribed to it in Sylloge. The agreement is good except in the color of the gills, which in our specimens passes from whitish to purplish brown instead of incarnate brown. The peculiar characters of the species are its tendency to form dense tufts, to grow chiefly on decaying wood, to be very hygrophanous, the difference between the color of the moist cap and the dry being well marked, and in the lateness of its appearance. The dimensions of the spores are given in Sylloge as 6–8 x 3–4 μ, in British Fungus Flora as 5 x 2.5 μ. In our specimens they agree better with those given in Sylloge.

Fascicularia

Pileus tenacious, glabrous, bright colored, dry, not hygrophanous.

The flesh of the pileus in this section is thicker and more firm than in the species of the preceding one. The prevailing colors of the pileus are red and yellow and its surface is smooth and not at all hygrophanous. They usually grow in tufts on dead or decaying wood and appear in autumn. The species resemble each other closely and should be cautiously separated.

KEY TO THE SPECIES

Young stem stuffed .... sublateritium
Young stem hollow 1
1 Prevailing color of the pileus red .... perplexum
1 Prevailing color of the pileus yellow .... capnoides

Hypholoma sublateritium (Schaeff.) Fr.

BRICK RED HYPHOLOMA

Sylloge V, p.1028

Pileus fleshy, convex or nearly plane, glabrous, obtuse, dry, dark brick red, often paler on the margin, flesh whitish or yellowish, taste commonly bitter, sometimes mild; lamellae close, adnate, whitish becoming sooty olivaceous or purplish brown; stem equal or tapering downward near the base, glabrous or slightly fibrillose, stuffed, sometimes becoming hollow when old, ferruginous; spores 6–8 μ long, 3–4 μ broad.

Pileus 2.5–7.5 cm broad; stem 5–9 cm long, 4–12 mm thick.

Commonly cespitose. On or about old stumps, prostrate trunks of trees and on decaying wood covered with earth. August to November. Common. Edible. Occasionally several stems grow from a common base.

Hypholoma sublateritium squamosum Cke. Pileus spotted with appressed darker scales, otherwise like the type. This variety is rare, having been found but once. Piseco, Hamilton co. August.

Hypholoma perplexum Pk.

PERPLEXING HYPHOLOMA

N. Y. State Cab. Rep't 23, p.99. Mus. Mem. 4, p.166, pl.60, fig.10–17

Pileus convex or nearly plane, sometimes umbonate, glabrous, reddish or brownish red, usually yellowish on the margin, flesh white or whitish, taste mild; lamellae thin, close, slightly rounded behind, adnexed, pale yellow becoming tinged with green, finally purplish brown; stem rather slender, equal or nearly so, firm, hollow, slightly fibrillose, whitish or yellowish above, reddish brown below; spores 6–8 μ long, 3–4 μ broad.

Pileus 2.5–7 cm broad; stem 5–7 cm long, 4–8 mm thick.

Generally cespitose. On or about stumps or prostrate trunks of trees in woods or open places. Common. August to November. Edible.

This is very closely related to the preceding species, its distinguishing features being its commonly smaller size, paler margin of the pileus, mild taste, paler and more slender stem which is always hollow, even when young. A small form of it has been found by F. C. Stewart growing from the base of cultivated red currants. This may indicate a parasitic tendency of it.

Hypholoma capnoides Fr.

FIR WOOD HYPHOLOMA

Sylloge V, p.1028

Pileus fleshy, convex or nearly plane, obtuse, glabrous, dry, yellowish, often reddish or ochraceous in the center, flesh white, odor and taste mild; lamellae moderately close, adnate, dry, smoky gray becoming purplish or brown; stem equal or nearly so, silky, striate at the top, sometimes curved or flexuous, hollow, pallid; spores 7–8 μ long, 4–5 μ broad.

Pileus 2.5–4 cm broad; stem 4–7 cm long, 4–6 mm thick.

Single or cespitose. On or about pine and spruce stumps or prostrate trunks. Adirondack mountains and Albany co. May to September. Rare.

The Friesian description ascribes only yellowish and ochraceous colors to the pileus of this species, but in our specimens the center of the pileus is often reddish or orange tinted. This color is also shown in the figures of the species as given in Icones, plate 133, and in Illustrations of British Fungi, plate 559. The mature lamellae of the typical form are described as purplish, but in our specimens they are brown with no apparent purplish tint. We have not thought it best to separate our plant on account of this slight deviation from the description of the color of the mature lamellae of the European form of the species.

Floccosa

Pileus silky or adorned when young with superficial floccose scales. This section at present is represented in our State by two species only.

KEY TO THE SPECIES

Pileus silky or fibrillosely spotted....................aggregatum
Pileus floccosely scaly....................fragile

Hypholoma aggregatum Pk.

AGGREGATED HYPHOLOMA

N. Y. State Mus. Ann. Rep't 46, p. 106; Botanist's ed. p. 26

Pileus thin, convex or subcampanulate, obscurely spotted by appressed brownish fibrils, grayish white, flesh white; lamellae subdistant, rounded behind, adnexed, whitish becoming brown or blackish brown, whitish on the edge; stem long, slender, hollow, slightly floccose or fibrillose, white; spores 7–8 μ long, 4–5 μ broad.

Pileus 2–3 cm broad; stem 5–8 cm long, 3–4 mm thick.

Densely cespitose. Base of trees and stumps. Albany co. September. Rare.

The densely tufted mode of growth and the grayish white, obscurely spotted pileus are distinguishing features of this species. From Hypholoma silvestre Gill. it may be separated by its smaller size, densely tufted mode of growth and adnexed lamellae with no rosy tint. From Hypholoma storea Fr. it is distinguished by its hollow stem, adnexed lamellae and the absence of an umbo.

Hypholoma aggregatum sericeum Pk.

N. Y. State Mus. Bul. 54, p.972, pl.79, fig.8–14

This variety differs from the typical form in its pileus being silky and destitute of spots and in having its stem striate at the top.

Warren co. September. Rare. Edible.

The edibility of the typical form of the species has not been tested by myself, but according to McIlvaine the caps are fine.

Hypholoma fragile Pk.

FRAGILE HYPHOLOMA

N. Y. State Mus. Bul. 131, p.22, pl.V, fig.1–7

Pileus thin, fragile, conic or subcampanulate becoming convex, obtuse or subumbonate, floccosely squamulose when young, glabrous when mature, yellowish, grayish or subochraceous, sometimes more highly colored in the center, the thin margin at first appendiculate with fragments of the white veil; lamellae thin, narrow, close, adnate, whitish or pallid becoming purplish brown; stem slender, fragile, stuffed or hollow, glabrous or minutely floccose, white or pallid; spores 8–10 μ long, 4–5 μ broad.

Pileus 1.2–2.4 cm broad; stem 2.5–5 cm long, 2–3 mm thick.

Gregarious. Decayed wood and among fallen leaves in damp places in woods. Starlake, St Lawrence co. Painted Post, Steuben co. August. Not common.

A small, delicate and fragile species. The specimens from Star lake are smaller and more highly colored than the others, but do not seem worthy of separation. The dried specimens bear some resemblance to Hypholoma incertum Pk., but the absence of the hygrophanous character of the pileus, its smaller size and more fragile nature and its different habitat lead me to keep it separate.

Velutina

Pileus silky or streaked with innate fibrils, sometimes glabrous. The characters of this section, as given in Sylloge, would strictly admit only species having a silky or fibrillose pileus, but inasmuch as species like Hypholoma atrichum Berk. and H. castanophyllum Berk., of which the pileus is described as glabrous, have been admitted to it, we have extended the definition to include glabrous species which in other respects belong here. The species of the section generally have the color of the spores darker than in the preceding sections. Therefore the color of the mature lamellae is almost or quite black and the spore print on white paper appears black or nearly so. On this account the species are liable at first sight to be referred to the black spored series. The shape and size of the spores are in some cases important characters in distinguishing closely related species.

KEY TO THE SPECIES

Pileus persistently hairy squamose or fibrillose 1
Pileus partly or wholly glabrous 2
1 Plant cespitose, spores 8–10 x 5–6 μ .... lacrymabundum
1 Plant gregarious, spores 10–12 x 6–8 μ .... rigidipes
2 Pileus even, the cuticle often rimose .... boughtoni
2 Pileus rugose or radiately wrinkled 3
3 Pileus tawny, spores rough .... rugocephalum
3 Pileus brown, spores smooth .... delineatum

Hypholoma lacrymabundum Fr.

WEEPING HYPHOLOMA

Sylloge V, p.1033

Pileus fleshy, convex, obtuse, persistently squamose with dark brown or blackish hairy tufts, not hygrophanous, often irregular from its crowded tufted mode of growth, brown or tawny brown, flesh whitish; lamellae moderately close, adnate or subsinuate, whitish becoming purplish brown, almost black when fully mature, whitish on the edge, often beaded with tearlike drops of moisture in damp weather; stem equal or nearly so, fibrillose or squamose, hollow, whitish, pallid or brownish; spores purplish brown, 8–10 μ long, 5–6 μ broad.

Pileus 5–8 cm broad; stem 5–8 cm long, 5–8 mm thick.

Single or cespitose. On or about old stumps. Albany co. August to October. Not common.

The ornamentation of the pileus is variable. The hairlike fibrils are sometimes elongated and appressed, sometimes collected in tufts. They are often black and occasionally coarse and strigose, specially on the margin.

Hypholoma rigidipes Pk.

RIGID STEM HYPHOLOMA

N. Y. State Mus. Bul. 139, p.24, pl.III, fig.1–6.

Pileus fleshy, thin, convex or broadly convex, dry, fibrillose squamulose, tawny brown, often reddish in the center, flesh whitish, taste mild; lamellae close, narrow, slightly sinuate, adnexed, brownish red becoming dark purplish brown or black; stem slender, rigid, equal, hollow, fibrillose squamulose, colored like or little paler than the pileus; spores broadly ellipsoid, apiculate, 10–12 μ long, 6–8 μ broad.

Pileus 2.5–5 cm broad; stem 5–10 cm long, 4–6 mm thick.

Gregarious. Damp places among tall herbs. North River, Warren co. September. Rare.

This species is well marked by its gregarious mode of growth. In the ornamentation of the pileus it is related to the preceding species, but it differs in its mode of growth, smaller size, more slender rigid stem and larger apiculate spores.

Hypholoma boughtoni Pk.

BOUGHTON HYPHOLOMA

N. Y. State Mus. Bul. 139, p.23, pl.II, fig.1–7

Pileus fleshy, thin except in the center, broadly convex or subhemispheric, rarely with an umbo, glabrous or slightly fibrillose, often concentrically or areolately cracking, pale reddish brown or grayish brown, flesh whitish, taste disagreeable; lamellae moderately close, adnate, purplish brown, seal brown or blackish, obscurely spotted, whitish on the edge; stem equal, floccosely fibrillose, striate at the top, hollow, white or whitish; spores broadly and unequally ellipsoid, apiculate, black on white paper, 10–12 μ long, 7–8 μ broad.

Pileus 2.5–7 cm broad; stem 2.5–6 cm long, 4–10 mm thick.

Ground in woods or open places. Albany, Monroe, New York and Tompkins counties. August and September.

Hypholoma rugocephalum Atk.

RUGOSE HYPHOLOMA

Mushrooms, Edible and Poisonous, 2d ed., p.30, pl.8, fig.29

Pileus fleshy in the center, convex becoming expanded, broadly umbonate, glabrous, irregularly wrinkled or rugose, tawny, the thin margin often curved upward, flesh tinged with yellow; lamellae thin, slightly sinuate, adnate, easily seceding from the stem, spotted, purplish black when mature; stem even, irregular, fleshy, hollow, glabrous, subbulbous, colored like the pileus, paler above the slight filamentous often spore-blackened remnants of the annulus; spores oval or broadly ellipsoid, inequilateral, pointed at each end, echinulate or minutely tuberculate, 8–11 μ long, 6–8 μ broad, black; cystidia cylindric, slightly enlarged at the top, hyaline, clustered.

Pileus 6–10 cm broad; stem 7–10 cm long, 6–10 mm thick.

Single or cespitose. Damp places in woods. July and August. Tompkins and Suffolk counties.

This is related to the preceding species from which it may be separated by its wholly glabrous tawny pileus and its rugosely wrinkled continuous cuticle. Both are allied to Hypholoma velutinum (Pers.) Fr., but may be distinguished from it by the absence of the hygrophanous character and by their broader spores.

Hypholoma delineatum n. sp.

DELINEATED HYPHOLOMA

Pileus fleshy, thin, convex or nearly plane, often slightly depressed in the center, glabrous, rugose or radiately wrinkled, commonly marked toward and on the margin even when dry with irregular radiating lines or ridges, occasionally wavy or irregular on the margin, brown, tawny brown or reddish brown, often darker in the center, flesh whitish; lamellae thin, close, adnate, brown becoming blackish brown; stem equal, glabrous, hollow, pallid or colored like the pileus; spores even, ellipsoid, not apiculate, 8–10 μ long, 4–6 μ broad; cystidia scarce, 40–60 μ long, 16–20 μ broad.

Pileus 2.5–5 cm broad; stem 3–5 cm long, 3–6 mm thick.

Gregarious. Ground and decayed wood. Port Jefferson, Suffolk co. August. Rare.

This species is likely to be easily mistaken for the preceding one, Hypholoma rugocephalum Atk., which it resembles externally but from which it is separated by its more narrow obtuse and smooth spores and by its broader flask-shaped cystidia. Its glabrous rugosely and radiately wrinkled pileus separate it from H. velutinum (Pers.) Fr. The pileus also having neither spots nor regular striations distinguishes it from H. lepidotum Bres. Specimens of it have been received from Eglon, West Virginia, and from Rockville, Indiana.

Pileus carnosus, tenuis, convexus vel subplanus, in centro aliquando leviter depressus, glaber, rugosus vel radiate rugosus, in siccitate margine striis irregularibus radiantibus ornatus, aliquando margine irregularis, brunneus fulvo-brunneus vel rufo-brunneus, frequenter in centro nigrescens, carne albida; lamellae tenues, confertae, adnatae, aliquando leviter sinuatae, brunneae deinde nigro-brunneae; stipes aequalis, glaber, cavus, pallidus vel pileo in colore similis; sporae laeves, ellipsoideae, 8–10 x 4–6 μ; cystidia 40–60 x 16–20 μ.

Several species formerly referred to this genus have been omitted because of erroneous determination or because they are more closely related to the genus Psilocybe.

NEW YORK SPECIES OF PSATHYRA

Psathyra Fr.

Pileus membranaceous, conic or campanulate, fragile, hygrophanous, the margin at first straight and appressed to the stem; mature lamellae brown or purplish brown; stem subcartilaginous, fragile, polished, hollow; veil none or only universal and floccose fibrillose.

The genus may be separated from Psilocybe by the fragile character of the pileus and stem and by the straight appressed margin of the young pileus. It is divided into three sections, Conopileae, Obtusatae and Fibrillosae. Of the first section no representative has yet been found within our limits.

Obtusatae

Pileus campanulate or convex, glabrous or atomate; lamellae plane or arcuate; veil none.

KEY TO THE SPECIES

Pileus growing on decaying wood ....conica
Pileus growing on ground among hair cap mosses............polytrichophila

Psathyra conica Pk.

CONIC PSATHYRA

N. Y. State Mus. Rep't 54, v. 1; report of the State Botanist p.153, pl.H, fig.17-22

Pileus thin, conic, rarely convex, glabrous, hygrophanous, dark brown when moist, pale ochraceous when dry; lamellae very broad, close, adnate, whitish or pallid when young, dark brown when mature, often white crenulate on the edge; stem slender, hollow, silky fibrillose, brown; spores 5-6 μ long, 3-4 μ broad.

Pileus 8-12 mm broad; stem 2-4 cm long, 1 mm thick.

Decaying prostrate trunks of spruce. Franklin co. September. Rare.

Psathyra polytrichophila Pk.

MOSS-LOVING PSATHYRA

N. Y. State Mus. Rep't 30, p. 42

Pileus thin, convex or subcampanulate, glabrous, fragile, sometimes with a slight umbo, hygrophanous, brown and striatulate on the margin when moist, pale ochraceous or buff color when dry, subshining; lamellae plane, adnate or slightly arcuate and subdecurrent, broad, subdistant, purplish brown; stem slender, equal, stuffed with a whitish pith, mealy at the top, slightly fibrillose toward the base, colored like the pileus; spores purplish brown, 8 μ long, 5 μ broad.

Pileus 4-10 mm broad; stem 2.5-5 cm long, 1-2 mm thick.

Gregarious. Ground among hair cap mosses, Polytrichum. Albany and Oneida counties. May. Rare.

Fibrillosae

Pileus and stem at first floccose or fibrillose from the universal veil.

KEY TO THE SPECIES

Pileus umbonate .... umbonata
Pileus obtuse .... vestita

Psathyra umbonata Pk.

UMBONATE PSATHYRA

N. Y. State Mus. Rep't 50 1:106

Pileus submembranous, campanulate, strongly umbonate, hygrophanous, purplish brown and striatulate when moist, grayish white when dry, even or slightly rugulose, atomate, often radiately sulcate and slightly fibrillose on the margin, the umbo usually becoming paler than the rest; lamellae broad, subdistant, ventricose, subadnate, brownish red becoming purplish brown, finally almost black; stem slender, flexuose, hollow, white, commonly hairy tomentose at the base and slightly mealy at the top; spores blackish brown or almost black, 12–16 μ long, 6–8 μ broad.

Pileus 2–3 cm broad; stem 4–7 cm long, 1.5–2 mm thick.

Gregarious or subcespitose. On chip dirt and vegetable mold. Hamilton co. July. Rare.

It is closely related to Psathyra corrugis (Pers.) Fr. from which it may be separated by its much darker colored and striatulate moist pileus, atomate and with a white umbo when dry, less glabrous and more slender stem and broader spores. The umbo is very prominent and loses its moisture before the rest of the pileus. In consequence it becomes very conspicuous, appearing like a white knob in the midst of a dark background. Because of the fibrils on the margin of the pileus it is placed in this section though the fibrils are not always present. In the dried specimens the margin is sulcate striate.

Psathyra vestita Pk.

CLOTHED PSATHYRA

N. Y. State Mus. Bul. 105, p.28

Pileus submembranaceous, ovate, conic or subcampanulate, obtuse, at first covered with white flocculent fibrils, reddish becoming pallid or white and silky fibrillose, sometimes slightly striate on the margin when moist, striate to the center when dry; lamellae thin, narrow, close, adnate, white when young, becoming blackish brown; stem equal, hollow, flexuous, floccose fibrillose becoming silky fibrillose, mealy and often striate at the top, white; spores purplish brown, 8–10 μ long, 5–6 μ broad.

Pileus 8–16 mm broad; stem 2.5–4 cm long, 2–3 mm thick.

Gregarious. Among fallen leaves and grass. Essex co. September.

This species is closely related to Psathyra semivestita B. & Br. from which it differs in color and in being wholly clothed when young with white floccose fibrils.

EXPLANATION OF PLATES

Plate 121

Boletus albus Pk.

WHITE BOLETUS

1 Young plant
2 Mature plant
3 Vertical section of upper part of a young plant
4 Vertical section of upper part of a mature plant
5 Four spores x 400

Lycoperdon atropurpureum Vitt.

PURPLE SPORED PUFF BALL

6 Two young plants
7 A mature plant
8 Vertical section of a fully grown plant while yet in edible condition
9 Vertical section of a fully mature plant
10 Four spores x 400

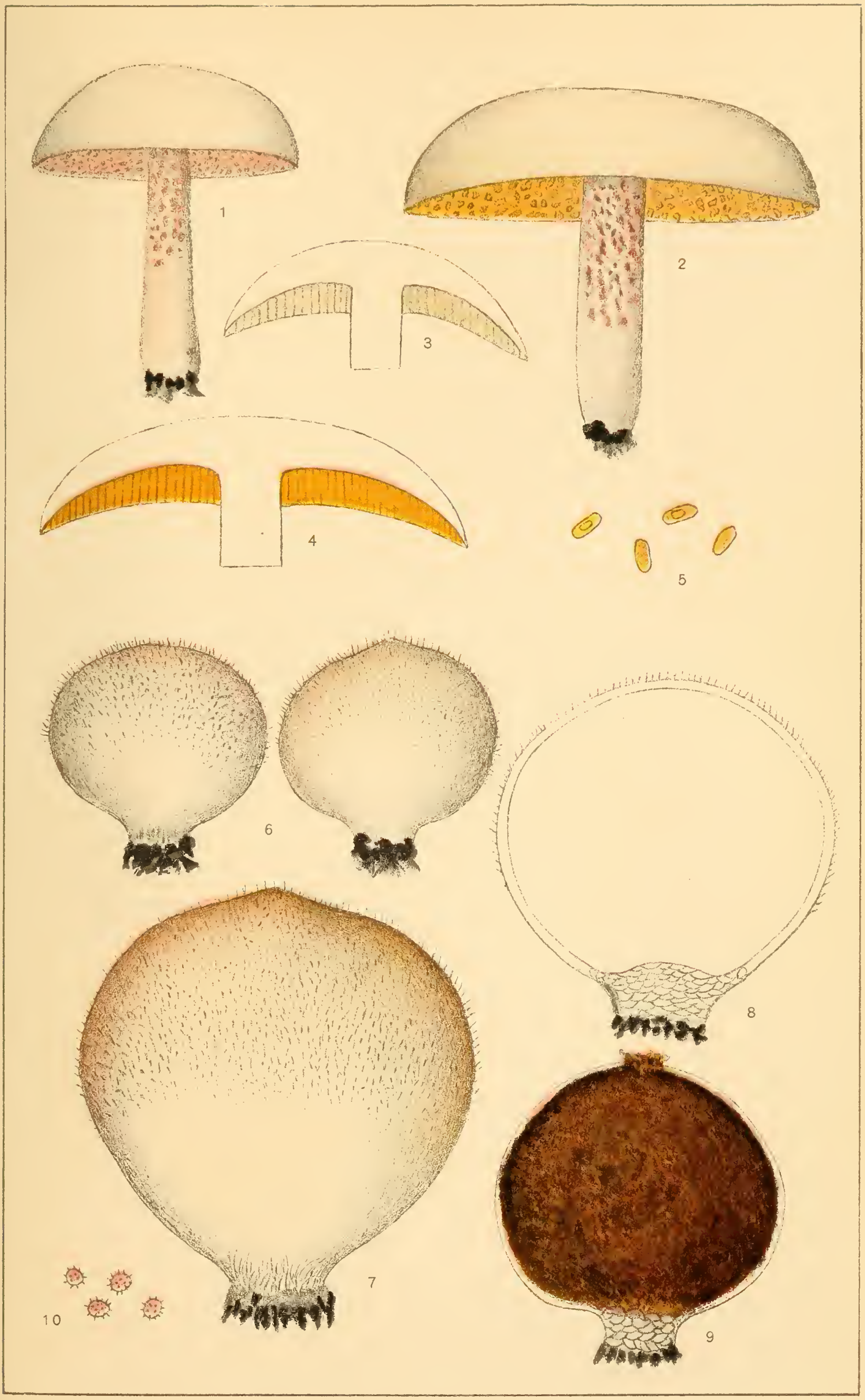


FIG. 1-5
BOLETUS ALBUS PK.
WHITE BOLETUS

FIG. 6-10
LYCOPERDON ATROPURPUREUM VITT.
PURPLE SPORED PUFF BALL

Plate 122

Lactarius camphoratus Fr.

FRAGRANT LACTARIUS

1 Young plant
2 Mature plant showing hymenium
3 Mature plant showing umbonate pileus
4–5 Vertical section of upper part of two plants
6 Transverse section of stem
7 Four spores x 400

Cantharellus aurantiacus Fr.

ORANGE CHANTARELLE

8 Young plant
9 Mature plant
10 Mature plant with brown center of pileus
11 Mature plant with gills paler than usual
12 Mature plant with white pileus and pale gills
13–14 Vertical section of upper part of two plants showing variation in color of gills
15 Diagrammatic representation of forking of the gills
16 Four spores x 400

FIG. 1-7
LACTARIUS CAMPHORATUS FR.
CAMPHORY LACTARIUS

FIG. 8-16
CANTHARELLUS AURANTIACUS FR.
ORANGE CHANTARELLE

Plate 123

Lactarius lignyotus Fr.

SOOTY LACTARIUS

1 Young plant
2 Plant of medium size showing crenate and striate margin of cap
3 Large plant with fully expanded cap showing a small umbo and irregular radiating ridges; also discolored wound of gills and drop of milk issuing from it
4 Vertical section of upper part of a young plant
5 Vertical section of upper part of a mature plant
6 Four spores x 400

LACTARIUS LIGNYOTUS Fr.

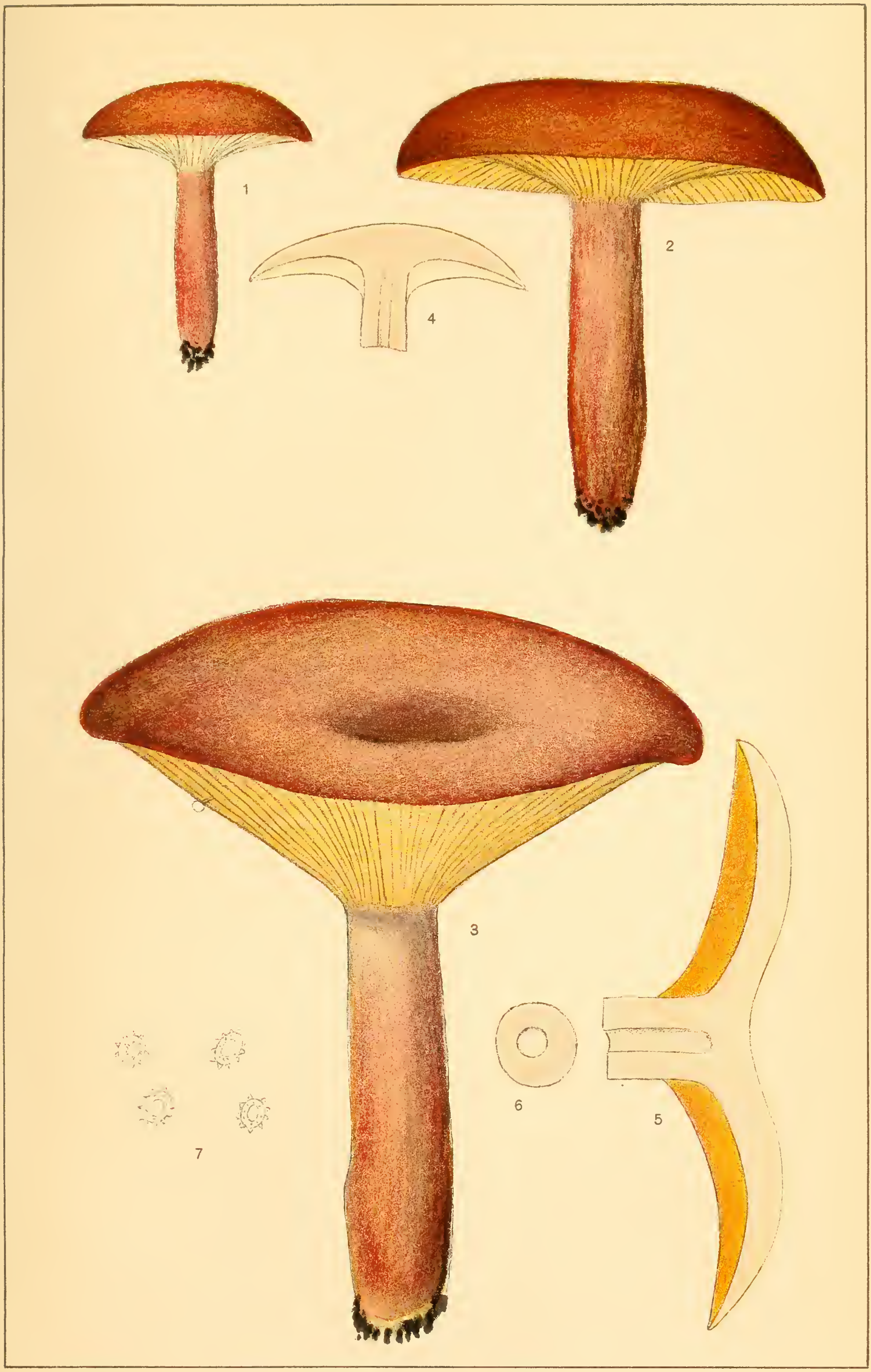
SOOTY LACTARIUS

Plate IV

Lactarius boughtoni Pk.

BOUGHTON LACTARIUS

1 Young plant
2 Middle-aged plant
3 Mature plant
4 Vertical section of upper part of a young plant
5 Vertical section of upper part of a mature plant
6 Transverse section of a stem
7 Four spores x 400



LACTARIUS BOUGHTONI Pk.

BOUGHTON LACTARIUS

Plate VI

Cortinarius croceofolius Pk.

SAFFRON-GILLED CORTINARIUS

1 Young plant
2 Middle-aged plant
3–4 Mature plants
5 Vertical section of upper part of a young plant
6 Vertical section of upper part of a mature plant
7 Transverse section of a stem
8 Four spores x 400

Clitocybe biformis Pk.

TWO-FORMED CLITOCYBE

9 Young plant
10 Middle-aged plant
11 Mature plant showing more highly colored cap and gills
12 Mature plant with eccentric stem
13 Vertical section of upper part of a middle-aged plant
14 Vertical section of upper part of a mature plant with eccentric stem
15 Four spores x 400

FIG. 1-8
CORTINARIUS CROCEOFOLIUS PK.
SAFFRON GILLED CORTINARIUS

FIG. 9-15
CLITOCYBE BIFORMIS PK.
TWO FORMED CLITOCYBE

INDEX

Appendix 5

Archeology

Museum Bulletin 144

Education Department Bulletin

Published fortnightly by the University of the State of New York

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

No. 482 ALBANY, N. Y. November 1, 1910

New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 144

IROQUOIS USES OF MAIZE AND OTHER FOOD PLANTS

BY

ARTHUR C. PARKER

New York State Education Department

Science Division, September 27, 1910

Hon. Andrew S. Draper LL.D.

Commissioner of Education

Sɪʀ: I have the honor to submit herewith for your approval, a manuscript entitled *Iroquois Uses of Maize and Other Food Plants,* which has been prepared by Arthur C. Parker, Archeologist of the State Museum, and to recommend its publication as a museum bulletin.

Very respectfully

Jᴏʜɴ M. Cʟᴀʀᴋᴇ

Director

State of New York
Education Department
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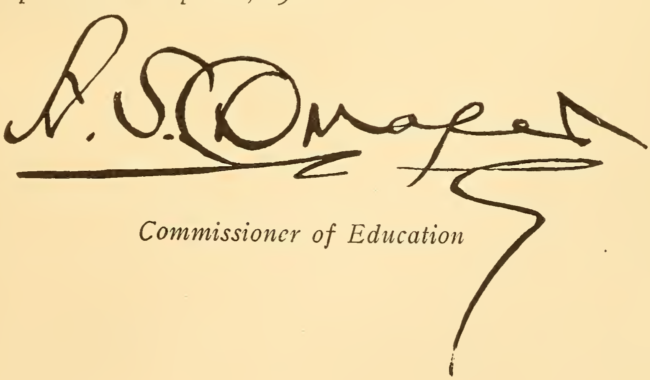
Approved for publication Sept. 28, 1910



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Museum Bulletin 144

IROQUOIS USES OF MAIZE AND OTHER FOOD PLANTS

BY

ARTHUR C. PARKER, *Archeologist*

PREFATORY NOTE

These notes on the preparation and uses of maize and other vegetable foods by the Iroquois have been gathered during a period of 10 years, while the writer has been officially concerned with the archeology and ethnology of the New York Iroquois and their kindred in Canada. They embrace all it has been possible for him to gather from the Iroquois themselves concerning the uses of their favorite food plants. Scores of Indians were questioned and many interesting facts were brought out from almost forgotten recesses of their minds.

The greater part of this treatise is the result of a purely original inquiry. An attempt has been made to cite the records of early explorers and travelers where the case seemed of interest or importance, but no general historical review of the subject is given.[1] The aim is rather to present an ethnological study of the Iroquois uses of food plants. This it is hoped will also have an economic and sociologic value.

Maize played an important part in Iroquois culture and history. Its cultivation on the large scale to which they carried it necessitated permanent settlements, and it was, therefore, an influential factor in

[1] For a general review of the subject of Indian foods consult Thomas. Mound Explorations, Bureau of Ethnology, 1890–91; Carr. Mounds of the Mississippi Valley, Smithsonian Rep't, 1891; Carr. Foods of Certain American Indians, Am. Antiq. Soc. 1895.

determining and fixing their special type of culture. They had ceased to be nomadic hunters when their corn fields and vegetable gardens flourished. Many of the tribes of eastern North America were agriculturalists to an extent hardly realized by those unfamiliar with early records and this is especially true of the Huron-Iroquois family, though it is not to be disputed that the Algonquin tribes of the east and southeast had large fields and raised corn and other vegetables on a large scale.

My principal informants as to names and recipes are the following Iroquois Indians: on the Tonawanda Seneca Reservation, Lyman Johnson, Otto Parker, Peter Sundown; on the Allegany Reservation, Mrs Henry Logan, Mrs Fred Pierce and others; on the Cattaraugus Reservation, Mrs Aurelia Jones Miller, George Dolson Jimerson, Thomas Silverheels, Mrs Frank Patterson, Mrs Emily Tallchief, Mrs Julia Crouse (Aweniyont), Chief and Mrs Edward Cornplanter, Chief and Mrs Delos Big Kettle, John Jake, George Pierce, John Lay jr, Skidmore Lay, Mrs Emily C. Parker (Tuscarora), Mrs Cassie Gordon (Cayuga), Job King, Mrs Naomi Jimeson and many others; on the Onondaga Reservation, Chief and Mrs Baptist Thomas, Marvin Crouse and others; on the Grand River Reservation of the Six Nations, Canada, Albert Hill, Chief and Mrs D. C. Loft, Mr and Mrs Seth Newhouse (all Mohawks), Chief Michael Anthony and Lawson Montour (Delaware), Chief Josiah Hill (Nanticoke), Chief Jacob Johnson, Fred Johnson (Oneida), Chief Gibson (Seneca) and many others, of the Oneida of Muncytown, Ontario, Chief Danford, Elijah Danford, and of the Caughnawaga Mohawk, Mr and Mrs Longfeather (James Hill), Mrs Dibeux, Mrs Saylor and others.

As far as practicable the writer has followed the system of orthography used by the Smithsonian Institution in recording American languages, and especially that employed by Hewett in his *Cosmology*. For certain reasons there are a few minor departures from the system as employed by Hewett but in general there is little difference.

Alphabet and abbreviations

a as in *father, bar;* Germ. *haben*
ā the same sound prolonged
ă as in *what;* Germ. *man*
ä as in *hat, man, ran*
ǟ the same sound prolonged
â as in *law, all;* Fr. o in *or*

ai as in *aisle,* as i in *mine, bind;* Germ. *Hain*

au as ou in *out,* as ow in *how;* Germ. *Haus*

c as sh in *shall;* Germ. sch in *schellen;* Fr. ch in *charmer*

ç as th in *wealth*

d pronounced with the tip of the tongue touching the upper teeth as in enunciating the English th; this is the only sound of d in the language

e as e in *they,* as a in *may;* Fr. *ne*

ĕ as in *met, get, then;* Germ. *denn;* Fr. *sienne*

g as in *gig;* Germ. *geben;* Fr. *gout*

h as in *has, he;* Germ. *haben*

i as in *pique, machine*

ī the same sound prolonged

ĭ as in *pick, pit*

k as in *kick, kin*

n as in *no, nun, not*

ñ as ng in *ring, sing*

o as in *note, boat*

q as ch in Germ. *ich*

s as in *see, sat*

t pronounced with the tip of the tongue on the upper teeth, as in enunciating the English th, this being the only sound of t in the language

u as in *rule;* Germ. *du;* Fr. ou in *doux*

ŭ as in *rut, shut*

w as in *wit, win*

y as in *yes, yet*

dj as j in *judge*

hw as wh in *what*

tc as ch in *church*

^{n} marks nasalized vowels as a^{n}, e^{n}, ĕ^{n}, o^{n}, ă^{n}, ai^{n}, etc.

‘ indicates an aspiration or soft emission of the breath which is initial or final, thus ‘h, ĕ^{n}‘, o‘, etc.

’ marks a sudden closure of the glottis preceding or following a sound, thus ’a, o’, ä’, ă’, etc.

′ marks the accented syllable of a word

th in this system are always pronounced separately

In abbreviating the names of the various languages the following have been used: Mk., Mohawk; Od., Oneida; Onon., Onondaga; Ca., Cayuga, and Sen., Seneca.

Unless otherwise specified the Iroquois names and words used in the body of this paper are all Seneca. The writer is more familiar with this dialect of the Iroquois than the others, and this coupled with the fact that the Seneca are the most conservative of the Iroquois and remember more concerning their ancient usages, it is hoped will justify the employment of that tongue to the exclusion of the others.

In a work of this character one is always tempted to add in full the myths which hover about the subject and to describe the various rites and ceremonies that attend it. These things, interesting as they are, are reserved however for notice in other works where they will be more properly correlated.

Arthur C. Parker

I MAIZE OR INDIAN CORN IN HISTORY

1 **The origin of maize.** From the Greek ζαω meaning to live has come the Latin *zea,* the family name of Zea mays Linn., Indian corn or maize. The term *zea* as applied to the name of maize is highly significant and most appropriate for with the Iroquois as with many other Indian tribes maize was the principal and favorite vegetable food. So important was it to the Iroquois that they called it by a name meaning " our life " or " it sustains us."

That maize is a native American plant there is now no question. The testimony of archeology, history and botany all point to this conclusion. From botanical studies its origin in southern Mexico can be practically demonstrated.[1]

Several early investigators have endeavored to show that Zea mays is not indigenous to America by referring to the corn of Egypt and the Levant.[2] Most of these writers, if not all, have based their premises upon statements by no means unassailable. It is difficult to imagine what advantage is to be derived from creating or fostering misstatements as to the origin of maize but this has been done by several writers.[3] In 1810 Molinari, a European writer, published a work called *Storia d'Incisa* in which there was a reference to ". . . a purse containing a kind of seed of a golden color and partly white, and unknown in the country and brought from Anatolia."[4] This strange seed was supposed to have been given by two crusaders, companions of Boniface III, to the town of Incisa. This reference to the seed " of golden color " caused some discussion at the time and many believed it to be maize, but after much controversy the celebrated *Storia* was found by the Comte de Riant to be a pure forgery, but not until it had been cited widely as proof of the Old World origin of maize.[5] There are many historical references as vague and unreliable as this which nevertheless seemed to have a certain weight.

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[1] For origin and botanical character of maize *see* Harshburger. Botanical Studies, Univ. Pa. and Iowa Agric. Exp. Sta. Bul. 36, 1907. *See also* Brown, P. A. Farmer's Cabinet, v. 2. Albany 1838; Brown, D. J. Amer. Inst. Trans. 1846.

[2] *Cf.* Van der Donck. New Netherlands. Amsterdam 1656. 1:158. Reprint Hist. Soc. Trans. Ser. 2.

[3] Compare the account of Lundy, John P. Zea Mays, as it is Related to the Incipient Civilization of Red Men all the World Over. Numismatic & Antiq. Soc. Phila. 1883.

[4] De Candolle. Origin of Cultivated Plants, p. 388, Internat. Sci. Ser. N. Y. 1885.

[5] Riant. La Charte d'Incisa. 1877. Reprinted from Revue des Questions Historiques.

The names applied to maize during the 16th century in Europe have confused some writers. It was variously called Roman corn, Turkish wheat, Sicilian corn, Spanish corn, Guinea corn, Egyptian corn and Syrian dourra. The people or localities after which the corn was named, however, universally disclaimed all knowledge of its origin and referred it to some other source, and so named it; thus the Turks called it Egyptian corn and the Egyptians always referred to it as Syrian dourra, each in turn disclaiming its origin. Possibly the most widespread name by which maize was known in Europe was Turkish wheat which was the name generally used by the English. The name seems to have been first used by the botanist, Reullins,[1] in 1536, and later, in 1552, Tragus represented a maize plant in his *Stirpium* calling it Frumentum turcicum, but afterward, having read some vague reference to a plant thought to be similar he conceived the idea that it must be a species of Typhia grown in Bactriana. Other writers, however, denied this, Matthiole in 1570, Dodens in 1583 and Camerarius in 1588, all asserting its American origin.[2]

D'Herbelot, the oriental scholar, thought he had discovered maize in the references of the Persian historian, Mourkoud, who lived in the 15th century and who recorded that Rous, son of Japhet, sowed a certain seed on the shores of the Caspian sea.[3] He could not, of course, substantiate his belief but his statements at the time had a certain weight. Candolle[4] cites the finding of an ear of corn in an Egyptian sarcophagus at Thebes by Rifaud but says that the incident was probably the result of a trick played by an Arab imposter.[5] If maize had grown in Egypt, says Candolle, " it would have been connected with religious ideas like all other remarkable plants." He further cites that Ebn Baithar, an Arab physician, who had traveled through all the territory lying between Spain and Persia mentions no plant which may be taken for maize. Maize was so little known as a food plant in India in the 18th century that it was only grown in gardens as an ornamental grass.[6] In China it has been cultivated since the middle of the 17th century[7] although there are attempts to show earlier introduction, which, however, are denied by the best Chinese authorities.

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[1] Reullins. De Natura Stirpium, p. 428. *Cf.* Candolle, p. 339.
[2] Candolle. Origin of Cultivated Plants, p. 389. N. Y. 1885.
[3] *Ibid.* p. 390.
[4] *Ibid.* p. 390.
[5] *See* Reply of President Price to Lundy's Paper *Zea Mays*. Numismatic & Antiq. Soc. Trans. Phila. 1883.
[6] Roxburgh. Flora Indica, III:568.
[7] Candolle. Origin of Cultivated Plants, p. 392.

A review of the subject [1] leads to the fact that there is no authentic reference to maize in the writings of travelers or naturalists prior to the discovery of America by Columbus. Hebrew parchments and Sanscrit scrolls are alike silent. With the opening up of the New World and the discovery of the great staple grain of the western continent, maize cultivation spread with lightning rapidity throughout the eastern hemisphere. It became a definitely known and accurately described food plant.

One early writer,[2] who no doubt had read with interest the early discussions as to the origin of maize says: "Maize was carried from America to Spain and from Spain into other countries of Europe, to the great advantage of the poor, though an author of the present day, would make America indebted to Europe for it, an opinion the most extravagant and improbable which ever entered the human brain."

If the grain had been known before the Columbian epoch it would have spread quite as rapidly as it did subsequently, which is good evidence of its American origin and this origin is no longer disputed by competent authorities.[3] Edward Enfield in his book on maize is so positive that maize is an American plant that he declares that ". . . if any further evidence were wanting on this point it may be found in the impossibility that a grain so nutritious, prolific and valuable, so admirably adapted to the wants of man could have existed in the eastern world before the discovery of America without coming into general use and making itself universally known. Had this cereal existed there at that period it would have made its record too clearly and positively to leave any doubt on the subject." [4]

The researches of Harshburger and others indicate that maize is a development of a Mexican grass known as teosinte (Euchlaena mexicana Schrad.). Maize and teosinte by cross fertilization produce fertile hybrid plants known as Zea canina Watson, or

[1] *See* Salisbury. History and Chemical Investigation of Corn, p. 8. Albany 1846.

[2] Clavigero. History of Mexico; trans. by Charles Cullen, Lond. 1787. 1:26.

Clavigero in a footnote further states that the name *Grano di Turchia,* by which it (maize) is at present known in Italy, must certainly have been the only reason for Bomares adopting an error, so contrary to the testimony of all writers on America, and the universal belief of nations. The wheat is called by the Spaniards of Europe and America, *maize*, taken from the Haitina language which was spoken in the island Hispaniola or St Domingo."

[3] *Cf.* Beverly. Hist. of Va. Lond. 1722. p. 125.

"They say that they had their corn and beans from the southern Indians, who received their seed from a people who resided still farther south." *Van der Donck, New Netherlands,* (1656). Reprint N. Y. Hist. Soc. Trans. 1:137.

[4] *See* Bailey. Cyclopedia of American Agriculture, 1:404.

as the Mexicans call it, *mais de coyote* (Lupus latrans). Harshburger says that our cultivated maize is of hybrid origin probably starting as a sport of teosinte which then crossed itself with its normal ancestor, producing our cultivated corn.[1] Plants which by hybridizing and cultivation will produce maize are not found outside of Mexico and for this reason, if no other, it would seem conclusive that maize had its origin there. As to the exact locality, Harshburger who has made a special study of the plant and its origin, says that it originated in all probability north of the Isthmus of Tehuantepec; and south of the 22° of north latitude near the ancient seat of the Maya tribes.[2] In this connection it is worthy of notice that nearly all the traditions of the Indians, not pure myths, point to the far southwest as the mother country of the corn plant.

An important proof of the cultivation of maize in America before the Columbian epoch is the fact that the kernels and cobs in a charred state have been found in ancient pits and refuse heaps all over eastern North America. Impressions of the kernels have been taken from Precolumbian mounds and the actual ears and cobs from the storage places of the Pueblos, Cliff Dwellers, Aztecs and Peruvians where time and crumbling ruins had sealed up the stores. No American archeologist doubts the cultivation of maize in America in Precolumbian times. The revelations of his own spade and trowel assert the fact in no uncertain way.

The name *maize* is derived from the Arawak *mahiz*. Columbus found maize growing on the island of Hayti and his mention of it is the first record of that plant. In the *Life of Columbus, By His Son,* under the date of November 5, 1492, is the following note:

> There was a great deal of tilled land some sowed with those roots, a sort of beans and a sort of grain they call maize, which was well tasted, baked, or dried and made into flour.[3]

This is the first historical reference to maize which it is possible to find in any work and the first use of the term maize.[4]

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[1] Harshburger. Contributions from the Botanical Laboratory of the University of Pennsylvania, v. 1, no. 2.

[2] Harshburger. Bailey's Cyclopedia of American Agriculture, 1:399.

[3] Life of Christopher Columbus, By His Son, in Pinkerton's Voyages and Travels. Lond. 1832. 12:38.

[4] Among the first probable references to Indian corn is one by Capt. John De Verazzano, who early in the 16th century coasted along the middle Atlantic coast. In his report to the King of France, under date of 1524, 32 years after the discovery, he said in describing the Indians whom he saw: "Their food is a kind of pulse which there abounds, different in color and size from ours and of a very delicious flavor." In the light of subsequent descriptions by other explorers it seems very probable if not certain that the *pulse* was maize.

2 Importance of maize in the early English colonies. There is no plant more vitally or more closely interwoven into the history of the New World [1] than maize or Indian corn.[2] At the most critical stages in colonial history corn [3] played an important part. Our Pilgrim fathers and the less hardy cavaliers of Jamestown and Maryland were rescued from starvation more than once when it was hard upon them by foods made from the corn given them by the Indians who had cultivated and harvested it. Had it not been for the corn of the Indians the stories of Jamestown and Plymouth instead of being stirring accounts of perseverence and endurance might have been brief and melancholy tragedies. The settlement and development of the New World would have been delayed for years.[4] History would have been changed, the foothold of the English colonists weakened and another tongue spoken along the Atlantic coast.

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[1] Prescott in reviewing this subject says: "The great staple of the country, as indeed of the American continent, was maize, or Indian corn, which grew freely along the valleys and up the steep sides of the Cordilleras to the high level of the tablelands. The Aztecs were as curious in its preparation, and as well instructed in its manifold uses, as the most expert New England housewife. Its gigantic stalks, in these equinoctial regions, afford a saccharine matter not found to the same extent in northern latitudes, and supplied the natives with sugar little inferior to that of cane itself . . ." *Conquest of Mexico*. N. Y. 1866. 1:112.

John Fiske in his *Discovery of America*, writes: "Maize or Indian corn has played a most important part in the history of the New World, as regards both white and red men. It could be planted without clearing or plowing the soil. It was only necessary to girdle the trees with a stone hatchet, so as to destroy their leaves and let in the sunshine. A few scratches and digs were made in the ground with a stone digger, and the seed once dropped in took care of itself. The ears could hang for weeks after ripening and could be picked off without meddling with the stalk; there was no need of threshing or winnowing. None of the Old World cereals can be cultivated without much more industry and intelligence. At the same time when Indian corn is sown on tilled land it yields with little labor more than twice as much per acre than any other grain." *Fiske, Discovery of America,* 1:27.

[2] In using the term *corn* hereinafter we refer exclusively to maize.

[3] Lawson very emphatically describes the utility of maize in the following: "The Indian corn or Maize proves the most useful Grain in the World; and had it not been for the fruitfulness of this species, it would have proved very difficult to have settled some of the Plantations in America. It is very nourishing whether in Bread, sodden or otherwise; and those poor Christian Servants in Virginia, Maryland and the other northerly Plantations, that have been forced to live wholly upon it do manifestly prove that it is the most nourishing Grain for a Man to subsist on, without any other Victuals." History of Carolina. Lond. 1714. *Cf.* Cartier Voyages. Tross ed.

[4] . . . we are indebted to the Indians for maize, without which the peopling of America would have been delayed for a century." Cyrus Thomas. Agriculture, in Hand-Book of American Indians. Bureau of Ethnology Bul. 30.

Almost the first discovery which the Pilgrim historian records is that of a cache of Indian corn found along the shore. On November 11, 1620 the historian writes:

They found a pond of clear fresh water and shortly after a good quantitie of clar ground where y^e^ Indeans had formerly set corne and some of their graves. And proceeding furder they saw new-stuble wher corne had been set y^e^ same year, also they found where latly a house had been wher some planks and a great ketel was remaining and heaps of sand newly padled with their hands, which they digging up found in them diverce faire Indean baskets filled with corne and some in eares faire and good of diverce colours . . . and took with them parte of y^e^ corne and buried y^e^ rest . . . And here is to be noted a spetiall providence of God . . . that hear they got seed to plant them corne y^e^ next year, or els they might have starved for they had none, nor any liklyhood to get any.[1]

Few of us in these modern days realize the frightful struggles of these early pioneers to obtain food enough to sustain even the spark of life. It is recorded that some of the desperate Pilgrims, driven by the despair of hunger would even cut wood and fetch water for the Indians for a cap of corn. Others, we are told, "fell to plaine stealing both night & day from ye Indeans of which they (the Indians) greviously complained."[2]

The bitter experiences of the winter of 1622–23 compelled them to think how they might raise as much corn as they could and "obtaine a beter crop then they had done, that they might not still thus languish in miserie."[3] The struggle for existence was a hard one with all the colonists until they had mastered the methods of corn cultivation. The Indians who were the teachers soon found that they had students that outclassed them in many ways. Bradford's account of how the settlers learned to plant and cultivate is both interesting and enlightening. He writes:[4]

Afterwards they, as many as were able, began to plant ther corne, in which servise Squanto stood them in great stead, showing them both ye maner how to set it, and after how to dress and tend it. He also tould them excepte they gott fish and set with it in these old grounds it would come to nothing.

Trumbull also tells that the Connecticut Indians instructed the first settlers in the manner of planting and dressing corn.[5]

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[1] Bradford. History Plymouth Plantation, p. 49. Cols. Mass. Hist. Soc. Ser. 4. III:87. Bost. 1856.
[2] *Ibid.* p. 130.
[3] *Ibid.* p. 134.
[4] *Ibid.* p. 100.
[5] Trumbull. History of Connecticut, Hartford 1797. 1:46.

It was the success of the corn crop that made it possible for the eager colonists to live and to become the Pilgrim Fathers. The experiences of the Connecticut colonists did not differ, for as one historian says, ". . . by selling them corn when pinched with famine they relieved their distress and prevented them from perishing in a strange land and uncultivated wilderness." [1]

Significant also is the statement of Capt. John Smith in his *History of Virginia:* ". . . such was the weakness of this poor commonwealth, as had not the salvages fed us we directlie had starved. And this relyfe, most gracious queen (Anne), was brought by this lady Pocahontas; . . . during the time of two or three years, shee next under God, was still the instrument to preserve this colonie from death, famine and utter confusion." [2]

Corn saved the colony as it had others before and after Smith's time, and as in other instances, our historian naïvely remarks, to obtain it, ". . . many were billited among the savages." [3]

And thus it is that the maize plant was the bridge over which English civilization crept, tremblingly and uncertainly, at first, then boldly and surely to a foothold and a permanent occupation of America.

II EARLY RECORDS OF CORN CULTIVATION AMONG THE IROQUOIS AND COGNATE TRIBES

As early as 1535, Jacques Cartier, pushing his way up the St Lawrence, saw fields of waving corn on the island of Hochelaga where he found a thriving village occupied by Iroquois people. He left us the record that these Indians had large fields and that they stored the harvested corn in garrets "at the tops of their houses." [4] Cartier also described the Hochelagans as "given to husbandrie . . . but are no men of great labour." [5]

Nearly every explorer who left a detailed record of his voyages recorded in a minute way his impressions of Indian agriculture and particularly of their cultivation of corn. Henry Hudson repeatedly mentioned in his records the maize which he saw on his voyage up the river which takes its name from him. Recording the events of

[1] Trumbull. History of Connecticut, 1:47.
[2] Smith, Capt. John. History of Virginia. Lond. 1632. p. 121.
[3] *Ibid.* 2:229. Richmond reprint. 1819.
[4] Hakluyt. Voyages. Lond. 1810. 3:272.
[5] *Ibid.*

September 13, 1609, and giving the latitude[1] as 42° 18′, Hudson wrote:[2]

> I saw there a house well constructed of oak bark . . . a great quantity of maize or Indian corn and beans of last year's growth, and there lay near the house for the purpose of drying enough to load three ships, besides what was growing in the fields.

In the journal of Robert Juet,[3] mate on the Half Moon, is a statement under date of September 4, 1609, that " . . . they have a great store of corn whereof they make good bread." This corn was undoubtedly maize, if we are to judge by contemporary descriptions that name the corn specifically.

Sagard has left us a good description of corn cultivation among the Huron, and his account being one of the earliest and most detailed, we quote it in full.

> The wheat (Indian corn) being thus sown in the manner that we do beans, of a grain obtained only from a stalk or cane, the cane bears two or three spikes, and each spike yields a hundred, two hundred, sometimes 400 grains, and some yield even more. The cane grows to the height of a man and more, and is very large, (it does not grow so well or so high, nor the spike as large nor the grain so good in Canada nor in France, as there) in the Huron country. The grain ripens in four months and in some places three. After this they gather and bind the leaves (husks), turned up at the top and arrange it in sheaves (braids), which they hang all along the length of the cabin from top to bottom on poles, which they arrange in the form of a rack descending to the front edge of the bench. All this is so nicely done that it seems like a tapestry hung the whole length of the cabins. The grain being well dried and suitable to press (or pound) the women and girls take out the grains, clean them and put them in their large tubs (tonnes) made for this purpose, and placed in their porch or in one corner of the cabins.[4]

It, however, remained for Champlain to give us the first detailed accounts of the cornfields and the methods of cultivation by the Indians in the region of the St Lawrence and lower lake district. Champlain in the beginning probably believed much as many per-

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[1] The present city of Hudson lies in latitude 42° 14′.

[2] De Laet. New Netherlands. N. Y. Hist. Soc. Col. Ser. 2. N. Y. 1841. 1:300.

[3] Extract from the *Journal of the Voyage of the Half Moon, Henry Hudson, Master, From the Netherlands to the coast of North-America in the Year 1609* by Robert Juet, Mate. Republished by the N. Y. Hist. Soc. Col. Ser. 2. N. Y. 1841. 1:323.

[4] Sagard. Voyage to the Hurons. (*Le Grand Voyage du pays des Hurons*, 1632). Tross ed. Paris, 1865. 1:135.

Plate I

View of Seneca farm lands and cornfields in the Cattaraugus flats. This is a typical farm of the conservative Seneca. It may be regarded as typical also of the Seneca farms of a century ago.

sons do even now, that the Indians were hunters only but his changed opinion is recorded as follows:

July the tenth, 1605.

They till and cultivate the soil, something which we have not hitherto observed. In place of ploughs, they use an instrument of hard wood, shaped like a spade. This river is called by the inhabitants of the country Chouacoet. The next day Sieur de Monts and I landed to observe their tillage on the banks of the river. We saw their Indian corn which they raise in gardens. Planting three or four kernels in one place they then heap up about it a quantity of earth with shells of the signoc before mentioned. Then three feet distant they plant as much more, and this in succession. With this corn they put in each hill three or four Brazilian beans which are of different colours. When they grow up they interlace with the corn which reaches to the height of from five to six feet; and they keep the ground very free from weeds. We saw many squashes and pumpkins and tobacco which they likewise cultivate . . . The Indian corn which we saw at that time was about two feet high and some as high as three. The beans were beginning to flower as also the pumpkins and squashes. They plant their corn in May and gather it in September.[1]

When the Iroquois took possession of the territory which we now know as New York State, they carried on corn culture on a large scale and so important an article of food and commerce was it that most of the European invaders of their territory burned their cornfields and destroyed their corncribs instead of shooting the Iroquois themselves but, as one writer says, the power of the Confederacy remained unbroken.[2]

The French made a mistake fatal to French supremacy in the middle Atlantic region. In 1609 under Champlain they fired upon a small detachment of Iroquois at Ticonderoga and thereafter the Iroquois were the bitter enemies of the French, while they espoused the cause of the English.[3] The French realized their error most

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[1] Voyages of Samuel de Champlain, 2:64–65. Prince Soc. Reprint 1878. *Cf. also* p. 81–82.

[2] Carr. Mounds of the Mississippi Valley, p. 515. Smithsonian Report. 1891.

[3] The Iroquois, especially the Seneca, were not always uniformly consistent in their alliances with the British, but in general their arms were at the disposal of the English colonial authorities. The espousal of the English cause by the Iroquois greatly strengthened the hold of the British in eastern North America and led to the expulsion of French domination from the continent.

In an address before the New York Historical Society in 1847, Dr Peter Wilson, a Cayuga-Iroquois, reminded the society of this fact in the following keenly when they found the Iroquois a barrier between them and the trails to central New York and down the Ohio river. To break the power of the Iroquois Confederacy, expedition after expedition was sent out against them, notably those of Champlain in 1615, of Courcelles in 1655, of De Tracy in 1666, of De la Barre in 1684, of Denonville in 1687 (whose work was particularly destructive to cornfields), and of Frontenac in 1692 and 1696. All these gallant commanders failed to accomplish the destruction of Iroquois power perhaps for reasons such as given by Denonville in the following:

I deemed it our best policy to employ ourselves laying the Indian corn which was in vast abundance in the fields, rather than to follow a flying enemy to a distance and excite our troops to catch only some straggling fugitives. . . We remained at the four Seneca villages until the 24th; the two larger distant four leagues and the others two. All that time was spent in destroying the corn which was in such great abundance that the loss including old corn which was in cache which we burnt and that which was standing, was computed according to the estimate afterwards made at 400 thousand minots (about 1,200,000 bushels) of Indian corn. . . A great many both of our Indians and French were attacked with a kind of rheum which put everyone out of humor.[1]

The quantity of corn here destroyed by Denonville is claimed by some authorities to be overestimated and perhaps this is true, as being "out of humor," the amount may have seemed larger than it really was.

The corn-destroying habit of the invaders of the Iroquois dominion was still active when later, in 1779, Maj. Gen. John Sullivan made his famous raid against the Iroquois. The accounts of his officers and soldiers which have come down to us in their journals are most illuminating, when aboriginal corn statistics are sought. "The Indians," said Gen. Sullivan in discussing the subject, "shall see that there is malice enough in our hearts to destroy everything that contributes to their support." How well he fulfilled his threat may be known by reviewing the record of his campaign.

The journals of Sullivan's campaign through the Iroquois country are replete with descriptions of the Iroquois cornfields and the fre-

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words: "Had our forefathers spurned you from it (the Iroquois "Long House") when the French were thundering at the opposite end, to get a passage and drive you into the sea, whatever had been the fate of other Indians, the Iroquois might still have been a nation and I too might have had a country."

[1] Doc. Hist. of the State of N. Y. 1:328–29. Albany 1849. *Cf.* Charlevoix. Nouvelle France, 2:355; Lahontan. Voyages, I, p. 101.

quent mention indicates the importance of corn as a food to the Iroquois. The destruction of the corn supply was a greater blow to the Iroquois than the burning of their towns. Huts might easily have been built again but fields would not yield another harvest after September.

In the journal of Maj. John Burrowes, as in other journals covering the Sullivan campaign, there are many references to the Indian fields. Some instances follow:

Friday, August 27, 1779. Observations. We got this night at a large flat three miles distant from Chemung where corn grows such as can not be equalled in Jersey. The field contains about 100 acres, beans, cucumbers, Simblens, watermelons and pumpkins in such quantities (were it represented in the manner it should be) would be almost incredible to a civilized people. We sat up until between one and two o'clock feasting on these rarities.

Monday, Middletown, 30th Aug. The army dont march this day but are employed cutting down the corn at this place which being about one hundred and fifty acres, and superior to any I ever saw . . . (*Observations*) The land exceeds any I have ever seen. Some corn stalks measured eighteen feet and a cob one foot and a half long. Beans, cucumbers, watermelons, muskmelons, cimblens are in great plenty. . .

Camp on the Large Flats 6 Miles from Chenesee 15th Sep. Wednesday morning. The whole army employed till 11 o'clock destroying corn, there being the greatest quantity destroyed at this town than any of the former. It is judged that we have burnt and destroyed about sixty thousand bushels of corn and two or three thousand of beans on this expedition.

In his letter to John Jay under date of September 30, 1779, General Sullivan reported among other things:

Colonel Butler destroyed in the Cayuga country five principal towns and a number of scattering houses, the whole making about one hundred in number exceedingly large and well built. He also destroyed two hundred acres of excellent corn with a number of orchards one of which had in it 1500 fruit trees. Another Indian settlement was discovered near Newtown by a party, consisting of 39 houses, which were also destroyed. The number of towns destroyed by this army amounted to 40 besides scattering houses. The quantity of corn destroyed, at a moderate computation, must amount to 160,000 bushels, with a vast quantity of vegetables of every kind. . . I flatter myself that the orders with which I was entrusted are fully executed, as we have not left a single settlement or a field of corn in the country of the Five Nations. . .

In his report of Sept. 16, 1779, to General Washington concerning his raid against the Seneca on the Allegany, Daniel Brodhead said:

The troops remained on the ground three whole days destroying the Towns & Corn Fields. I never saw finer corn altho' it was planted much thicker than is common with our Farmers. The quantity of Corn and other vegetables destroyed at the several Towns, from the best accounts I can collect from the officers employed to destroy it must certainly exceed five hundred acres which is a low estimate and the plunder is estimated at 30m Dollars[1] . . .

[1] Meaning probably $30,000.

Quotations from the journals of soldiers and officers could be multiplied to some length with but one result, that of corroborating the fact that the Iroquois cultivated corn, beans, squashes, pumpkins and other vegetables in large quantities and to an extent hardly appreciated by the general student of history.[2]

The beautiful valley of the Genesee, renowned among the Indians as the fertile garden region of the Seneca was cultivated for miles of its length. Luxuriant fields, patches of forest land and wide openings of grass land were found throughout the valley. The impetuous army of Sullivan, inflamed by the depredations of the Iroquois and bent upon wreaking vengeance upon a tribe of ignorant savages entered the Genesee valley with feelings of utmost surprise for they found the land of the savages to be, not a tangled wilderness but a smiling blooming valley, and the savages domiciled in permanent houses and settled in towns. General Sullivan describes the town of Genesee, for example, as containing 128 houses, mostly large and elegant, and names it as one of the largest. It was beautifully situated, he added, " almost encircled with clear flat land extending a number of miles; over which extensive fields of corn were waving, together with every kind of vegetable that could be conceived." Forty towns were obliterated, 60,000 bushels of corn destroyed, fruit orchards uprooted, girdled or chopped down, one containing 1500 trees. Ruin was spread like a blanket over the Iroquois country and their garden valley reduced to a desolate blighted and forsaken region dotted with blackened ruins. Hardly a food plant remained for the oncoming winter.[3]

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[2] *See* Stone. Life of Brandt. N. Y. 1838. v. 2, ch. 1; Journals of the Military Expedition of Major General John Sullivan against the Six Nations, 1779. Auburn 1887.

[3] *Cf.* Stone. Brant, 2:33.

III IROQUOIS CUSTOMS OF CORN CULTIVATION

1 **Land clearing and the division of labor.** Land for cornfields was cleared by girdling the trees in the spring, and allowing them to die. The next spring the underbrush was burned off. By burning off tracts in the forests large clearings were made suitable for fields and towns. Early travelers in western New York called these clearings "oak openings."[1] Certain tracts, however, seem always to have been open lands and it is a mistake to believe that the country was entirely wooded.

Van der Donck was much impressed by the "bush burnings" of the Indians of New Netherlands and records that they present a "grand and sublime appearance."[2] Unless the trees were girdled or dead they were not ordinarily injured by the "bush burning."

The work of girdling the trees[3] and of burning the underbrush was that of the men.[4] With the tall trees girdled and the underbrush burned off it was an easy matter to scrape up the soft loam and plant the corn but the field was not considered in fit form until the small shrubbery and weeds had been subdued. Fields with standing dead trees were not regarded as safe after the first year

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[1] *See* Ketchum. Buffalo and the Senecas, 1:17–19. *Cf.* Dwight. Travels in New England and New York

[2] Van der Donck. New Netherlands. Amsterdam 1656.

[3] La Potherie. Paris 1722, 3:18.

[4] Sagard in his *Voyages des Hurons* has left us a good description of this work among the Hurons. The translation which follows is taken from Carr's *Mounds of the Mississippi Valley.*

"The Indians belt (coupent) the trees about two or three feet from the ground, then they trim off all the branches and burn them at the foot of the tree in order to kill it and afterwards they take away the roots. This being done, the women carefully clean up the ground between the trees and at every step they dig a round hole, in which they sow 9 or 10 grains of maize which they have first carefully soaked for some days in water."

Peter Kalm, whose observations of Indian usages were accurate and detailed, records:

"The chief use of their [stone] hatchets was according to the unanimous accounts of all the Swedes to make good fields for maize-plantations; for if the ground where they intended to make a maize-field was covered with trees they cut off the bark all round the trees with their hatchets, especially at the time when they lost their sap. By that means the tree becomes dry and could not take any more norishment and the leaves could no longer obstruct the rays of the sun from passing. The smaller trees were pulled out by main force, and the ground was turned up with crooked or sharp branches." Kalm, 515, Pinkerton's Voyages and speedy means were taken thereafter to burn them down. In the Seneca invocations to the Creator at the midwinter thanksgiving is a prayer that the dead branches may not fall upon the children in the fields.

In time the trees were burned or rotted away to leave cleared patches. The Iroquois men[1] did very little in the way of field work but it is said that they sometimes helped clear the land but never allowed any one to see them. Some of the old Indians whom the writer interviewed told laughable stories of grim old " warriors " who had been caught with a hoe and how they excused themselves.

One early writer even goes so far as to say that if a man loved his wife devotedly he often helped her with the field work. As a rule, however, among the Iroquois the men disdained the work which they deemed peculiarly that of women.

One writer remarks that the Iroquois were too busy with their conquests to engage in field work and this is largely true. In the age of barbarism the condition of society is one of constant emergency. Invasion and the destruction of property is momentarily expected. The Iroquois by dividing the labors necessary to sustain life in the manner in which they did contributed much to the strength of their nation and its arms. The function of the men was to hunt, to bring in the game and stand ever ready to defend their people and their property and to engage in war expeditions. An Iroquois man must be ever generous and give to every one who asked for his arms or his meat. If he brought his bear to the village it became public property, to the material injury of himself and family. He therefore left his game hidden in the outskirts of his town and sent his wife[2] to bring it in.[3] She was not bound to give of her husband's bounty and could properly refuse the appeals

[1] La Potherie in his *Historie de l'Amérique,* volume III, page 18 et seq. says that the men cleared the ground and assisted in braiding the harvested ears. *Cf.* Lawson. Carolina.

[2] The writer in mentioning Indian females never uses the term *squaw.* As a name in colonial days it may have been proper but it is no longer good form and its use is frowned upon by the Iroquois women of this State and Canada. It has come with them to mean a degraded female character. The Superintendent of the Six Nations of Canada was severely rebuked several years ago by an old Mohawk woman who resented the term as applied to the women of her nation. The term is of course of Algonquin origin. An Allegany Seneca once explained to me that this word was no longer good language, just as Shakspere's word *wench* is no longer good English as applied to a housewife, or *villian* as applied to a farmer.

[3] *Cf.* Carr. Food of Certain American Indians, p. 167; Tanner. Narrative, p. 362; Cadillac in Margry 68, Charlevoix, v. 171.

of the hungry, lazy or others who loved to prey upon generosity. After the meat was cooked, however, the case was different and she was bound to feed any who came to her door.

The Iroquois and other Indians have frequently been reproached by writers for allowing or forcing their women to do field labor while the men enjoyed the hunt[1] or lazily fished, or perchance went "high ho!" on the war path. It should be remembered, however, that hunting in those raw days was no easy task. It was not sport then as it is now but work that demanded the use of every faculty. Heckewelder[2] remarks most aptly that the "fatigues of hunting wear out the body and constitution more than manual labor." Another writer says, and there is a sense in which his description might apply in these modern times, that "their manner of rambling through the woods to kill deer is very laborious exercise, as they frequently walk 25 or 30 miles through rough and smooth grounds, and fasting, before they return to camp loaded." [3]

Heckewelder sums up the case when he says that woman's labor in the fields consumed but six weeks out of the year while "the labor of the husband to maintain his family lasts throughout the year." [4]

Woman's part in the division of labor was not a hard one nor even a compulsory one. The labor of the fields was a time welcomed by the women then as modern people now welcome an outing. It was the occasion of productive pleasure. As Heckewelder says,[5] ". . . The cornfield is planted by her and the youngsters in a vein of gaiety and frolic. It was done in a few hours and taken care of in the same spirit."

In the *Life of Mary Jemison*,[6] the white captive of the Genesee, she states:

Our labor was not severe, and that of one year was exactly similar in almost every respect to that of others, without that endless variety that is to be observed in the common labor of white people. Notwithstanding the Indian women have all the fuel and bread to procure, and the cooking to perform, their task is probably not harder than that of white women who have those articles provided for them; and their cares certainly not half as numerous, nor as great. In the summer season we planted, tended and harvested our corn, and

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[1] *Cf.* Lawson, p. 188.

[2] Heckewelder. Historical Account of the Indian Nations, p. 146.

[3] Adair. History of the American Indians. Lond. 1755. p. 402.

[4] Heckewelder. Historical Account of the Indian Nations, p. 142

[5] *Ibid.* p. 142.

[6] Seaver. Life of Mary Jemison, p. 69.

generally had our children with us; but had no masters to oversee or drive us, so that we could work as leisurely as we pleased.

With the breaking up of the military power of the Iroquois and the subjection of all Indian tribes to the federal government, the men were left freer. War with them was over. The disdain which they had for field labor, and the feeling that it was not a part of their work clung for some time, but as the old reason for abstaining from field work passed away and as the environment of the white man was forced upon them, the Iroquois man gradually became the man with the hoe and thought it no disgrace. This was hardly the case, however, a century ago.

The women of each settlement each year elected a chief matron, onä$^{n\prime}$o gäin'dago^{n} et'igowānĕ[1] to direct their work in the communal fields. She ordered all the details of planting, cultivation and harvesting. She also had the right to choose one or two lieutenants who could give out her orders.

Certain fields were reserved for the use of the nation, that is, to supply food for the councils and national festivals. These fields were called Kĕndiŭ''gwă'ge' hodi'yĕn'tho'.

2 **Preparation of the soil and planting.** In preparing the soil a digging implement made of wood, somewhat resembling a short hoe was used. The blade was sometimes a large flat bone or simply a piece of wood worked flat. The hoe in this case was of one piece, the trunk of a sapling serving as a handle and the tough bulbous root end which ran off at right angles, shaped into a blade, served as the digging end.[2]

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[1] Literally meaning "corn plant, its field's female chief.

[2] "Use wooden hoes," Williams. Key, p. 130.

"Spades made of hard wood." Bossee. Travels Through Louisiana, p. 224

"Ils ont un instrument de bois fort dur, faict en facon d'une besche." Champlain, 1:95.

"Il leur suffit d'un morceau de bois recourbe de trois doigts de largeur, attaché a un long mauche qui leur sert a sarcler le terre et a la remuer legerment." Lafitau. Moeurs des Sauvages Ameriquains, II:76.

"Use shoulder blade of a deer or a tortoise shell, sharpened on a stone and fastened on a stick instead of a hoe." Loskiel. Missions of North America, p. 67.

"Performed the whole process of planting and hoeing with a small tool that resembled in some respects a hoe with a very short handle." Seaver, Life of Mary Jemison, p. 70.

Cf. Hakluyt. Voyages, III:329.

"In order to sow Indian Corn they make Pick-Axes of Wood." A Continuation of the New Discovery, Hennepin, Father L. Lond. 1698.

The writer has found in various old sites pieces of flattened antler[1] [*see* fig. 1] with one worn edge and the lower surfaces well polished which seem to have been hoe blades. In the Mississippi valley and often in New York hoe heads of picked and chipped stone were used.

Fig. 1 Antler hoe blade (Cut is ½ actual size.)

Where wooden hoes were used it is probable that the digging ends were hardened in the fire by a semicharring of the surface. Hardening in this manner was usual where a resisting surface was needed.

Thomas Hariot, a keen and reliable observer though not always a good speculator, has left us in his *Brief and True Report* an excellent description of the cultivation of maize by the coastal Indians of Virginia. In 1587 he writes:

All the aforesaid commodities for victuals are set or sowed sometimes in grounds apart and severally by themselves, but for the most part together in one ground mixtly: the manner thereof with the dressing and preparing of the ground, because I will note unto you the fertility of the soil, I think good briefly to describe.

The ground they never fatten with muck, dung, or anything, neither plow or dig it as we in England but only prepare it in a sort as followeth: A few days before they sow or set the men with wooden instruments made almost in the form of mattocks or hoes with long handles, the women with short peckers or parers, because they use them sitting, of a foot long and five inches in breadth, do only break the upper part of the ground, to raise up the weeds grass and old stubs of cornstalks with their roots. The which after a day or two days drying in the sun, being scraped up into many small heaps, to save them the labor of carrying them away, they burn to ashes. And whereas some may think that they use the ashes for to better the ground, I say that then they would either disperse the ashes abroad, which we observe they do not, except the heaps be too great, or else would take special care to set their corn where the ashes lie, which also we find they are careless of. And this is all the husbanding of their ground that they use.

Then their setting or sowing is after this manner. First, for their corn, beginning in one corner of the plot with a pecker they make a

[1] *Cf.* Parker, A. C. Excavations in an Erie Indian Village. N. Y. State Mus. Bul. 117. p. 535.

hole wherein they put out four grains, with care that they touch not one another (about an inch asunder), and cover them with the mould again; so throughout the whole plot, making such holes and using them in such manner, but with this regard, that they be made in ranks, every rank differing from the other half a fathom or a yard and the holes also in every rank. By this means there is a yard of spare ground between every hole; where according to discretion here and there they set as many beans and pease; in divers places also among the seeds of Macocqwer, Melden and Planta Soles. . .

Another early description of corn and its cultivation is given by Harris in his *Discoveries and Settlements.* For the purpose of comparison with the foregoing, as well as for its information, this description is given verbatim:

The manner of planting is in holes or trenches, about five or six feet distance from each other; the earth is opened with a hoe (and of late years, with a plough), four inches deep, and four or five grains thrown into each hole or trench, about a span distant from each other, and then covered with earth; they keep weeding it from time to time, and as the stalk grows high they keep the mould about it like the hillocks in a hop garden; they begin to plant in April but the chief plantation is in May, and they continue to plant till the middle of June; what is planted in April is reaped in August; what is planted in May is reaped in September; and the last in October.[1]

While the ground is being prepared for sowing, the seed corn is soaked[2] in warm water or in a decoction made of helebore[3] root and some other herb which the writer has not yet identified. These roots are said to be a "medicine for the corn" but in reality the "medicine" is a poison for crows and other field pests which might eat the seed corn. A bird eating this "doctored" corn becomes dizzy and flutters about the field in a way which frightens the others.

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[1] Harris. Discoveries and Settlements Made by the English. *In* Pinkerton. Voyages, 12:242. *Cf.* Beverly, p. 126–27.

Cf. Their manner of planting it is to make with the finger or with a little stick, separate holes in the ground, and to drop into each one eight or nine grains which they cover with the same soil that had been taken out to make the hole." Jesuit Relations, 67:143. (Rale's letter to his brother.)

Cf. Beverly. History of Virginia, p. 127.

[2] *Cf.* Sagard. Voyages des Hurons, p. 134. Paris 1632.

[3] *Cf.* Kalm. Travels in North America. Lond. 1772; Pinkerton. Voyages, 13:527.

Peter Kalm is the only observer in whose writings the author has found the use of the poison decoction mentioned.[1]

Handsome Lake, the prophet, in his code commanded that these herbs always be used.

The corn was carefully dropped in the hills so as not to break the germs which had nearly burst through. Among the Senecas, in planting corn the seeds of the squash and bean were sown in every seventh hill because it was thought that the spirits of these three plants were inseparable. They were called Diohe''ko, *these sustain us.*[2]. In the Green Corn Thanksgiving the leader rises and says, "Diettino^n'nio' diohe''ko^n, *we give thanks to our sustainers.*"

Certain women banded themselves together in a society called the Tonwisas[3] or To^{n}wi'sas Oä'no. They propitiated the spirits of the three sisters by certain ceremonies. In their ceremonial march, We-nŭntoñwi'săs, the leader holding an armful of corn and a cake of corn bread leads her band in a measured march about a kettle of corn soup. The ritual of this society has been translated by the writer. A pen drawing of the march of the Toñwi'sas made by a Seneca youth is shown in figure 2.

Each year at planting time each community observed a planting festival in which the Creator was implored to continue his bounty and his accustomed ways. Sacrifices of tobacco and wampum were made to the spirits of growth and to the pygmies, Djo^{n}gä'o^n, and a general thanksgiving for past blessings was given. Especial favor was asked in the growth of the corn.[4]

The Planting Thanksgiving was called by a council of elders in whose charge this festival was placed and lasted for a full day. The addresses to the Creator, however, were all given in the early morn-

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[1] *Ibid.* p. 531.

See also Kalm on bird pests, *Ibid.* p. 523, 527, 531.

[2] The Aztecs called the corn goddess Tonacaygohua, *She feeds us.*

She was sometimes called Centeotl. She was also regarded as the goddess of the earth and was the most beloved deity worshiped by the ancient Mexicans and was the only one that did not require the sacrifice of human victims. It is interesting to note that the Corn goddess was also called Tzinteotl, the original goddess. Her name changed to Xilonen, Iztacaccuteotl, and Tlatlauhquicenteotl according to the various stages in the growth of the corn.

[3] For a fuller description *see* American Anthropologist. New Ser. 1909. v. 11, no. 2. Parker, A. C. Seneca Medicine Societies.

[4] Clark, J. H. V. Onondaga. Syracuse 1849. 1:54.

Fig. 2 Ceremonial march of the Toñ'wisas Company. The leader carries an armful of ears of corn in one arm and a tortoise shell rattle in her outstretched right hand. (From a drawing by Jesse Cornplanter, Ganundaiyeoh, a Seneca boy)

ing. The office of speaker belonged of course to a man but other offices were held by women.

The address to the Creator as given by Morgan, follows:

Great Spirit, who dwellest alone, listen now to the words of thy people here assembled. The smoke of our offering arises. Give kind attention to our words, as they arise to thee in the smoke. We thank thee for this return of the planting season. Give us a good season, that our crops may be plentiful.

Continue to listen, for the smoke yet arises. [Throwing on tobacco] Preserve us from all pestilential disease. Give strength to us that we may not fall. Preserve our old men among us and protect the young.

Help us to celebrate with feeling the ceremony of this season. Guide the minds of thy people, that they may remember thee in all their actions, na-ho.[1]

Earlier in the spring the Thunder dance was held to honor He''-no^{n} Ti'sōt, *Thunder, our grandfather.* He was asked to remember the fields with a proper amount of rain and prevent the maize fields from parching. If rain failed to come another Thunder ceremony might be held.[2]

Cornfields were not always owned by the tribe or clan. Individuals might freely cultivate their own fields[3] if they were willing to do their share in the tribal fields. If they did not do this they could not claim their share of the communal harvest. Individual fields were designated by a post on which was painted the clan totem and individual name sign. Any distressed clansman, however, might claim a right in the individual field and take enough to relieve his wants, provided he notified the owner.

The first hoeing[4] is called de'owĕnyē', and takes place when the corn is a span high. The second and final hoeing is called the *hilling up,* ĕye^{n}'o^{n}' or hadiyĕ^{n}s', and is called for when the corn is knee high.

3 **Communal customs.** The women of a community who own individual fields and their husbands or male friends may form a

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[1] Morgan. League, p. 196.

[2] *Ibid.* p. 196–97.

[3] *Cf.* Margry 1:123; Jesuit Relations, 52:165.

[4] "The Indians used to give it one or two weedings, and make a hill about it, and so the labor was done." Beverly. Hist. of Virginia. Ed. 2. p. 125–28. Lond. 1722.

mutual aid society[1] known as "*(In the) Good Rule they assist one another,*" Gai'wiu O^{n}dännide'oshä, (Sen). This society chooses a matron of the cornfields, eti'gowānĕ, who inspects the individual fields or gets reports regarding their progress and who orders the rest of the band to go to the field she wishes cultivated at a certain day and hour. She commences the hoeing and ranges her helpers in equal numbers on either side and a little to the rear and hoes to the end of the row a little in advance of the rest, counts off the unhoed rows and takes her position again.

[1] Roger Williams in his *Key* notes this custom among the New England Algonquins. "When a field is to be broken up," he says, "they have a very loving, sociable, speedy way to dispatch it; all the neighbors, men and women, forty, fifty or a hundred, do joyne and come in to help freely with friendly joyning they break up their fields and build their forts."

"As an organized body of workers, the women of each gens formed a distinct agricultural corporation." Stites, Sara H. Economics of the Iroquois, p. 31, Bryn Mawr Col. Monographs v. 1, no. 3.

In Seaver's *Life of Mary Jemison* [*see* p. 70–71] we find a detailed description of this cooperative work:

"We pursued our farming business according to the general custom of Indian women, which is as follows: In order to expedite their business, and at the same time enjoy each other's company, they all work together in one field, or at whatever job they have at hand. In the spring they choose an old active squaw to be their driver and overseer, when at labor for the ensuing year. She accepts the honor and they consider themselves bound to obey her.

When the time for planting arrives and the soil is prepared, the squaws are assembled in the morning and conducted into a field where each one plants a row. They then go into the next field and plant once across and so on until they have gone through the tribe. If any remains to be planted, they again commence where they did at first (in the same field) and so keep on till the whole is finished. By this rule, they perform their labor of every kind and every jealousy of one having done more or less than another is effectually avoided."

This custom of helping is continued to this day. Among the Christian Iroquois such work is called a "bee" but among the followers of the old ways the mutual aid societies still exist and they continue "in the good rule (gai'wiū) to assist one another." *A. C. P.*

Compare also Lawson's *Carolina,* page 179. "They are very kind and charitable to one another, but more especially to those of their own Nation . . . The same assistance they give to any Man that wants to build a Cabin, or make a Canoe. They say it is our Duty, thus to do; for there are several Works that one Man can not effect, therefore we must give him our Help, otherwise our Society will fall, and we shall be deprived of those urgent Necessities which Life requires."

Cf. Adair. p. 407.

Cf. Cullen. Clavigero's Mexico.

It is the duty of the owner of the field to provide a feast at the end of the hoeing and each helper takes home her supply of corn soup, hominy or ghost bread. After the hoeing and before eating the women flock to the nearest stream or pond and bathe. The whole work is accompanied by singing, laughing, joking and inoffensive repartee[1] and the utmost humor prevails, topped off by a splash in the water to remove dust and fatigue.

This hoeing "bee" is called ĕndwă''twenogwa', (Sen.).

4 **The harvest.** In the autumn when the corn is ripe, when the "great bear chase is on in the heavens," the harvesting begins. The corn standing in the fields may be stripped of the ears by the harvesters who throw the ears over their shoulders, generally the left, into a great harvesting basket, ye'nistĕⁿnĕ́k'wistă'. The corn is then deposited in piles in the field or carried to the lodge. Sometimes the cornstalks are pulled up by the roots and carted to the house where they are piled up in layers crosswise for future husking. The plucking bee was called hadĭ'nest'e'oes or if engaged in by women alone, wadi''nĕst'eoes.

The husking bee that followed was called hadinowe'yă'ke' or if women only engaged in the work, wadinowi'yă'ke'. Husking time was another time for a long season of merry industrial gatherings. Work was play in those days when mutual helpfulness made money unnecessary. It was not uncommon for men to engage in this work.[2] They were lured to the scene by the promise of soup, song and the society of wise old matrons and shy maidens.[3] The old women carefully noted the industry of their younger assistants and scheming parents were able to obtain information about prospective mates for their children.

The older men did some work but not much. They aired their wisdom by making wise observations but soon lost their reserve in narrating exciting stories of personal adventure or by relating folk tales, gagä'ä'. They knew full well that a pail full of soup awaited them when the husking ceased whether they worked or not. Often

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[1] *Cf.* Adair. p. 407.

[2] Lafitau, volume 2, page 78, says that the men braided corn, but that this was the only time when they were called upon to do such menial work.

[3] Lafitau, volume 2, page 79, writing of harvest customs says: "At harvest time the corn is gathered with the leaves surrounding the ears which serve as cords to keep the ears together. The binding of the ears belongs to a peculiar ceremony which takes place at night and it is the only occasion where the men, who do not trouble themselves about harvesting or field work, are called by the women to help."

the " bee " would be enlivened by a marching dance, and for this emergency the men brought their water drums[1] and horn rattles and cleared their throats for singing.

The men smoked incessantly of native tobacco mixed with dried sumac leaves and red willow bark. Some of the older women, if not all, claimed the same privilege. The writer has attended some of these " bees " and though he never saw a pipe in a young woman's mouth,[2] he sometimes thought he saw a quid of store tobacco tucked away in a bloomy brown cheek, no doubt used as a toothache preventive.

The " bees " were often conducted out of doors under the white moonlight. A roaring fire of sumac brush or logs tempered the crisp air of the night but left it sufficiently invigorating to keep up spirit and keep the workers active. There was nothing unhealthful in these night carnivals where the smell of the corn plant, the breath of the pines blown by the autumn wind, the smoke of the fragrant burning wood and the pure merriment of the workers and the knowledge of good work furnished the sole exhilaration.

Husked ears may be placed in a corncrib, onä^n′o‘ iadă′kwȧ, or arranged for roasting. When the husk is stripped back for braiding the ears are stood up in rows, against the wall or log with the husks on the floor or ground. When the worker arose for rest the others covered the husks with corn leaves and loose husks to keep them moist. The work of braiding was called waest″shâni′ (com. gen.), or wastĕ^n′shâni (fem. gen.).

Sick and injured members of the " mutual aid company " were always assisted by the company even in the matter of preparing the soil, planting and harvesting. This help was considered as a right and never as a charity.

In the work of tillage plows or digging sticks are called yetogatŏt′thă; hoes are called gâu″djishä′. The bone husking pin is called yĕ^{n}nowiyă″thă.

Husking pins are shaped much like the ancient bone and antler awls but generally have a groove cut about a third of their length about which is fastened a loop, through which it is designed that the middle finger be thrust. The point of the husking pin is held against the thumb. In husking the hand is held slightly open, the ear grasped

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[1] *Cf.* Adair, p. 407.

[2] *Cf.* Jesuit Relations, 67:141.

in the left hand, ear butt downward, the point of the husker thrust into the nose of the ear and under the husk, by a sidewise shuttle motion, the thumb closes quickly over the pin and tightly against the

Fig. 3 Seneca husking pin (specimen is 4⅞ inches in length)

husk, and a pull of the arm downward and toward the body tears away the husk. Many of the ancient bone awls found in refuse pits may be husking pins as well as leather awls.

a Abnormal ears. When harvesters find a red ear all the harvesters give the finder for his or her own use two ears of corn with the husk pulled back ready for braiding. The red ear is called the " King ear " or Hosan′nowa′nĕ^{n}ʻ.

When one finds an ear with only two diametrically placed rows filled out the finder receives as a reward an ear of corn ready for braiding from each harvester. This ear is called oa′de meaning *the roadway*. The unfilled space is " caused by the devil who has licked the cob with his tongue! "

When a large ear is found on which no kernels have grown or on which they are undeveloped, it is called gagĕ^{n}'tci, *it is an old one*. The finder is rewarded by the gift of a single ear of normal corn with the husk pulled back ready for braiding. The finding of one of these abnormal ears is the cause of much merriment. The gagĕ^{n}'tci ear is short and of unusual diameter,— " it is all gone to cob." Sometimes these ears are collected and braided in strings for decorative purposes.

When the husk is pulled back for braiding the ear is called ganoñyon or onoñ′yo^{n}. If men, boys, girls and women engage in this work the process is called hadi′nonyoñtă'. If only women are working the work is called wa′dinonnyoñtă'.

When the ears are entirely stripped of husks the ear is called ganowiyă′′go^{n}. The work of husking by a mixed company is called hă′dinowiyas, or if by women alone, wadi′nowiyas.

Corn smut is called odji^{n}gwĕ^{n}shoʻ (syphilis). The smut-blighted ear is termed odji^{n}gwĕs oʻnisdă′′ge.[1] The blighted cornstalk and its fruit is not used but cast aside and burned.

[1] The pink azaleas, Rhododendron nudiflorum, are known as odji′gwĕ^{n}dă'wĕ^{n}oʻ, syphilitic flowers.

5 **Storage of corn.** The braided bunches[1] of corn[2] were hung on poles in the house or in a protected outbuilding. The shelled corn was preserved in bark barrels and might either be natural kernels or charred. When the braided strings of corn were stored in the house the pole hung from the ridge pole or from the cross beams. Cartier noticed this method in all probability when he wrote that they preserved it in garrets at the tops of their houses.[3]

Champlain mentions that corn was stored in the tops of the houses and enough cultivated to last three or four years.[4]

Lafitau[5] described minutely the Iroquois long house and said that it had storerooms for barrels and bark shelves above for storing provisions. Certain spaces below also were reserved for this purpose.

The description left us by Sagard previously quoted in this work, of the rows of braided corn, is a most vivid one. He says it hung like a tapestry the whole length of the cabin.[6]

The Iroquois harvested corn in greater quantities than they could consume and thus generally had a surplus for trade or emergency. Should one of the five nations have ill luck with their crops the others would respond to the need, for a consideration or gratuitously, as the case demanded.

The storage of corn was an important matter. Morgan, however, says:[7] "The red races seldom formed magazines of grain to guard against distant wants." A little examination of the works of early writers contradicts this statement which Morgan knew did not apply at any rate to the Iroquois.

Referring to the custom of burying corn and vegetables in pits Lafitau wrote:[8]

Didore of Sicile said that the first people of la grande Bretagne, having gathered their corn, kept it in subterranean granaries and it was only taken out in quantites immediately necessary. The Indian women have some sort of an underground granary where also they keep pumpkins (citroulles) and other fruits. It is a hole four to

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[1] *Cf.* Sagard. Voyages des Hurons. Ed. n. 1865. pt 1, p. 135; or *see* footnote p. 31 of this work.

[2] *Ibid.* p. 93.

[3] Cartier in Hakluyt's Voyages, 3:271.

[4] Champlain. Voyages. Paris 1682. p. 301.

[5] Lafitau. Moeurs des Sauvages. Paris 1724. 2:12 et seq.

[6] *Cf.* Morgan. League, p. 318.

[7] Morgan. League, p.372.

[8] Lafitau, 2:80.

Plate 2

1 The ear of corn is plucked from the stalk and thrown over the shoulder into the picking basket. 2 Husking Tuscarora corn for braiding. Note how the husks are pulled back and the ear stood nose up against the basket.

Plate 3

Seneca women plucking Tuscarora corn. The small picking basket carried on the back is dumped into the large harvesting basket.

Plate 4

Braid of Seneca calico-hominy corn. This is the native method of preserving dried corn on the cob, now widely adopted by white people and others.

Plate 5

Seneca elm bark storage barrel, now obsolete among the Iroquois. Specimen is 31 inches high. Collected 1908 by A. C. Parker

five feet deep, lined with bark and covered with earth. Their fruits keep perfectly sound during the winter without any injury from the frost. As for the corn,— it is different,— instead of burying it, except in the case of necessity, they allow it to dry on scaffolds and under the eaves or in sheds outside of their houses.

At Tsonnontouann[1] they make bark granaries round and place them on elevations, piercing the bark from all sides so that the air will get in and prevent the moisture from spoiling the grain.

Morgan in his League[2] describes the *cache* in a somewhat similar way:

The Iroquois were accustomed to bury their surplus corn and also their charred green corn in caches, in which the former would preserve uninjured through the year, and the latter for a much longer period. They excavated a pit, made a bark bottom and sides, and having deposited their corn within it, a bark roof, water tight, was constructed over it, and the whole covered with earth. Pits of charred corn are still found near their ancient settlements.

The writer has found these corn pits throughout the Iroquois region in New York, one of them shown in plate 6. Many of these ancient pits show that they had been lined with long grass or with hemlock boughs,[3] for after the corn had been removed the pit was filled with rubbish and the entire matter burned or charred. In this manner the grass lining, if it were carbonized, was preserved and when excavated the charred grass lining could be removed in chunks or sheets. Mr Harrington has also noted this occurrence throughout his field of investigation in New York. The Iroquois have not abandoned this custom even now. Among the more primitive the custom of burying parched corn and other vegetables is still in vogue. In plate 7 is shown a group of pits on the Cattaraugus Seneca Reservation in Erie county. In the background the Council

[1] Also known as Sonnontouan, Totiacton and La Conception. The site of this old Seneca town is in the present town of Mendon, Monroe co., 1½ miles from Honeoye Falls.

[2] Morgan, p. 319.

[3] In describing corn storage, Kalm writes: "After they reaped their maize, they kept it in holes underground during winter; they dug these holes seldom deeper than a fathom, and often not so deep; at the bottom and sides they put broad pieces of bark. The Andropogon bicorne, a grass which grows in great plenty here, and which the English call Indian grass . . . supplies the want of bark; the ears of maize are then thrown into the hole, and covered to a considerable thickness with the same grass and the whole is again covered by a sufficient quantity of earth; the maize keeps extremely well in these holes and each Indian has several such subterranean stores where his corne lay safe though he travel far from it." Kalm. Pinkerton's Voyages, 13:539.

or Long House is to be seen. These pits are near the house of Edward Cornplanter and were photographed in the spring of 1909 after the store had been removed.

The custom of caching vegetables in the ground is, of course, one now followed by white people generally. Beauchamp[1] says the Mohawk word for making a *cache* is asaton. The Seneca word is similar, being wae'sado^{n}, meaning *she buried it*. *It is buried* would be, gasa'do^{n}.

The modern *caches* are lined with hemlock boughs instead of bark although wood is sometimes used and sometimes bark instead of boughs at the top. Over this is placed a mound of earth.[2]

Champlain is the first writer to describe the pit method of storing corn. He says: "They make trenches in the sand on the slope of the hills some five to six feet deep more or less. Putting their corn and other grains into large grass sacks[3] they throw them into these trenches and cover them with sand three or four feet above the surface of the earth, taking out as their needs require. In this way it is preserved as well as it would be possible in our granaries."

The corn found by the Pilgrims in November 1620 was buried in a similar manner.

In the Journal of a Dutch agent, by some supposed to be Arent Van Curler, who journeyed among the Mohawks and Oneidas in 1634–35, is a statement that the houses were full of corn, some of them containing more than 300 bushels.[4]

Corncribs are an Indian invention and for general construction have been little improved upon by white men. Figure 2 in plate 7 shows a modern Seneca crib.

IV CEREMONIAL AND LEGENDARY ALLUSIONS TO CORN

In the cosmologic myth of the Senecas corn is said to have sprung from the breasts of the Earth-Mother who died upon delivering the twins, Good Minded and Evil Minded. Thus the food of the mother's bosom still continued to give life to her offspring. Esquire Johnson, an old Seneca chief, in an interview with Mrs Asher

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1 Beauchamp, *Dr* W. M. N. Y. State Mus. Bul. 89. p. 193.

2 Compare the following: "The Indians thrash it as they gather it. They dry it well on mats in the sun and bury it in holes in the ground, lined with moss or boughs, which are their barns." Pinkerton. Voyages, 12:258.

3 *Cf.* Hennepin. Voyages. Lond. 1698. p. 104.

4 Amer. Hist. Ass'n Trans. 1895. Wilson, *Gen.* J. G. Arent Van Curler, Journal of, 1634–35, p. 91.

Wright, the missionary, in 1876 said that the beans, squashes, potatoes and tobacco plants sprang also from the grave. Some of the writer's informants declare that the squash grew from the grave earth directly over the Earth-Mother's navel, the beans from her feet and the tobacco plant from her head. Thus it is said of the latter plant, "It soothes the mind and sobers thought."

From the manuscript of Mrs Wright's interview with Johnson, the following is quoted:

Johnson says that a long time ago squashes were found growing wild. He says that he has seen them and that they were quite unpalatable, but the Indians used to boil and eat them. He says that in their ancient wars with the southern Indians they brought back squashes that were sweet and palatable and beans which grow wild in the south, calico colored, and which were very good, and he thinks the white folks have never used them. Also the o-yah-gwa-oweh (oyen'kwaoñ'weⁿ, tobacco) they brought from the south where it grows wild, also various kinds of corn, black, red and squaw corn, they brought from the prairie country south where they found it growing wild. All these things they found on their war expeditions and brought them here and planted them and thus they abound here, but he does not know where they first found the potato.

The mythology of the Iroquois is full of allusions to corn, its cultivation and uses. The story of its origin from the breasts of the mother of the two spirits, previously referred to, is generally accepted as the proper version, but there are other stories which, however, are regarded simply as *gaga'*, or amusement tales, rather than religious explanations. One story relates that an orphaned nephew who had been adopted by an eccentric uncle with strange habits thought that he would discover how his uncle obtained food. He pretended to be asleep and looking through a peephole in his skin coverlet found that the old man had a strange lot of nuts fastened on a stick (a corncob). Cautiously removing a nut (kernel) he placed it in a small pot of water and making some mysterious passes over it as he crooned a mysterious song, he caused the vessel to expand to a great size and fill with a delicious food. The next day the old man went on a journey to a distant gorge and the young man determined to try the experiment which he had seen his uncle perform. He shelled all the corn from the cob, threw it in the pot, sang and motioned until the pot swelled up so large that it filled the house and burst the walls. A great mound was formed and when the old man returned he cried out in dismay, "You have killed me," and gave as his reason that he was the custodian of the corn which was the only ear in the country, the remainder being in the possession of a ferocious company of women who killed by their very glances. Beasts and serpents guarded the path to their houses and as there was nothing else to eat the nephew and uncle must starve. The nephew laughed and set out to conquer all the difficulties. The story of his conquest of all these things is detailed and exciting. However, he chased the women up a tree and made them promise to deliver up the corn, which they did and the hero went home, stepping disdainfully over the carcasses of monsters and serpents. Since then corn has been plentiful.

Beauchamp refers to this tale which he found among the Onondaga but thinks it of European origin. Hewett in his *Cosmology*[1] gives this tale substantially as outlined above. The reference in the tale to the nuts on the stick has given some Iroquois the idea that chestnuts were meant and the story is given as the origin of chestnuts. The Seneca names for chestnuts and corn kernels are not dissimilar, the former being o'nīs'tă' and the latter o'nie'stă'.

Dr Beauchamp relates another tale which he had from Joseph Lyon, an Onondaga. A fine young man lived on a small hill, so the story runs, and being lonely he desired to marry some faithful, agreeable maiden. With his long flowing robes and tasseled plumes he lifted up his voice and sang, " Say it, say it, some one I will marry." He kept up his song day after day and at last there came a fair maiden, arrayed in a flowing green mantle over which were fastened beautiful yellow bells. " I have come to marry you," she smiled, but the tall young warrior responded, " No, you are not the one, you wander too much from home and run over the ground so fast that I can not keep you by my side." The poor rejected pumpkin maiden went sorrowfully away and floating after her came the echo of the song, " Some one I will marry."

One morning a tall slender maiden appeared drawn toward the singer by the magic of the song (which even we of these degenerate days must confess, though even inaudible, is a song that attracts). The maiden was covered with clusters of flowers and gracefully dangling leaves. The tall young man needed but to look and there was an immediate consciousness of affinity. The two embraced each other and to this day in the Indian's cornfield the two plants are inseparable. The cornstalk bean twines around her lover still.

[1] Bureau of Ethnology Rep't. 1903.

Dr Beauchamp adds that they are inseparable even in death " for the beans make a part of Indian corn bread."[1]

Mrs Converse relates a very pretty story of the three plant sisters in her *Myths and Legends*.[2] The writer has heard the same story. The corn, however, is a female and not a pining, singing lover. The corn plant in the old days produced a heavy grain rich in an oil which was most delicious. The Evil Minded spirit, jealous of the good gifts which the Good Minded had given *men beings* watched his opportunity to capture the spirit of the corn. Detaining the spirit he sent his messengers to blight the fields. The sun sent a ray of light to liberate the captive spirit but ever since corn has been less productive and required greater care. Morgan also mentions this legend in the *League*.[3]

There is an allusion to the spirit of the corn plant in the code of Handsome Lake, as follows:

It was a bright day when I went into the planted field and alone I wandered in the planted field and it was the time of the second hoeing. Suddenly a damsel appeared and threw her arms about my neck and as she clasped me she spoke saying " When you leave this world for the new world above it is our wish to follow you." I looked for the damsel but saw only the long leaves of corn twining round my shoulders. And then I understood that it was the spirit of the corn who had spoken, she the sustainer of life. [*See* Code of Ga-nio-dai-o,[4] § 48, ¶ 2]

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1 Jour. Am. Folk Lore, p. 195.

2 Converse. Myths and Legends of the Iroquois; ed. by A. C. Parker. N. Y. State Mus. Bul. 125.

3 Morgan. League of the Iroquois. Rochester 1854. p. 161.

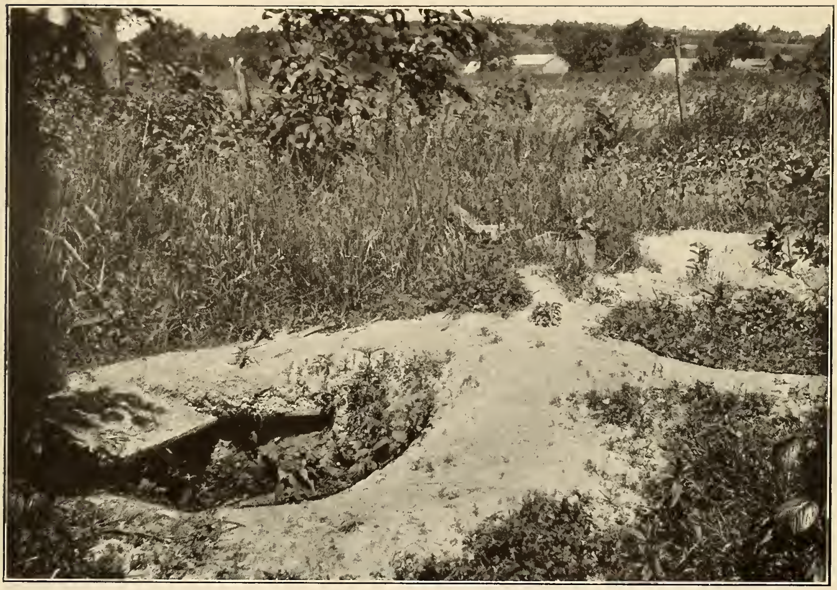
4 Manuscript in N. Y. State Library, trans. by Parker, A. C. and Bluesky, William.

Fig. 4 The Spirit of the Corn speaking to Handsome Lake, the Seneca prophet. (From a drawing by Jesse Cornplanter, a Seneca boy artist)

Plate 6

Corn pit excavated by Harrington and Parker, 1903 (Peabody Museum of Archeology and Ethnology Expedition) on the Silverheel's site, Brant township, Erie county, N. Y.

Plate 7



1 Vegetable storage pits near Chief E. Cornplanter's house, Cattaraugus Reservation. 2 Seneca corncrib on the James Sandy place, Cattaraugus Reservation

Plate 8

Scenes about an Iroquois bark house, from a drawing by Jesse Cornplanter, a Seneca youth. Note the manner in which the corn braids are placed on the drying pole.

V VARIETIES OF MAIZE USED BY THE IROQUOIS AND OTHER EASTERN INDIANS

1 Varieties mentioned by historians. Few authorities agree as to the varieties of Indian corn. Beverly[1] mentions four "sorts" among the Virginia Indians, two of which he says are early ripe and two late ripe. He describes the four varieties carefully and ends by saying that his description is without respect to what he calls the "accidental differences in color, some being blue, some red, some yellow, some white and some streaked." He continues that the real difference is determined by the "plumpness or shriveling of the grain." To him the smooth early ripe corn was flint corn and the "other . . . with a dent on the back of the grain . . . they call *she-corn*." This is probably the *Poketawes* of the Powhatan Indians.

In Harris's *Discoveries*[2] is another description of corn giving the variety of colors as "red, white, yellow, blue, green and black and some speckled and striped but the white and yellow are most common."[3]

Thomas Hariot in his *Brief and True Report*, reports[4] the "divers colors" as red, white, yellow and blue which in the light of the descriptions of his contemporaries would seem to make his report true but not the whole truth.

Morgan[5] is even more unsatisfactory in his descriptions and records

[1] Beverly. Virginia, p. 126.

[2] Pinkerton. Voyages and Travels, 12:242.

[3] ". . . maise or Indian corn, which is not our pease in taste, but grows in a great ear or head as big as the handle of a large horse whip, having from three hundred to seven hundred grains in one ear, and sometimes one grain produces two or three such ears or heads; it is of various colours, red, white, yellow, blue, green and black, and some speckled and striped, but the white and yellow are most common; the stalk is as thick as an ordinary walking cane, and grows six or eight feet high, in joints, having a sweet juice in it, of which a syrup is sometimes made, and from every joint there grow long leaves in the shape of sedge leaves." *Ibid.* p. 242.

[4] Pagatowr, a kind of grain so called by the inhabitants; the same is called mayze, Englishmen call it Guinywheat or Turkey-wheat, according to the names of the countries from whence the like has been brought. The grain is about the bigness of our ordinary English pease and not much different in form and shape; but of divers colors, some white, some red, some yellow and some blue. All of these yield a very white and sweet flour being used according to his kind, it maketh a very good bread." Hariot. Reprint. N. Y. 1872. p. 13–16.

[5] League of the Iroquois, p. 370.

only three kinds of corn among the Seneca. He enumerates them as white, O-na-o-ga-ant, red, Tic-ne, and white flint, Ha-go-wa. These were the varieties which he collected and sent the State Cabinet (Museum) in 1850.

It is difficult to say what kind of corn Columbus saw on the island which he discovered, but we may be reasonably sure that Cartier mentioned the white flint corn when he described the corn of the Hochelagans. Morgan[1] mentions this as the bread corn of the Seneca mistaking it for the white Tuscarora or squaw corn.

Sweet corn was long known to the Indians and its seed was first obtained by Sullivan's soldiers from the Seneca fields on the Susquehanna.[2]

Purple or blue corn is mentioned in the Journal of Lieut. Erkuries Beatly, an officer under Sullivan. In describing the events of Friday the 3d of September he says ". . . the Indians had just left their kettles on the fire boiling fine corn and beans which we got, but what was most remarkable — the corn was all purple . . ."

Esquire Johnson, an aged Seneca chief, in an interview with Mrs Laura Wright in 1879 said, ". . . They brought it from the south, also various kinds of corn black, red and squaw corn. . . All these things they found on their war expeditions and brought them here and planted them and thus they abound." The object of Iroquois raids, according to many of the old Indians, was to get new vegetables and slaves as well as to subjugate insubordinate tribes.

Dent corn, with the Iroquois (Seneca), is called ono'dja, *tooth*. Tradition relates that this is a western form derived from Sandusky Iroquois in Ohio.

The writer has conducted a lengthy inquiry as to the varieties of corn cultivated by the Iroquois during the last 100 years and the result is embodied in the list, which is found below.[3] At the present day while they conserve the forms with a zeal that has in it a religious and patriotic sentiment, they also cultivate the new varieties with equal ardor for in the modern types is found the corn which produces the most money in the markets.

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[1] *Ibid.* p. 370.

[2] *Cf.* Journal of Capt. Richard Begnall.

[3] *Cf.* Harrington. Seneca Corn Foods, Am. Anthropologist, new ser. v. 10, no. 4, p. 575, 576. Four varieties are mentioned.

2 Varieties of corn used by the Iroquois

Zea mays amylacea, soft corns

Tuscarora or Squaw, Onä′oñga^{n}= [1] *white corn*
Tuscarora short eared, Onyuñ′gwĭktă′= *growing over the tip*
Purple soft, Oso^{n}gwŭdji′ = *purple*
Red soft, gwĕ^{n}dä‘ä = *red*

Zea mays indurata, flint corns

Hominy or flint, dionĕo′′stäte′=the corn glistens
Hominy or flint, long eared, hĕ′′kowă
Calico, { yodjisto′goñnyi = *it spotted is*
Calico, { deyuneo^{n}′de^{n}iŭs = mixed colors
Yellow, djitgwä^{n}′ä^{n} hĕ′′kowă = yellow hĕ′′kowă

Zea mays saccharata, sweet corns

Sweet, diyut′gotnogwi = *puckered corn*
Black sweet, oso^{n}gwud′dji deutgo^{n}′negaidĕ = *black puckers*

Zea mays everta, pod corn

Red pop, gwĕ^{n}′′dä‘ä wata′toñgwus = red, *it bursts*
White pop, wata′toñgwus = *it bursts*

Zea mays (variety ?), pod corn

Sacred corn, onä′o^{n}wĕ = original corn

The Mohawks cultivate some of these varieties now. Mr William Loft, a Mohawk Indian of the Six Nations Reservation in Canada, gives the Mohawk names for the following:

Tuscarora, ono^{n}staga^{n}′rha
Tuscarora, short, ono^{n}staoan′nal
Sweet corn, degon′derho^{n}wix
Hominy or white flint, onust′teoñwe‘
Hominy, longeared, ga′hrades
Yellow, o‘jinegwa′′onuste‘
Purple, orhon′ya‘
Husk or pod, oo^{n}′na^{t}
Pop, wadada′gwas oniuste‘

[1] Seneca terminology.

VI CORN CULTIVATION TERMINOLOGY[1]

1 The process of growing

SENECA	ENGLISH
a Onä'o'	Corn
b waeeyŭnt'to'.	She plants
c ohwĕ^{n}o'dadyiĕ'	It is just forming sprouts
d oga''hwäoda^{n}	It has sprouted
e otgaä'häät	The blade begins to appear
f otga'äähät	The blade has appeared
g deyuähă'o	The blade is already out
h ogwä^{n}'dääodyiĕ'	The stalk begins to appear
i ogwä^{n}'dää'e'	The stalk is fully out
j oge''odadyie'	It is beginning to silk
k owä^{n}'dă'	The ears are out
l o'geot	It has silked out
m ogwä^{n}dŭ'äe', ogwä^{n}'dä^{n}e'	The tassels are fully out
n ono''gwaat	It is in the milk
o dĕju'gö^{n}säät	It is no longer in the milk
p oweă^{n}däädyĕ', owĕ^{n}dādyĕ'	The ears are beginning to set
q onĕ'oda'dyiē'	The kernels are setting on the cob
r hadi'nonyo^{n}cos	They are husking (indefinite as to method)
s yestä'änyo^{n}nyano'	She is braiding
t dŭsta^{n}'shoni	It is braided
u gasdä^{n}t'shudoho'	It is hung over a pole
v gano^{n}'gadi'	It is strung along a pole

2 Terminology of cultivation

a waĕ'yuntto'	She plants
b yeeo'do'gwŭs	She weeds
c deyonanyaoh, or deyo'wĕnnyē'	She stirs up the earth
d wae'oao^{n}, or waeä	She hills it up

3 Parts of corn

a oea'	Leaves
b odjo^{n}'wa'sa	Leaves of corn
c oaya', oe'ä'	Stalk

[1] Based upon manuscript lexicon of Rev. Asher Wright. For the sake of uniformity the Wright system of orthography has been changed to that used in the body of this work.

Plate 9

Varieties of Iroquois corn. From left to right the ears are: 1 Tuscarora. 2, 3 Red. 4, 5 Purple. 6 Calico. 7 White flint. 8 Short-eared calico. There are seven other varieties cultivated as native corn. Specimens are one third natural size.

d onoⁿ′gwaⁿ′a′	Cob
e gagosswa′ge′, ogoishă′′ge	Butt of cob (meaning nose)
f oji‘jut	Tassels
g onäo onius′ta or o’nis′ta’	Kernels
h onyo′nia’	Husk
i oaya okdayä, or ok’te′ä	Roots
j okta′a	Hulls
k ogai‘tă’	Waste matter
l onäo’a’wĕn′niăsă’	Germ = heart
m ogŭdjidä’	Pollen when it comes off
n ganäoñgwe’	Seed corn
o o″gioⁿt	Silk

VII UTENSILS EMPLOYED IN THE PREPARATION OF CORN FOR FOOD

The implements and utensils employed for the planting, cultivating and harvesting and the preparation of corn for food embraced the larger part of Iroquois domestic furniture. To a large extent many of the old-time corn utensils are still made and used by the Iroquois who prefer the "old way" and it is surprising to find that even the Christianized Iroquois, who generally live in communities away from their "pagan" brothers, cling to their corn mortars and the other articles which go with them. Today on all the Iroquois reservations both in New York and Canada the corn articles form the great part of their Indian material, and in fact constitute much of their aboriginality. As far as the writer can learn this same observation applies to all of the Indian tribes or remnants of such east of the Mississippi river.

Corn mortars are still made in the ancient way by burning out the hollow.

The men probably made most of the bark and wooden dishes[1] and carved the spoons and paddles while the women made the baskets and sieves.

Hennepin writing on this subject remarks: "When the Savages are about to make Wooden Dishes, Porringers or Spoons, they form the Wood to their purpose with their Stone Hatchets, make it hollow with their Coles out of the Fire and scrape them afterward with Beavers Teeth for to polish them.[2]

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[1] *See* Jesuit Relations, 23:55, 13:265; Lawson. Carolina, p. 208.

[2] Hennepin. Voyage, p. 103.

Large kettle, Gano^{n}'′djowanĕ′. Anciently large clay vessels were used. Later brass or copper kettles obtained from the whites were used. The use of clay vessels was early noticed by travelers[1] among the Indians of eastern North America. There are several good descriptions of the methods of pottery making, references to the use of the vessels for cooking and several illustrations of them [*see* fig. 15]. It seems most probable from these early accounts and illustrations that the clay kettles were placed directly over the fire, though perhaps supported by three or four stones properly arranged. Schoolcraft, however, illustrates one suspended over the fire. The writer once found a clay vessel in a fire pit with the remains of the fire about it and four or five pieces of angular shale at the bottom as a supporting base. There are several illustrations depicting this method in old works.

The coming of the traders with brass kettles was an event in the history of Indian cooking. It enlarged their capacity for cooking food in quantities. As brass kettles became common with them the smaller clay vessels passed out of use and were made but rarely. In this way the art gradually became forgotten.

Among the Seneca the writer found several persons who remembered hearing in their youth how the vessels were made. They asserted that clay was thus occasionally employed up to the middle of the last century. The Seneca seem to have conserved the art[2] at any rate for some time after their settlement at Tonawanda, Allegany and Cattaraugus.

The use of brass kettles among the Iroquois is still found, some of the more conservative seeming to prefer them [*see* pl. 10], but the majority now use iron or the more modern enameled ware pots.

Wooden mortar, Ga''niga''ta.[3] The corn mortar was made of the wood of the trunk of a niiu''gägwasā, *pepperidge tree* or ogo′wä,

[1] These vessels are so strong that they do not crack when on the fire without water inside, as ours do, but at the same time they can not stand continued moisture and cold water long without becoming fragile and breaking at any slight knocks that any one may give them but otherwise they are very durable." Sagard. Histoire du Canada. 1638. Tross ed. Paris 1866. p. 260.

[2] *Cf* Harrington. Last of the Iroquois Potters. N. Y. State Mus. Rep't of Director. 1908.

[3] Ga'ni′ga' in Mohawk.

Sebastien Cramoisy in his relations (1634–36) said " . . . we have learned by experience that our sagamites are better pounded in a wooden mortar in the fashion of the Savages than ground within the mill. I believe it is because the mill makes the flour too fine." [*See* Jesuit Relations. Thwaite's ed. v. 8] *black oak*. To conform to the proportions specified by custom the log was reduced to a diameter of 20 inches and then a section 22 inches long was cut or sawed off. A fire was built in the center of the end naturally uppermost and when it had eaten its way into the block for half an inch or thereabouts, the charcoal was carefully scraped out to give a fresh surface to a new fire which ate its way still deeper. The process was repeated until the bowlike hollow was of the desired depth, generally about 12 inches.[1] In this hollow was placed the corn to be pulverized. The relative values of mortars depended on their freedom from cracking and the grinding quality of the wood.

The use of the mortar[2] and pestle is shown in plates 11, 12 and 20. In the same illustrations is shown the corn strung or braided for convenience in handling, after the old Indian style now universally adopted by farmers.

The wooden mortar and pestle are found among most of the eastern Indians. The styles and shapes differed greatly. The Cherokee, for example, had a shallow saucerlike depression in the top of their mortars and a socket in the center. Their pestles were bulbous at the top but the grinding end was small and of a size designed to fit the socket loosely. As the meal was pounded it rose to the top and settled around the "saucer" top where it could easily be swept or scooped into a receptacle. Cherokee mortars like the Iroquois were made upright. The Pottawatomie, Chippewa and some others had horizontal mortars, that is the cavity was made in the side of the mortar log. The Seminole not content with one cavity made three or four in the side of a fallen tree. The Nanticoke made their mortars vase-shaped with a supporting base and the Choctaw chopped their mortar vases to a point to hold them stationary. Dr Speck found an odd mortar among the Connecticut Mohegan. It had been carved so as to resemble somewhat an hour glass. He was not able

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[1] Adair describes the process as follows, ". . . cautiously burned a large log to a proper level and length, placed fire a-top, and with mortar [clay] around it, in order to give the utensil proper form, and when the fire was extinguished or occasion required, they chopped the inside with their stone instruments, patiently continuing the slow process till they finished the machine to the intended purpose." Adair, p. 416. Lond. 1725. *Cf.* DePratz. Paris 1724, 2:177.

[2] "The Indians always used mortars instead of mills and had them with almost every other convenience when first opened to trade." Adair, p. 416.

"They pound it in a hollow tree." De Vries. Second Voyage. Hoorn 1655, p. 107. N. Y. Hist. Soc. Col. Ser. 2, v. 3, pt 1.

to obtain it because the tribe held it as communal property and looked upon it with a feeling of veneration. The pestles differ as much as the mortars, some being mere clublike sticks.

Pestle, Hĕtge′o‘ or He’tgĕn″khă’[1] The Seneca words mean *upper part* and are derived from hetgää′gwa, meaning *upper*. The pestle is generally of hard maple wood about 48 inches long. It is shaped the same on both ends and either may be used for pounding, although one end is generally chosen and always used thereafter. The other end serves as a weight that adds to the power of the arm in making the stroke. The mortar and pestle are used in pulverizing corn for soups, hominy, puddings and bread, and are by far the most important utensils used in preparing corn foods made from meal.

Stone mortar and pestle, Yeĭstonniă″tă’. Up to within the time of the Civil War it was a common thing for the Seneca, as well as others of the Iroquois, to use stone mortars and pestles or rather mullers. Some of these mortars were so small that they could easily be carried in a basket without inconvenience. Corn could be cracked for soup by a single blow or by rubbing once or twice it could be re-

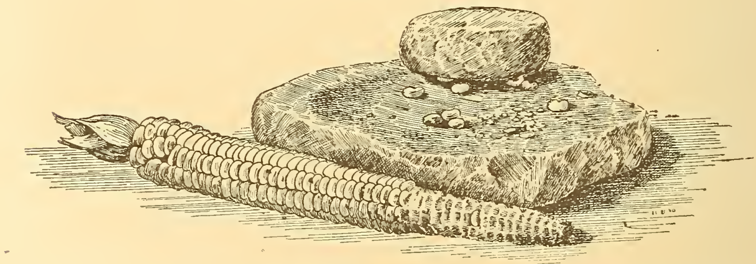


Fig. 5 Seneca stone mortar and muller. The mortar is 8 inches in length

duced to meal. Many of the older people remember these "stone mills" by which their odjis′to^{n}nondä‘, *cracked corn hominy* was made[2] [*see* fig. 5]

M. R. Harrington found one of these mortars still in use by the Oneida in Madison county and described it in the American *Anthropologist*.[3]

[1] Ga′ni′ga‘ in Mohawk.

[2] *Cf.* Jesuit Relations, 1716–27, v. 67:213. They crush the corn between two stones reducing it to a meal; afterward they make of it a porridge which they sometimes season with fat or with dried fish.

[3] New Ser. v. 10, no. 4. 1908. p. 579.

Plate 10

Interior of the Canadian Seneca ceremonial cook house, Grand River Reservation. Note the large brass kettle. From a photograph by the author

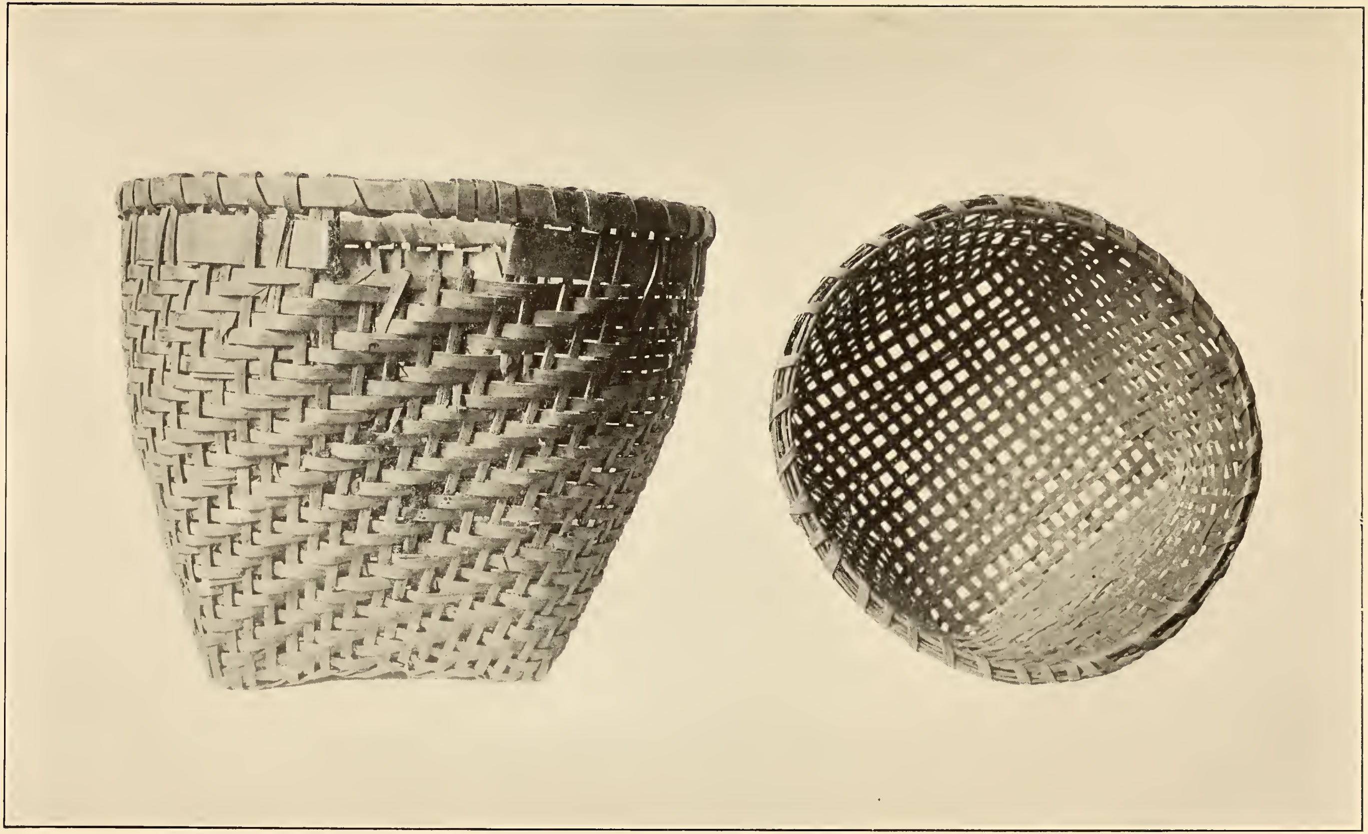
Plate 11

Iroquois corn mortar and pestle. The mortar is 25 inches high. (Museum collection)

Plate 12

Feast makers at the New York Seneca midwinter festival, February 1909. The costumes and other articles except the corn mortar are now in the State Museum collections.

Plate 13



Hulling and hominy baskets. Illustrations are one fifth actual size. A. C. Parker, collector, 1908

Mullers and mealing slabs are commonly found on Iroquois village sites and sometimes may be picked up near log cabin sites on the present reservations. The Iroquois probably did not use the long cylindrical pestles to any great extent, as did the New York Algonquins as late as the Revolutionary War.

Mr Harrington found one of these cylindrical pestles among the descendants of the Shinnecock at Southampton, Long Island, together with a small wooden mortar. The Minisink Historical Society has one which was given an early settler by one of the Minsis before the Revolutionary War.

Hulling basket, Yegai'′toätă'.[1] The Seneca word for hulling basket means *it washes corn.* This basket is woven with tight sides

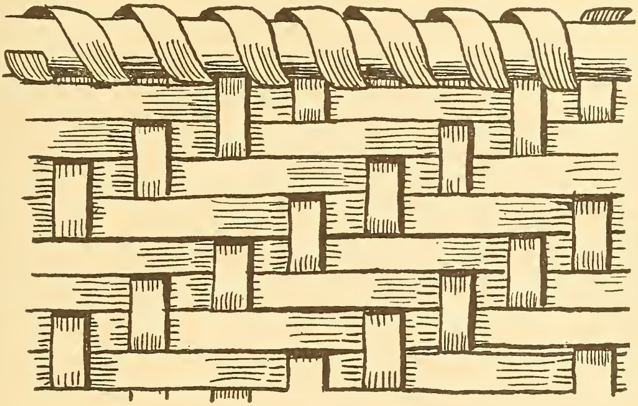


Fig. 6 Technic of the hulling basket

and a coarse sievelike bottom. It is about 18 inches deep and as many broad at the top tapering down to 12 inches at the bottom. In this basket is put squaw or hominy corn after it has been boiled in weak lye to loosen the hulls and outer skin. The basket of corn is then soused up and down in a large tub of water until all the hulls are free and have floated off in the many rinse waters.

The details of weaving the hulling basket are shown in figure 6 and the basket itself in plate 13. Hulling baskets are made in four styles; without handles of any sort; with handles made by openings in the body of the basket just below the rim; by raised loop handles made by fastening pieces of bent wood through the rim and into the body of the basket; and by a raised handle that arches from side to side. For the various styles see figure 7. This type of basket is

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[1] Yegahreda^{n}da'kwa' in Mohawk

widely found among the eastern Indians although the Iroquois basket seems to have been higher.

The hominy sifter is woven in the same manner and the State Museum has specimens from the Cherokee and Shawnee which are

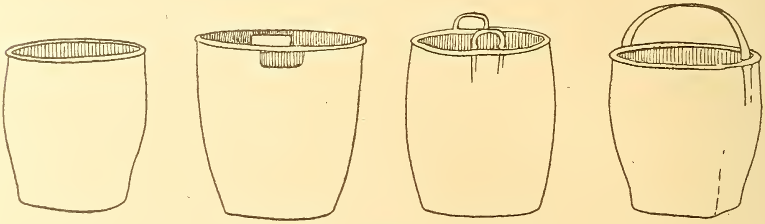

Fig. 7 Various forms of hulling baskets

similar in all details to the Iroquois baskets. Both of these peoples of course have been in contact with the Iroquois at different periods. The Delaware sifting and washing baskets were often made of shreds of bark but the Iroquois preferred the inner splints of the black ash.

Hominy sifter, Onĭius'tawanĕs.[1] The Seneca term means *coarse kernels.* This basket is of the same weave as the hulling basket. It is a foot square at the top and tapers down to 10 inches at the bottom. The bottom is sievelike, the openings being about $\frac{3}{16}$ inch square. The hominy corn cracked in the mortar is sifted through this basket and the coarser grains that remain are thrown back in the mortar to be repounded and resifted until all are of the requisite size.

Meal sifter,[2] Niu'nyo^{n}'sthasā'.[3] The Indian word is derived from niwa'a, *small,* and oniius'tă' *kernels.* In size and shape this basket is like the hominy sifter. The splints of which it is woven, however, are very fine, being about $\frac{1}{16}$ inch wide. Except for decorative purposes, no baskets were ever woven finer. The niu'nyo^{n}s'thasā' was used for sifting corn meal for bread puddings. Sometimes it was used to sift other things, such as maple sugar, salt, seeds etc. So much labor was required to make one of these meal sifters that many of the Iroquois ceased to weave them when cheap wire sieves could be obtained, the price of the meal sieve basket being as high as $1 [*see* fig. 8].

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[1] Yuno^{n}'owa'nĕs in Mohawk.

[2] "They have little baskets which they call *notassen,* and which are made of a kind of hemp the same as fig frails, which they make to serve as sieves." De Vries, p. 187.

[3] Niga'te'sera, flour sieve, in Mohawk.

Metallic meal sifters, now sometimes used, are regarded as inferior for sifting the Indian prepared meal because they give a metallic

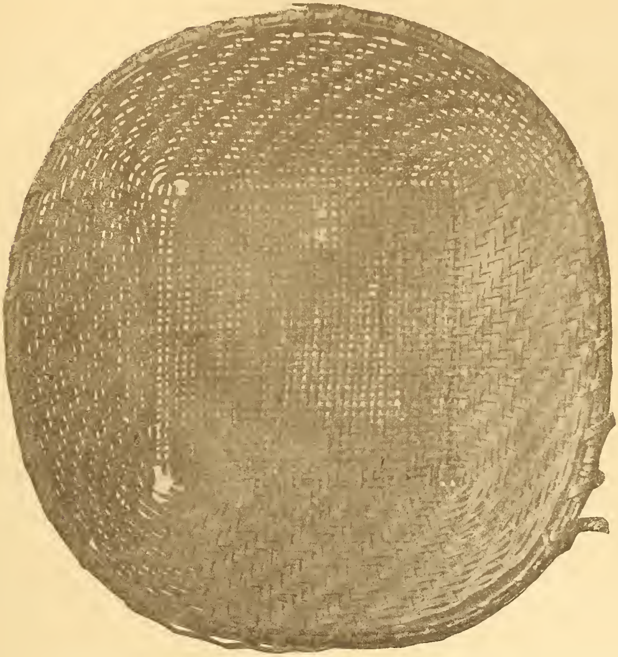

Fig. 8 Meal sifter. Specimen is 12 inches in diameter and 4 inches deep. The mesh is $\frac{3}{16}$ inch.

taste to the food. It is said that the basket sieve makes lighter flour.

Ash sifter, Ogä'yeo^{n}to'.[1] The ash sifter was a small basket about 6 inches square at the top, 5 inches square or less at the bottom and about 3 inches deep. It was woven like the hominy sifter, the sieve bottom having somewhat smaller openings.

Ash sifters are rare in collections illustrating the series of baskets used in the preparation of corn for food. One in the State Museum is very old and was collected by Morgan at Tonawanda in 1851.

Bark bread bowl, Gŭsno^{n}găoñ'wə'.[2] This dish is made from bark peeled in the spring or the early summer time, bent into the required shape and bound around the edges with a hoop of ash sewed on with a cord of inner elm or basswood bark. The usual dimen-

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[1] Yo^{n}ga^{n}rawakto' is the Mohawk form.

[2] Ga''sna'gahoñ'wa' in Mohawk.

sions are from 1 to 2 feet in diameter and from 4 to 9 inches deep. Some bowls are elliptical in shape. These bark bowls were used for mixing the corn meal into loaves previous to boiling and afterward for holding the finished loaf.

The writer has seen these bark bowls used for cooking vessels, heated stones being thrown into the liquid within it. The bark vessel can also be put over an outdoor earthen or stone fireplace and water heated if the flames are kept away from the rim. Bark bowls are still used in some parts of the Seneca reservations as dish pans, sap tubs, wash pans, etc. Bark dishes are easily made and their first use may be referred to very early times. Two of these bowls are shown in plate 14. Morgan collected a series of bark vessels for the State Museum in 1854 and some of the specimens are still on exhibition.

Wooden bread bowl, Owĕ^{n}gä‘gă’oñ′wă’.[1] Sometimes instead of a bark dish a wooden one was used for a bread bowl. It was of about the same relative size and carved from pine or maple. The form naturally differed somewhat from the bark bowls, but in general outline followed them. Some of these bowls are carved from maple knots, or knots from other trees. Usually, however, they were carved from softer wood.

Wide paddle, Gatgŭn′yasshuwa′nĕ.[2] The wide paddle was used for lifting corn bread from the kettle in which it was boiled. Some of these paddles are beautifully carved and ornamented. The wide bread paddle took two forms, the round blade and the rectangular bladed paddle [*see* pl. 16]. A feature which distinguishes a lifting from a stirring paddle is the hole made in the middle of the blade. The holes are either round or heart-shaped.

Narrow paddle, Nigat′gwünyashäa′.[3] This paddle was used for stirring boiling soups and hulled corn.

Both wide and narrow paddles were carved from some hard wood, preferably some variety of maple. Some are decorated with carvings of phallic symbols. Such designs are regarded as sacred, in the Iroquois religion, and are never looked upon with levity. The carving of paddles gave opportunity for the carver to display his best genius. Chains were carved from the solid wood of the paddle handle and balls cut in barred receptacles [*see* pl. 16, fig. 3]. Even some of the plainer forms had decorations made by carving a series of small triangles arranged in figures on the handle.

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[1] Oyĕn′de’^{n}gaon^{n}wa’ in Mohawk.
[2] Gagawe″tserhowanĕ‘ in Mohawk.
[3] Nigagawĕ″tsĕlha in Mohawk.

Within recent years this work of making and decorating these kitchen utensils has been the work of the men. No doubt they thought that a fine paddle would furnish a proper incentive for the making of a good soup.

Great dipping spoons, Ato'gwassho^{n}wa'ne'.[1] For dipping hulled corn soup, or in fact any other soup from a kettle, a large dipping spoon was generally used when there was one at hand. In form it was like the common eating spoon used by the Iroquois but very much larger, the bowl being about a foot in diameter. At present these large spoons are very rare. One specimen that the writer obtained for the American Museum of Natural History is said to have been used for years in council meetings on the Genesee Reservation, especially at the Green Corn Festivals. There are several large dipping spoons in the State Museum, but they are now not to be found in use on the New York Indian reservations. The specimen shown in the illustration, figure 1, plate 17, has a shorter handle than most.

The great dipping spoons were used for apportioning out the contents of the great feast cauldrons. The activity of collectors and the greater convenience of civilized articles has brought the tin dipper into greater prominence.

Deer jaw scraper, Yigăssho^n'gäya"to'.[2]. This implement is a very rare one. It is simply one of the rami of a deer's lower jaw and

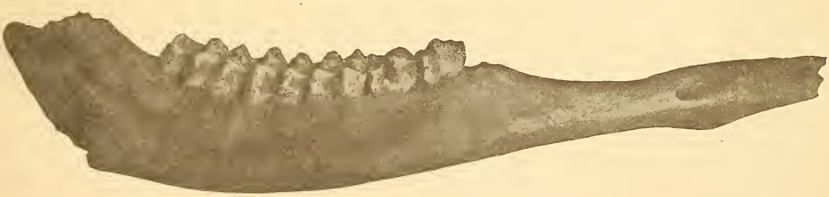


Fig. 9 Deer jaw scraper for green corn. Specimen is about 8 inches long

is complete without trimming or finishing in any way. The jaw was held by the anterior toothless portion and with the sharp back teeth the green corn was scraped from the cob. The name of the implement, Yigăssho^n'gäya"to', is derived from ogo^n'sä, *green corn,* and yigowe^n'to', *it scrapes.*

The Seneca housewife when she uses the jaw scraper, with characteristic humor, says, "I am letting the deer chew the corn first for me."

[1] Wadogwa'tserhowānĕ' in Mohawk.

[2] Yĕ^{n}nos'stogä^{n}yatha' in Mohawk.

Another method of bruising green corn on the cob was to place a flat grinding stone in a large wooden or bark bowl, hold the ear on the stone with one hand and mash the unripe kernels with a milling stone held in the other hand. The bruised corn was then brushed from the mortar stone and the kernels that yet adhered to the cob, scraped off. When enough material had been thus prepared the lower stone was removed from the bowl and the mashed corn removed for cooking.

Dried corn was milled much in the same way. A handful of the corn was placed on the millstone and pulverized with the miller. The cracked corn would fall into the bowl and be pounded again and again until enough hominy or meal was obtained. The Seneca abandoned this method about 50 years ago, although a few have used it in recent times when a wooden mortar was not accessible.

The writer collected a deer jaw scraper in 1903 for the American Museum of Natural History and believes his description and specimen the first on record. Mr Harrington later collected and described the deer jaw scraper in Canada, corroborating the writer's data.[1]

Sagard in his *Voyages to the Hurons* describes another jaw method of removing green corn from the cob but says the jaws were those of the old women, the maidens and children who prepared the mass. He remarks that he had no liking for the food.

Eating bowl, Gă'oñ'wă'. Eating bowls[2] were made from bark or wood and were of various shapes.

Feast bowls oftentimes were of large size and were ornamented in various ways to distinguish them from ordinary dishes. There are two interesting specimens of feast bowls in the State collections. Both are Mohawk bowls from Grand River, Can. One has a handle styled after a beaver tail, a beaver's tail being the symbol of a feast. The other bowl is made of elm bark. It was used at one of the Five Nation's councils some 10 years ago. The interior is divided into five sections by painted lines of yellow radiating from the center. At the angles of the radiating division lines are beaver tails, five in all. Upon the inner raised sides of the bowl is painted in red the names of the five nations and in black beneath the modern council names: Ga-ne-a-ga-o-no, Mohawk, Owner of the Flint; Gue-gweh-o-no, Onondaga, On the Hill; Nun-da-wah-o-no, Seneca, The

[1] *See also* Parker, A. C. N. Y. State Mus. Bul. 117, p. 544.

[2] "Their dishes are wooden platters of sweet timber." Raleigh, in Hakluyt's Voyages. Lond. 1600. 3:304.

Great Hill People; O-na-ote-kah-o-no, Oneida, The People of the Stone. The label reads as follows:

(CANADIAN) MOHAWK BREAD BOWL.

This decoration is a fac-simile of the old bowl taken by the Mohawks when they left the League and departed with Brant.

5 yellow lines — The sun's path guarding the 5 nations. 5 Beaver tails — the beaver tail soup symbol. At the 5 Fire councils each Fire (or nation) was compelled to dip his soup from its own national division of the bowl. The dipping of the spoon into each portion allotted to its Fire signified union and fidelity. This bowl, obtained in Canada, was decorated by a Seneca Indian Artist on the Cattaraugus Reservation, June 12, 1899.

Harriet Maxwell Converse
Cattaraugus Reservation, N. Y.
June 15, 1899.

Ordinary eating bowls were smaller than feast bowls and were often carved with great nicety from maple, oak or pepperidge knots. After carving and polishing the bowls were dyed in a solution made from hemlock roots. Continual scouring soon reduced the bowl to a high polish and the grease which it absorbed gave it an attractive luster which contributed in a large measure to preserve the wood. Bowls which have been in the State Museum for 50 years still yield grease if scraped with a penknife.

Eating bowls are usually round but many of the older forms have suggestions of handles oppositely placed. Some of these handles go beyond mere suggestions and take the form of a bird's head and tail or two facing human effigies.[1] Bowls are shown in plates 14 and 15.

Wooden spoons, Atog'washä.[2] Great care was exercised in carving wooden spoons. As a rule, each individual had his own

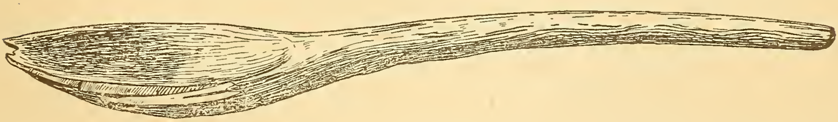


Fig. 10 Wooden spoon from bottom of Black lake. Collected by E. R. Burmaster[1] 1910. Specimen is 15 inches in length.

spoon which he recognized by the animal or bird carved on the handle. In olden times, the dream animal or clan totem was usually carved upon the handle, but specimens of later times nearly always

[1] *See* Harrington. Some Unusual Iroquois Specimens. Am. Anthropologist. new ser. 11:85.

[2] Niwado^{n}kwatserha, in Mohawk.

have the conventionalized forms of birds carved upon them. In rare instances the figure was carved from a separate piece of wood and attached to the spoon handle with a peg.

The wood chosen for spoons was usually curly maple knots, although knots of other woods were valued and often used. The Iroquois preferred to have their spoons of a dark color and as the "spoon wood" was white or yellow, they used dyes to darken them. Hemlock bark or roots were boiled in water until the liquid was of the proper shade, which was dark red, and then the spoon

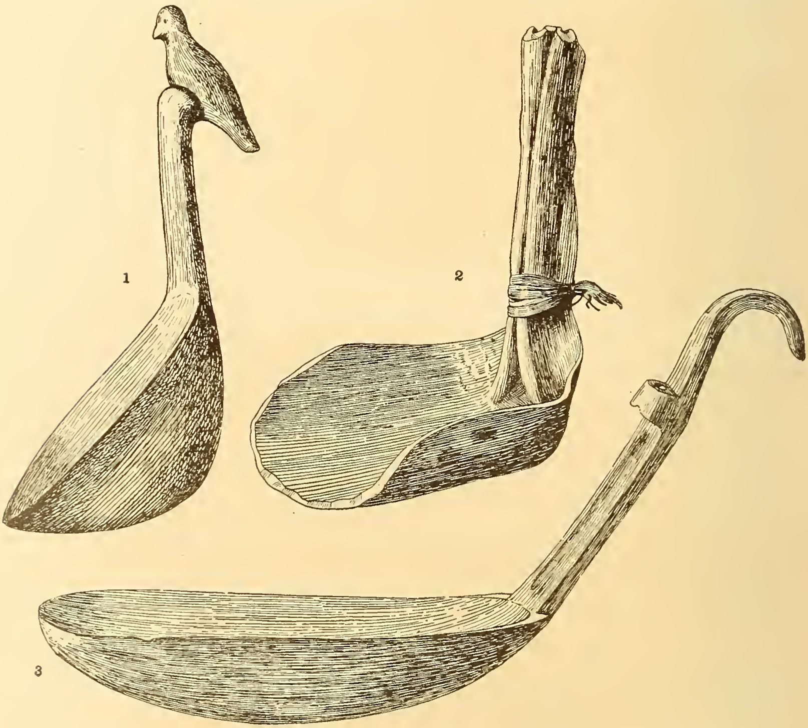


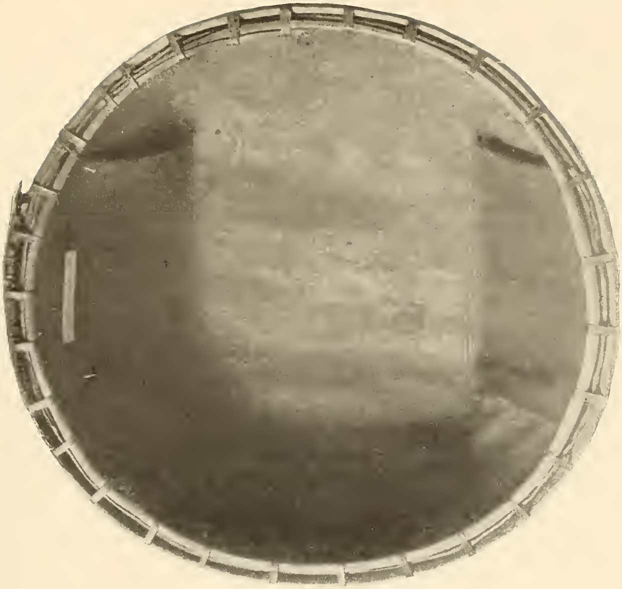
Fig. 11 Types of Seneca and Onondaga eating spoons. 1, wooden spoon; 2, bark ladle; 3, buffalo horn spoon. Number 3 was collected by E. R. Burmaster, 1910, from the Alec John family who had preserved it as an heirloom for many years.

was plunged in and boiled with the dye until it had become thoroughly saturated with the dye and had partaken of the desired color. By use and time the spoon became almost as black as ebony and took a high polish.

Spoons were sometimes shaped from elm bark but these were not durable. They were scoops rather than ladles or spoons.

The Iroquois did not readily abandon the use of wooden spoons and in some districts they are still used. The Indians say that food

Plate 14

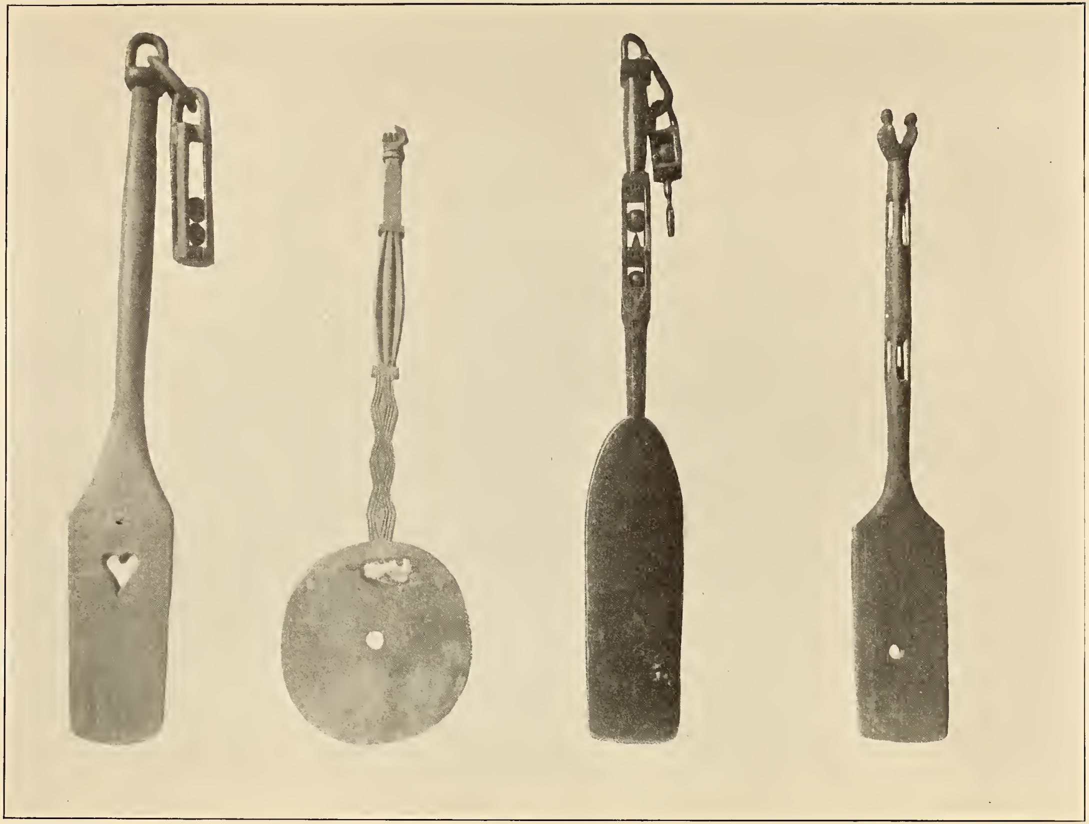


1 Seneca bark bowl. 2 Mohawk feast bowl used at the Six Nations annual meetings. The beaver tail symbols refer to a section in the Iroquois Constitution and symbolize peace and plenty. Illustrations are one sixth actual size. Coverse collection

Plate 15

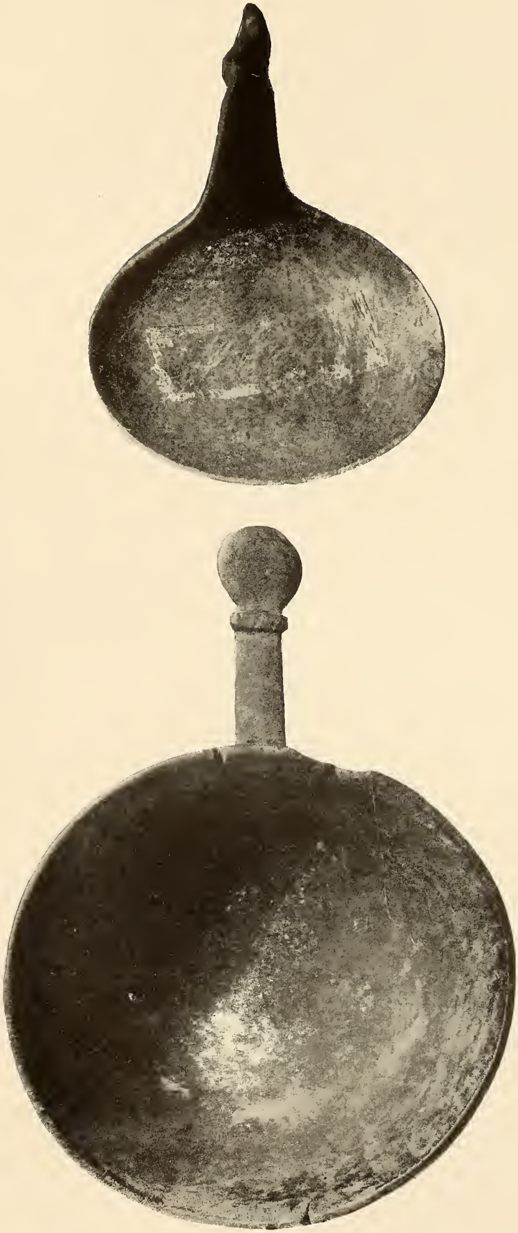
Iroquois bread and eating bowls

Plate 16



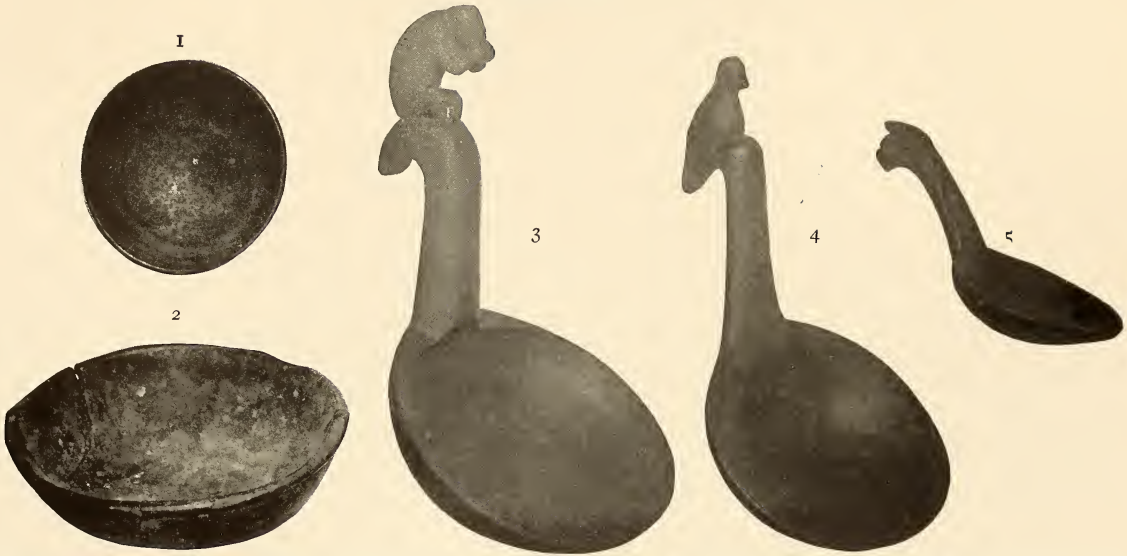
Iroquois soup and bread paddles and turners. State Museum collection

Plate 17



1 Seneca feast dipping spoon. 2 Mohawk beaver tail national feast bowl. Illustrations are about one fifth actual size. Mrs H. M. Converse collection in State Museum

Plate 18



1 Onondaga salt bowl; 2 Seneca eating bowl; 3 Seneca spoon; 4 Onondaga spoon; 5 Delaware child's spoon

Plate 19

Elm bark planting baskets. 1 Seneca double-pocket basket, Morgan collection. 2 Delaware planting basket, collected by M. R. Harrington for the State Museum. Illustrations are one fourth size of specimens.

tastes much better when eaten from one and those who have not used them for some years express a longing to employ them again, recalling with evident pleasure the days when they ate from an "atog'washä."[1]

The favorite decorations for the tops of the handles were ducks, pigeons and sleeping swans. The tails of the birds projecting backward afforded a good hold for the hand and at the same time acted as a hook that prevented the spoon from slipping into the bowl when it was rested within it [*see* pl. 18].

The shape of the wooden spoon bowl is significant and seems to suggest that it was copied from the form of a clam shell or from a gourd spoon, these forms perhaps being the prototypes. Various types of spoons are shown in figure 11 and plate 18.

Husk salt bottle, Ojike'ta'hdä'wa. While not employed directly as a utensil for preparing corn foods, the husk salt bottle was used as a receptacle for the seasoning substances used for giving an added flavor to soups, bread etc. made from corn. The bottle was made of corn husk ingeniously woven. The stopper was a section of a corncob. Corn husk bottles sometimes were woven so tightly, it is said that they would hold water. On the other hand the bottles were valued for their property of keeping the salt dry, the outer husk absorbing and holding the moisture before it reached the salt within [*see* fig. 12].

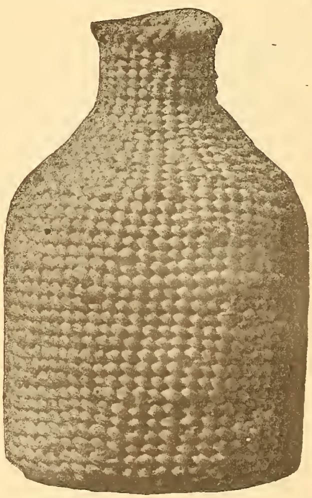


Fig. 12 Husk salt bottle. Cut is ½ size of specimen.

The Iroquois have used these salt bottles within the last 10 years but only a few are now to be found.

The Iroquois say that they have not always used salt in the quantities which they now do and say that it has a debilitating effect upon them.

Parched corn sieve, Yŭndĕshoyondagwathä. This utensil was first described by Morgan[2] who collected a single specimen for the

---

[1] Beverly in describing the eating customs of the Virginia Indians, says, "The Spoons which they eat with do generally hold half a pint; and they laugh at the English for using small ones, which they must be forced to carry so often to their Mouths, and their Arms are in Danger of being tir'd before their Belly."

[2] *See* Morgan. Fabrics of the Iroquois. State Cabinet of Nat. Hist. Fifth An. Rep't 1852. p. 91.

State Museum in 1850. It consists of strips of wooden splints a little more than an $\frac{1}{8}$ inch wide laid longitudinally, bound together with basswood cords and fastened tightly at either end making a canoe-shaped basket. It was used for sifting the ashes from parched corn and for sifting out the unburst kernels from pop corn. The writer has not been able to collect another old specimen of this basket and was told that the hominy sieve is now used instead.

The corn sieve is an interesting survival of a form of basket (the melon basket) now obsolete among the Canadian and New York Iroquois.[1] It has been preserved, however, among the Cherokee and is common among other southern tribes. Morgan's figure in the Fifth Museum Report is a poor illustration of the specimen and has confused several writers who have attempted to copy it. A better drawing is shown in the accompanying cut, figure 13.

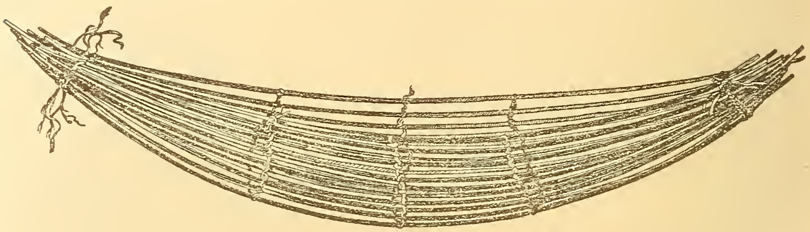


Fig. 13 Popcorn sieve. Morgan specimen. This type is a survival of the melon basket now obsolete among the Iroquois except perhaps the Oneida. Specimen is 20 inches long.

Planting and harvesting baskets

Planting basket, Yŭndŭshinun′dakhwă′.[2] This is the small basket used for containing the seed corn for planting. The basket is generally tied to the waist so as to leave both hands free for dropping the seed and covering it with the hoe.

One planting basket in the museum collection is made of bark doubled in such a maner as to leave pockets on either side and a handle in the middle [*see* fig. 1, pl. 19].

Carrying basket, Ye′nīstē^{n}nĕk′wistă′ or Yŭntge″dastha.[3] This basket is generally tied by a carrying strap, gŭsha′ā, to the head or chest and the ears of corn thrown over the shoulders into it as they were picked. The use of this basket is shown in plate 2, fig. 1.

[1] Harrington collected some interesting forms from the Oneida, two of which were acquired by the State Museum.

[2] Yu^{n}terhaha′wida″kwa′ in Mohawk.

[3] Yo^{n}da″terhagehtslakwa in Mohawk.

VIII COOKING AND EATING CUSTOMS

1 **Fire making.** The precolonial method of producing fire was of course by friction and there were a number of ways for this

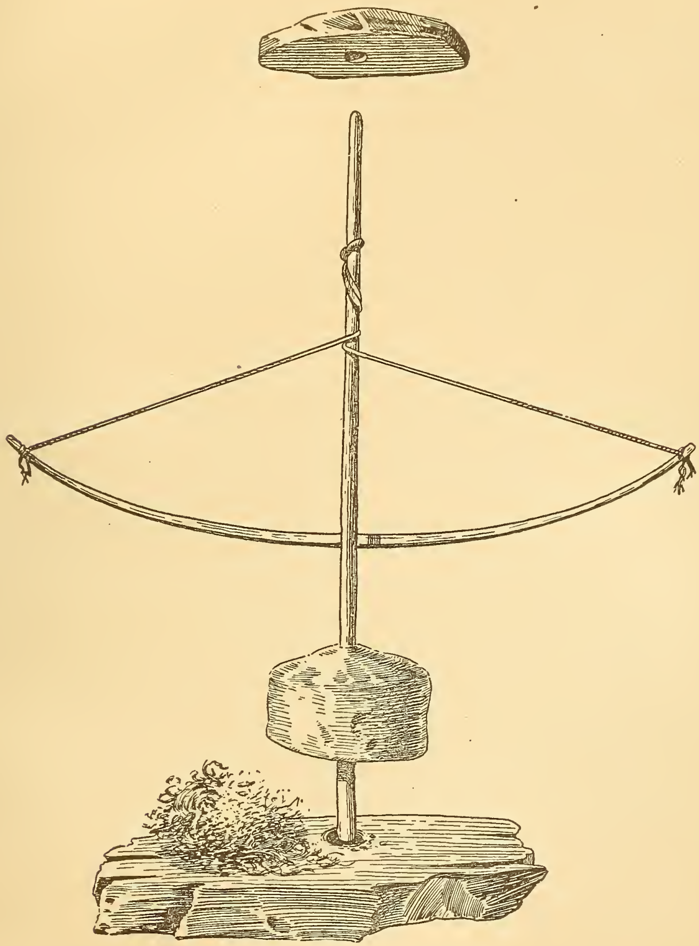


Fig. 14 Iroquois pump drill used for producing fire by friction. Collected by L. H. Morgan, 1850. Specimen is 18 inches high.

purpose. The most characteristic contrivance was the pump drill.[1] Morgan figured a pump drill in his report[2] to the Regents of the University. A pump drill is simply a weighted spindle of resinous

[1] Mason. Origin of Inventions, p. 88.

[2] N. Y. State Cab. Nat. Hist. Third An. Rep't. Albany 1851. p. 88.

wood to the top of which is fastened a very slack bow string, the bow hanging at right angles to the weight. By twisting up the string and then quickly pressing down on the bow a spinning motion is imparted to the spindle which immediately as the string unwinds, winds it up again in an opposite direction. The bow is then quickly pressed downward again and so continuously. The top of the spindle is inserted in a greased socket and the foot in a notch in a piece of very dry tinder wood. The rapid twirling of the spindle creates friction which as it increases ignites the powdered wood. A piece of inflammable tow is placed near this dust which suddenly ignites in the socket and fires the tow which is quickly transferred to a pile of kindling. Pump drills of course are not characteristically Iroquois, though the Iroquois used this means of producing fire by friction more generally than other methods [*see* fig. 14].[1]

TERMINOLOGY OF FIRE

Fire	ode′ka’
Match (it makes fire)	yiondĕkada‘′kwa‘
I make a fire	eñgade′gat
Fire wood	oyän′dă‘
Charcoal	odjă^{n}′stă’
Ashes	o‘gä‘′ä‘
Smoke (in house)	odiä‘′gwä‘
Smoke (out of doors)	odiä‘′gweot
Flame	o‘do^{n}′kot
Bake or broil	waen′dasko^{n}dĕ

For cooking food anciently the fires were generally made in sunken pits, variously called fire pits, pots or sunken ovens.

Pots of clay were probably placed only in shallow saucerlike depressions and held up by stones. The writer discovered such a pot at Ripley in 1906. It stood upright in a pit and was supported by some chunks of stone. Charcoal lay about it as if the fire had been hastily smothered. Schoolcraft pictures a clay pot suspended from a tripod, but most explorers picture the position of the clay vessel as above described.

Pits often were heated to a good temperature, the embers raked aside and corn, squashes or other foods thrown in, covered with

[1] *See* Morgan League, p. 381.

cold ashes and allowed to bake by the heat that remained in the ground. Small pits were thus made in clay banks and beans and other vegetables boiled to perfection. The remains of these pit ovens are found by all field archeologists who have worked in New York.[1]

2 **Meals and hospitality.** The Iroquois in precolonial and even during early colonial times had but one regular meal each day. This was called sĕdétcinegwa, *morning meal,* and was eaten between 9 and 11 o'clock. Few of the eastern Indians had more than two regular meals each day, but this did not prevent any one from eating as many times and as much as he liked for food was always ready in every house at all times.[2]

The food for the day was usually cooked in the morning and kept warm all day. For special occasions, however, a meal could be cooked at any time, but as a rule an Iroquois household did not

Fig. 15 Drawing of an Indian and his wife at dinner, from Beverly's *Virginia.* The numbers refer to Beverly's description which is as follows; "1. Is their Pot boiling with Hominy and Fish in it. 2. Is a Bowl of Corn, which they gather up in their Fingers, to feed themselves. 3. The Tomahawk which he lays by at Dinner. 4. His Pocket, which is likewise stript off, that he may be at full liberty. 5. A Fish. 6. A Heap of roasting Ears, both ready for dressing. 7. A Gourd of Water. 8. A Cockle-Shell, which they sometimes use instead of a Spoon. 9. The Mat they sit on."

expect a family meal except in the morning. As every one had four or five hours exercise before this meal it was thoroughly enjoyed.

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[1] *Cf.* Harrington. Mohawk Strongholds. Manuscript in N. Y. State Museum.

[2] *Cf.* Heckewelder, p. 193; Morgan. House Life, p. 99.

Large eaters were not looked upon with favor, but every one was supposed to satisfy his hunger.

The housewife announced that a meal was ready by exclaiming Hâu! Sĕdek′onĭ, and the guest when he had finished the meal always exclaimed with emphasis "Niawĕ^{n}′" meaning, *thanks are given.* This was supposed to be addressed to the Creator. As a response the host or hostess, the housewife or some member of the family would say "Niu′" meaning *it is well.* Neglect to use these words was supposed to indicate that the goddess of the harvest and the growth spirits or "the bounty of Providence" was not appreciated and that the eater was indifferent.

In apportioning a meal the housewife dipped the food from the kettle or took it from its receptacle and placed it in bark and wooden dishes, which she handed the men. They either sat on the floor or ground or stood along the wall as was most convenient. The women and children were then served. This old time custom still has its survival in the modern eating habits of the more primitive Iroquois. There are now tables and chairs and three regular meals, to be sure, but the women serve the men first and then, when the men have gone from the room, arrange the meal for themselves.

Regular meals two and three times a day did not come until the communal customs of the Iroquois had given way to the usages of modern civilization. Even then, as Morgan observes,[1] one of the difficulties was to change the old usage and accustom themselves to eating together. It came about, as this author says, with the abandonment of the communal houses and the establishment of single family houses where the food for the household was secured by the effort of the family alone.

Under the old régime food was kept ready for any one who might call for it at any time. The single meal of the late morning did not prevent any one from eating as many times as he pleased.

Springing from the law of communism came the law of common hospitality. Any one from anywhere could enter any house at any time if occupants were within, and be served with food. Indeed it was the duty of the housewife to offer food to every one that entered her door. If hungry the guest ate his fill but if he had already eaten he tasted the food as a compliment to the giver. A refusal to do this would have been an outright insult. There was never need for any one to go hungry or destitute, the unfortunate and

[46] Morgan. House Life, p. 99.

the lazy could avail themselves of the stores of the more fortunate and the more energetic. Neither begging nor laziness were encouraged, however, and the slightest indication of an imposition was rebuked in a stern manner.

Heckewelder explains this law of hospitality in a forcible manner. "They think that he (the Great Spirit), made the earth and all that it contains," he writes,[1] "that when he stocked the country that he gave them with plenty of game, it was not for the benefit of the few, but for all." This idea that the Creator gave of his bounty for the good of the entire body of people was one of the fundamental laws of the Iroquois. As air and rain were common so was everything else to be. Heckewelder expresses this when he continues, "Everything was given in common to the sons of men. Whatever liveth on land, whatsoever groweth out of the earth, and all that is in the rivers and waters flowing through the same, was given jointly to all, and every one is entitled to his share. From this principle hospitality flows as from its source. With them it was not a virtue but a strict duty; hence they are never in search of excuses to avoid giving, but freely supply their neighbors' wants from the stock prepared for their own use. They give and are hospitable to all without exception and will always share with each other and often with the stranger to the last morsel. They would rather lie down themselves on an empty stomach than have it laid to their charge that they had neglected their duty by not satisfying the wants of the stranger, the sick or the needy. The stranger has a claim to their hospitality, partly on account of his being at a distance from his family and friends, and partly because he has honored them with his visit and ought to leave them with a good impression on his mind; the sick and the poor because they have a right to be helped out of the common stock, for if the meat they are served with was taken from the woods it was common to all before the hunter took it; if corn and vegetables, it had grown out of the common ground, yet not by the power of men but by that of the Great Spirit."

When distinguished guests came into a community a great feast was prepared for them. Various French, Dutch and English writers who visited the Iroquois during the colonial period have written of these feasts and some of them describe the feasts in a vivid way. Sometimes the food was unpalatable to European

[1] Heckewelder. Indian Nations, p. 101.

taste and sometimes howsoever unpalatable it was eaten with great gusto, so sharp a sauce does hunger give.

John Bartram, who made a trip from Philadelphia to Onondaga in the middle of the 18th century, with Conrad Weiser, Lewis Evans and Shickalmy, records in his *Observations*:[1]

> We lodged within 50 yards of a hunting cabin where there were two men, a squaw and a child. The men came to our fire, made us a present of some venison and invited Mr Weiser, Shickalmy and his son to a feast at their cabin. It is incumbent on those who partake of a feast of this sort to eat all that comes to their share or burn it. Now Weiser being a traveler was entitled to a double share, but being not very well, was forced to take the benefit of a liberty indulged him of eating by proxy, and he called me. But both being unable to cope with it, Evans came to our assistance notwithstanding which we were hard set to get down the neck and throat, for these were allotted to us. And now we had experienced the utmost bounds of their indulgence, for Lewis, ignorant of the ceremony of throwing a bone to the dog, though hungry dogs are generally nimble, the Indian, more nimble, laid hold of it first and committed it to the fire, religiously covering it over with hot ashes. This seemed to be a kind of offering, perhaps first fruits to the Almighty Power to crave future success in the approaching hunting season.

Instances of the hospitality of the Iroquois toward the whites and Indians could be cited at great length,[2] with but one result, that of confirming the statement that hospitality was an established usage. The Indians were often greatly surprised to find that on their visits to white settlements they were not accorded the same privilege, and thought the whites rude and uncivil people. "They are not even familiar with the common rules of civility which our mothers teach us in infancy," said one Indian in expressing his surprise.

The Iroquois were not great eaters, that is to say, they seldom gorged themselves with food at their private meals or at feasts, except perhaps for ceremonial reasons. To do so ordinarily would be a religious offense and destroy the capacity to withstand hunger. Children were trained to eat frugally and taught that overeating was far worse than undereating. They were warned that gluttons would be caught by a monster known as Sago'dăkwŭs who would humiliate them in a most terrible manner if he found that they were gourmands.

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[1] Bartram. Observations. Lond. 1751. p. 24.

[2] *See* Morgan. House Life, p. 45–62.

The large appetites of white men who visited them was often a matter of surprise to the Indians who entertained them. Morgan[1] commenting on this says that a white man consumed and wasted five times as much as an Indian required. In a footnote[2] he quotes Robertson as writing that the appetite of the Spaniards appeared insatiably voracious; and that they affirmed that one Spaniard devoured more food in a day than was sufficient for 10 Americans (Indians).

The food and eating customs of the eastern Indians are described by various early writers with some conflict of opinion, but in general their system of free hospitality has the commendation of the majority of writers.[3]

There were and still are among the Iroquois, innumerable ways of combining foods and several ways of cooking each variety. Nearly all the early travelers expressed themselves as impressed with the number of ways of preparing corn and enumerate from 20 to 40 methods, though some are not so explicit.[4]

TERMINOLOGY

Food	gŭk′wa‘
Breakfast (early morning meal)	sĕde′tciane′gwa
Midday meal	hă‘de′wĕnishä
Sunset meal	hegä‘′gwaane′gwa‘
Appetite	yeo^{n}kwan′owas
A glutton	ha′kowane‘
(Come thou) eat (imper.)	sedĕko′ni
I eat	aga′dekoni
You eat	e^{n}sa′dĕkoni
Cook (she cooks)	yeko^{n}′nis
" (he cooks)	ha′ko^{n}′nis
Hanging crane	e^{n}sä‘′ĕnondăt
Kettle hook	adŭs′ha
Oven	yontä‘gonda′gwa‘ge

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[1] Morgan. House Life of the American Aborigines, p. 60.

[2] *Ibid.* p. 61.

[3] *See* Lahontan, 2:11; Van der Donck. N. Y. Hist. Soc. Cols. v. 1, ser. 2, 192; Jesuit Relations, 67:141; Adair, p. 412; Bartram. Observations, p. 16, 59, 63; Smith. Virginia. Richmond ed. 1:83, 84; Heckewelder, p. 193; Morgan. House Life, 45 et seq.; Robertson. History of America, p. 178. N. Y. 1856.

[4] "Forty-two ways," Dumont. Memoirs sur La Louisiane. Paris 1753. 1:33–34. *Cf.* Loskiel, p. 67; Adair, p. 409; "40 methods," Boyle, Report for 1898; *cf.* Jesuit Relations, 10:103, "twenty ways."

IX FOODS PREPARED FROM CORN

Leaf bread tamales, oniă″tci‘dă’. This is prepared from green corn. The kernels are cut or scraped from the cob and beaten to a milky paste in a mortar. The corn used for leaf cake tamales should be too hard for green corn good for boiling and eating on the cob. The paste will then be of the proper consistency. The paste is patted into shape and laid in a strip on one end of a broad corn leaf, the free half being doubled over the paste. Other leaves are folded over the first, the ends all projecting uniformly from one end for tying. The oniă″tci‘dă’ was then tied three times laterally and once transversely and dropped into boiling water. When cooked — cooking requires about 45 minutes — the wrappings are removed and the cake is eaten with sunflower or bear oil, though in these modern days bacon grease or butter are more in vogue. Oftentimes cooked beans are mixed with the mass before wrapping in the leaves. These impart their flavor and give variety.

Leaf cakes may be dried for winter's use if no beans have been used with the corn. In wrapping the leaf bread a bulbous shaped bundle is made resembling a large braid of hair doubled and tied, hence the name oniă″tci‘dă’, derived from yēnyă′tci‘dot, *doubled braid of woman's hair.*

Heckewelder[1] describes this bread but says it is too sweet although the Indians consider it a delicate morsel. He says the mashed green corn is put in the corn blades with ladles.

Adair[2] in describing it remarks, "This sort of bread is very tempting to the taste, and reckoned most delicious by their strong palates."

David DeVries[3] writing of the dish says, "They make flat cakes of meal mixed with water, as large as a farthing cake in this country, and bake them in the ashes, first wrapping a vine or maize leaf around them.

Sagard in describing leaf cakes says that the Huron called it Andataroni. He describes the process of preparing it substantially as given above. He mentions that berries and beans are often added.[4]

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[1] Heckewelder, p. 195.

[2] Adair. North American Indians.

[3] Second Voyage. N. Y. Hist. Soc. Col. Ser. 2. v. 3, pt 1, p. 107. *Cf.* Vincent. History of Delaware. Phila. 1870. p. 74.

[4] Grand Voyage. Tross ed. p. 96.

Plate 20

Seneca woman pounding Tuscarora corn. Photograph by M. R. Harrington

These early citations are interesting because they prove how persistently the Iroquois have clung to the dishes of their ancestors.

Baked green corn,[1] **Ogon′sä′.** When the milk has set, Tuscarora and sweet corn is scraped from the cob and beaten to a paste in a mortar. This should be done just before the evening meal. After the housework is finished the housewife lines a large kettle with basswood leaves three deep. The corn paste is then dumped in up to two thirds the depth of the vessel. The top is smoothed down and covered by three layers of leaves. Cold ashes to a finger's depth are now thrown over the leaves and smoothed down. A small fire is built under the kettle which hangs suspended from a crane or tripod. Glowing charcoal is placed on the ashes at the top. The small fire is kept brisk and the coals at the top renewed three times. The cook may now retire for the night if her kettle hangs in a shielded place or in a fire pit. In the morning the ashes and top leaves are carefully removed and the baked corn dumped out. The odor of this steaming ogon′sä′ is most appetizing and it is eaten greedily with grease or butter. For winter's use the caked mass is sliced and dried in the sun all day, taken in at night to prevent dew from spoiling it and dogs or night prowlers from taking too much of it, and set out again in the morning to allow the sun to complete the drying. The ogon′sä′ is then ready to be stored away for the winter. When ready for use the winter's store of ogon′sä′ was taken from storage and a sufficient quantity for a meal thrown in cold water and immediately put on the stove. Boiling for a little more than a half hour produces a delicious dish. Ogon′sä′ was one of the favorite foods of the Iroquois and remains so to this day. An Onondaga or Seneca can hardly mention the name without showing that it brings memories of the pleasant repasts that it has afforded.

In recent years the corn paste is prepared with a potato masher in a chopping bowl, or by running the corn as cut from the cob through a food chopper. Baking is done in shallow dripping pans in the oven. The food so prepared, however, lacks a deliciousness that makes the older method still popular.

Boiled green corn, O‘kni′staga^{n}′o‘.[2] This is simply the green corn on the cob with which we are all familiar. Tuscarora corn as well as sweet corn, however, was used with equal favor. It was

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[1] This is the ble′-grillé of the French.

[2] Ganossto′ho^{n} is the Mohawk equivalent.

eaten on the cob or scraped off and eaten in dishes. Sometimes the kernels were cut from the cob and boiled as a soup.

The Seneca name means delicious corn food, from o'nius'ta, *corn,* and oga^{n}'o^{n}, *delicious food.*

Fried green corn, Gagoñ's'ä ge''dā. This dish was prepared by scraping the green corn, in the milk, from the cob, mashing it in a mortar and either patting it into cakes or tossing it in a basket to make a loose light mass. The corn was then ready for frying. The older Indians say that the frying could be done in a clay kettle and that corn so prepared was especially good if cooked in bear oil.[1]

Succotash, Ogon'sä' ganon'dä.[2] Iroquois succotash was prepared much as is the modern form made by white people. The green corn cut or scraped from the cob was thrown in a pot of beans which had nearly been cooked and the mass cooked together until both ingredients were done. A sufficient quantity of salt and grease or oil was added for seasoning and flavor. The favorite corn for this dish was Tuscarora or sweet corn.

Baked cob-corn in the husk, Wades'kondŭk o'nis'ta. This was a popular way of preparing green corn on the cob. The ashes from the camp or hearth fire were brushed aside and a row of unhusked ears laid in the hot stones or ground. These were then covered with cold ashes. Embers were now heaped over and a hot fire built and continued until the corn beneath was thought sufficiently baked. Corn baked in this manner has a fine flavor and never becomes scorched.

Baked scraped corn, Ogo^{n}'sä' ohon'stä'.[3] The green corn is scraped from the cob with a deer's jaw or knife, pounded in a mortar or mashed in a wooden bowl with a stone, patted into cakes, sprinkled with dry meal and baked in small dishes. For baking in the ashes the cakes are wrapped in husk and covered with ashes. Embers are heaped over and a brisk fire built, this being kept going until the cakes were considered baked.

Carver, the British traveler, in writing of his experiences among the aboriginal Americans, says of this dish ". . . better flavored bread I never ate in this country." In describing the preparation

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[1] Carr, quoting Carver's *Travels* (London 1778), notes, "We . . . cook our vegetables by themselves though formerly this was not the case for according to an old writer (Carver), when made with bear oil 'the fat moistens the pulse and renders it beyond comparison delicious.'"

[2] Onon'darha is the Mohawk name for succotash.

[3] O'gaserho'da is the Mohawk name.

of these cakes he said that they were ". . . made without the addition of any liquid by the milk that flows from them; and when it is effected they parcel it out into cakes and enclosing them with leaves place them in the hot embers where they soon bake."

Cracked undried corn, Odjis'tănondä. The ripened but not dry corn was shelled from the cob and smashed kernel by kernel on a flat stone, a muller being used as a crusher. The crushed corn was mixed with new harvested beans and boiled for nearly three hours. Salt was used as a seasoning and deer or bear meat mixed with the mass if desired (*see* fig. 5).

Boiled corn bread, Gagai'tĕ^{n}tâ^{n}'ä''kwă'.[1] For bread, purple, calico and the two hominy corns were used. After the corn was shelled it was boiled for from 15 to 30 minutes in a weak lye made of hard wood ashes and water. The lye solution in order to be of the proper consistency must be strong enough to bite the tongue when tasted. When the hulls and outer skins had been loosened, looking white and swelled, the corn was put in a hulling basket, taken to a brook or large tub, where it was thoroughly rinsed to free the kernels of any trace of lye and to wash off the loosened hulls and skins. The corn was then drained, thrown in a mortar and pulverized with a pestle. The granules were sifted through the meal sieve to make the meal fine and light. After this process the meal was mixed with boiling water and quickly molded into a flattened cake about 8 inches in diameter and 3 inches thick. The cake was then plunged into boiling water and cooked for nearly an hour. The object of mixing the meal with boiling water was to coagulate the starch and make the meal stick together. After the meal is mixed with the hot water and molded, the hands are plunged in cold water and rubbed over the loaf to give it a smooth glossy surface. When the loaf floats it is considered properly cooked. Sometimes the molded loaf is baked instead of boiled, specially for journeys. The loaf is buried in hot ashes and a roaring fire built over it until it is baked thoroughly. When it is to be eaten the ashes are washed off and slices cut from the loaf. The baked loaf if not wet will not become moldy like boiled bread and this is the approved form for hunting and war parties.

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[1] Gano^{n}'stoharhe ganada'rho^{n}, in Mohawk.

In the course of boiling some of the meal on the outside of the cake comes off, together with a quantity of starch and gluten, and mixes with the water. When the bread is sufficiently cooked this liquid is poured out in bowls and drunk as a tea. The Iroquois considered this gruel a great delicacy.

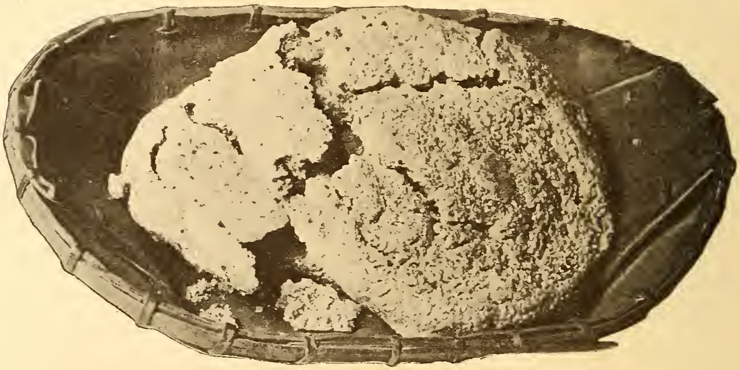

Fig. 16 Bark tray containing boiled bread, dried. Specimens ⅓ actual size. Seneca specimens collected 1908

Corn bread is fairly hard but readily crumbles when masticated. It is not dry, but moist and mealy. Before eating the cake it is sliced and spread with tallow or butter, bear or deer oil. It is a delicious food and considered highly nutritious. Often cooked cranberry beans or berries were mixed with the meal before boiling. These added to the flavor as well as nourishment.[1]

One of the best descriptions of boiled bread has been left us by Adair[2] who writes:

They have another sort of boiled bread which is mixed with beans or potatoes; they put on the soft corn till it begins to boil and pound it sufficiently fine; — their invention does not reach the use of any kind of milk. When the flour is stirred, and dried by the heat of the sun or fire, they sift it with sieves of different sizes, curiously made of the coarser or finer cane splinters. The thin cakes mixt with bear's oil, were formerly baked on thin broad stones placed over a fire, or on broad earthen bottoms fit for such a use, but now they use kettles. When they intend to bake great loaves, they make a strong

[1] "Some of the loaves were baked with nuts and dry blue berries and grains of the sunflower." *Van Curler's Diary, p.* 91.

[2] Adair. History of the American Indians. Lond. 1775. p. 407. *See also* Boyle. Ontario Arch. Rep't 1898. p. 188.

blazing fire, with short dry split wood on the hearth. When it is burnt down to coals they carefully rake them off to each side, and sweep away the remaining ashes; then they put their well kneaded broad loaf, first steeped in hot water, over the hearth, and an earthen basin above it, with the embers of coals atop. This method of baking is as clean and efficacious as could possibly be done in any oven; when they take it off they wash the loaf with warm water, and it soon becomes firm and very white. It is likewise very wholesome, and well tasted to any except the palate of an epicure.

Lafitau had no such pleasant impressions of the bread which would seem to bring him under the class of epicures. As a matter of fact white people of today regard the Iroquois boiled bread as a "well tasted" food, though a trifle heavy. The writer during his school days on the reservation often "swapped" his lunch of civilized viands with other Indian boys who were lucky enough to have half a loaf of boiled bread and a chunk of maple sugar or perhaps a leaf cake.

Beverly[1] describes the baking of corn bread in his *History of Virginia* and says that the Indians first covered the loaf with leaves and then with warm ashes over which were heaped the hot coals. The ash baked corn bread of the Indians has survived in the South as hoe cake, ash cake and "old fashioned" journey or Johnny cake.

Corn soup liquor, O'niyustagĭ'. The liquor in which the corn bread was boiled was carefully drained off and kept in jars or pots as a drink. It is said that the Indians were not fond of drinking water and preferred various beverages prepared from herbs or corn. One writer[2] in discussing this subject says: "Though in most of the Indian nations the water is good, because of their high situation, yet the traders very seldom drink any of it at home; for the women beat in mortars their flinty corn till all the husks are taken off, which having well sifted and fanned, they boil in large earthen pots; then straining off the thinnest part into a pot they mix it with cold water till it is sufficiently liquid for drinking; and when cold it is both pleasant and very nourishing; and is much liked even by genteel strangers."

Wedding bread, Goⁿniă''tă' oä'kwa. Corn was prepared in the same manner as for bread but was wrapped in two balls with a short connecting neck like a handleless dumbbell wrapped in corn

[1] Beverly. Virginia, p. 151.

[2] Adair, p. 416.

husk and tied in the middle. It was then ready for boiling. To complete the cooking required about one hour.

Twenty-four of these cakes were taken by the girl's maternal grandmother (by blood or by clan appointment, if the maternal grandmother was dead) to the door of the maternal grandmother of an eligible male. The recipient, who had previously conferred with the donor, if she favors the alliance suggested by the gift, tastes the bread and notifies her daughter that her (the daughter's) son is desired to unite with a certain young woman in marriage by the grandmother of that young woman. The mother of the boy must submit to her mother's wish if she can offer no substantial objection. The boy's grandmother then makes 24 wedding cakes[1] and carries them to the girl's grandmother who then notifies her daughter that the girl must marry a certain man. If the suit is rejected at the first proposal the wedding cakes are left untouched and the humiliated donor must creep back and reclaim the cakes. My informant says the rejected cakes were never eaten, but probably reserved as ammunition with which to pelt the offending old dowager, who had given reasons to believe that the suit was smiled upon. The bounds of a cake recipe forbid further discussion.

Sagard found this bread among the Huron who, he says, called it Coinkia. He remarked that instead of being baked it was boiled. His description " deux balles jointes ensemble " makes the identity of the dish absolute.[2]

Early bread, Ganēo^{n}tē′′do^{n}.[3] Before the corn was thoroughly dry in the autumn it was plucked for making early bread. The unhulled corn was mixed with a little water in a mortar and beaten to a paste instead of a meal. Loaves were molded by the hands from the paste and boiled. This bread was considered a great delicacy and valued especially as a food for invalids.

Early corn pudding, Ganeo^{n}tē′′do^{n} odjis′kwa. The paste from the mortar, as described above, was sometimes drained, sifted and tossed into a wet meal. It was then thrown in boiling water and boiled down into a pudding.

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[1] Morgan. League, p. 322; *cf.* Sagard, p. 94, 136.

[2] ". . . excepté le pain mis et accommodé comme deux balles iointes ensemble, enueloppé entre des fueilles de bled d'Inde, puis boüilly et cuit en l'eau, et non sous la cendre, lequel ils appellent d'vn nom particulier Coinkia." Sagard, Grand Voyage, p. 136, Paris 1682, *see also* Tross ed. p. 94.

[3] Ga'te′do^{n}gana′darho, *pounded bread,* Mohawk form.

Dumplings, Oho^n'stă'. Moisten a mass of corn meal with boiling water and quickly mold it into cakes in the closed hand moistened in cold water. Drop the dumplings one by one into boiling water and boil for a half hour.

Dumplings were the favorite thing to cook with boiling meats, especially game birds.

To fish the dumplings from the pot every one had a sharpened stick or bone. The dumplings were speared and held on the stick to cool and nibbled with the meat as it was eaten. The sticks after use were wiped off and stuck between the logs or bark of the wall for future use.

Many of the sharpened splinters of bone now excavated from village and camp sites are probably nothing more than these primitive forks, or more properly food holders.

Oho^nstă' was one of the foods of which children were very fond, nor did grown people despise it as a bread with their meat.

Hominy, Onon'däät.[1] Hominy is prepared from flint corns. For a family of five persons, a quart of corn was thrown in a mortar and moistened with a ladleful (four tablespoonfuls) of water.[2] To make the pounding easier a teaspoonful of white ashes or soda is thrown in also. The pounding with the pestle proceeds slowly at first to loosen the hulls, this work being accelerated if ashes have been used. When the hulls begin to come off easily the pounding is quickened until the corn is broken up into coarse pieces. It is then ready for the first sifting, e^nyowo^nk'. A basket called a onĭius'tawanĕs is used for this purpose. The hominy passes through and is placed in a bowl while the uncracked corn is thrown back into the mortar to be repounded. After the second sifting the uncracked kernels that remain are thrown out to the birds or chickens. The hominy is then ready for winnowing. The results of the two poundings are carefully mixed and then put in a tossing bowl or basket. The hominy is tossed with a peculiar motion the bowl being held at a slant. The lighter chit rises to the top while the heavier portion stays at the bottom. The hulls and chit are thrown out by hand or by the use of a fan made of a bird's wing, called onĕg'osta'. The process of winnowing is called waegai''tawāk.

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[1] Onoñ'darha is the Mohawk word.

[2] Harrington says cold water. *See* Seneca Corn Foods. Amer. Anthropologist. New Ser. v. 10, no. 3, p. 587.

The coarse granular meal so prepared is now ready for cooking. One part of meal is put in eight parts of water and boiled for two hours. Pork or bear's meat and beans are cooked with the hominy[1] for flavoring. When cooked salt or sugar were added, according to taste.

Sagard[2] in his *Grand Voyage* refers several times to this dish as *Sagamite*. In one instance he calls it a "good sort of substance" and says that its sustaining qualities surprised him.

With the Dutch hominy was called by another name. In Van der Donck's *Description of New Netherlands,* we find that the pap or mush of the Indians is called sapaen (suppawn). It was the common food of all Indians, he says, without which no Indian would think he had a satisfactory meal.

Hulled corn, O^{n}no''kwă'.[3] This favorite dish was made from some soft corn treated as corn used for bread. It was washed until free from skins and hulls and then put in cold water and boiled for four hours until the kernels had burst open and were tender. Small chunks of meat and fat were thrown in the boiling liquid and sometimes berries. O^{n}no''kwă' is the favorite feast dish of the Iroquois. This dish is a most palatable one and appeals to all tastes. It is used at Indian social gatherings as white people use ice cream, that is, as a fitting food for festal occasions. It must be confessed that the Indian's food was the more solid and perhaps the more sensible. Several canning companies now put up hulled corn under the name of Entire Hominy and it may be purchased in many modern provision stores.

Dried corn soup, Onädoonondä.[4] For winter's use, green, white, sweet or squaw sweet corn was cut from the cob and dried before a fire, taking care that the drying was rapid enough to prevent the milk from souring. The dried corn when prepared for

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[1] This is the sagamite of the French. *See* Jesuit Relations.

[2] "Le pain de Mais, et la sagamite qui en est faicte, est de sort bonne substance, et m'estonnois de ce qu'elle nourrit si bien qu'elle facit: car pour ne boire que de l'eau en ce pays-là, et ne manger que sort peu sonnent de ce pain, et encore plus rarement de la viande, n'vsans presque que des seuls Sagamités auec vn bien peu de poisson, on ne laisse pas de se bien porter, et estre en bon poinct, pourueu qu'on en ait suffisamment, comme on n'en manque point dans le pays; mais seulement en de longs voyages, où l'on souffre souuent de grandes necessitez", *Le Grand Voyage du pays des Hurons.* Paris 1632. p. 137; *Tross ed. Paris 1865.* p. 97.

[3] Gagarhedo^n'to^n is the Mohawk form of the word.

[4] Ganaha^n'da^t is the Mohawk word.

food was boiled until tender, three-quarters of an hour. This dried corn was sometimes roasted and pounded for pudding meal.

Nut and corn pottage, Oniä' degaiyĭst'o^{n} onä'o'khŭ'. This was prepared by mixing nut meal or nut milk, oniä''ge', with parched corn meal.

Heckewelder[1] describes the use of nut milk with corn in a fairly detailed way as follows:

> The Indians have a number of manners of preparing their corn. They make an excellent pottage of it, by boiling it with fresh or dried meat (the latter pounded), dried pumpkins, dry beans and chestnuts. They sometimes sweeten it with sugar or molasses from the sugar-maple tree. Another very good dish is prepared by boiling with their corn or maize, the washed kernels of shell bark or hickory nut. They pound the nuts in a block or mortar, pouring a little warm water on them, and gradually a little more as they become dry until, at last, there is a sufficient quantity of water so that by stirring up the pounded nuts the broken shells separate from the liquor, which from the pounded kernels assumes the appearance of milk. This being put into the kettle and mixed with the pottage gives it a rich and agreeable flavor. If the broken shells do not all freely separate by swimming on the top or sinking to the bottom, the liquor is strained through a clean cloth before it is put into the kettle.

Corn and pumpkin pudding, Oniŭ''să' odjis'kwa.[2] This favorite pudding was made from parched or yellow corn meal mixed with sugar and boiled pumpkin or squash. It was often used instead of gago^{n}să odjis'kwa.

Samp, Gwä'onondä' or O'ni'yustāgĕ'. In making samp the corn was treated with the same process as for corn bread except that it was not beaten so fine in a mortar. It was boiled in water and when cooked tasted like the soup of corn bread, but it did not have so delicate a flavor. Often berries or meat were mixed and cooked with samp. For samp any corn that would hull easily was used.

Adair after describing hominy says, " the thin of this is what my Lord Bacon calls Cream of Maize, and highly commends for an excellent sort of nourishment." This is the samp, or gwä'ondä' of the Iroquois.

Corn pudding, O^{n}so^{n}'wä.[3] For o^{n}so^{n}'wä white corn was

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[1] Heckewelder, John. History, Manners and Customs of the Indian Nations. Hist. Soc. Pa. 12:194.

[2] Onoo^{n}se'rhagowa odjis'kwa is the Mohawk name.

[3] Wadĕnosstatsaha''to', *burnt corn,* is the Mohawk name.

roasted brown and pounded slowly in a mortar and sifted until all the granules were uniform, the coarser ones being pounded and resifted until this end was achieved. The meal was then thrown in boiling water and cooked until tender.

Preserved in skin bags this meal was carried by hunters and either eaten raw with water, boiled as above or thrown in with boiling meat.[1]

Van der Donck, in his *Description of New Netherlands,* says:

> When they intend to go a great distance on a hunting expedition . . . where they expect no food, they provide themselves severally with a small bag of parched corn meal which is so nutritious that they can subsist upon the same many days. A quarter of a pound of the meal is sufficient for a day's subsistence; for as it shrinks much in drying, it also swells out again with moisture. When they are hungry they take a handful of meal after which they take a drink of water, and then they are so well fed that they can travel a day. [*See* N. Y. Hist. Soc. Col. Ser. 2. 1:193–94, 1841.]

Heckewelder describes this food as follows: "Their Psindamocan or Tassmanane, as they call it, is the most durable food made out of the Indian corn. The blue sweetish kind is the grain which they prefer for that purpose. They parch it in clean hot ashes until it bursts, it is then sifted and cleaned, and pounded in a mortar into a kind of flour, and when they wish to make it very good they mix some sugar with it. When wanted for use they take about a tablespoonful of this flour in their mouths, then stooping to the river or brook, drink water to it. If, however, they have a cup or other small vessel at hand they put the flour in it and mix it with water, in the proportion of one tablespoonful to a pint. At their camps they will put a small quantity in a kettle with water and let it boil down, and they will have a thick pottage. With this food, the traveler and warrior will set out on long journeys and expeditions, and, as a little of it will serve them for a day, they have not a heavy load of provisions to carry. Persons who are unacquainted with this diet ought to be careful not to take too much at a time, and not to suffer themselves to be tempted too far by its flavor; more

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[1] "The Indians boil it till it becomes tender and eat it with fish or venison instead of bread; sometimes they bruise it in mortars and so boil it. The most usual way is to parch it in ashes, stirring it so artificially as to be very tender, without burning; this they sift and beat in mortars into a fine meal which they eat dry or mixed with water." Harris. Discoveries and Settlements. Pinkerton's Voyages. 12:258.

than one or two spoonfuls at most at any one time or at one meal is dangerous; for it is apt to swell in the stomach or bowels, as when heated over a fire." :

A handful of the parched meal, 2 or 3 ounces, was considered a rather large meal if eaten out of hand and this quantity was even considered dangerous unless cooked in a pot.

Most of the old writers refer to this dish[2] and agree that it is a most sustaining food. Sugar was often mixed with the meal to give it flavor and dried cherries were sometimes pulverized with the parched corn. In this form the Mohawk call it O'hogwitz' orha.

Beverly[3] in describing traveling customs says, ". . . each man takes with him a Pint or Quart of Rockahomonie, that is, the finest Indian corn, parched and beaten to powder. When they find their Stomach empty, (and can not stay the tedious Cookery of other things) they put about a spoonful of this into their Mouths, and drink a Draught of Water upon it, which stays in their Stomachs. . ."

Roasted corn hominy, Odjis'tănondä'. The ripe corn was husked by the harvesters and stood "nose" upward against the top pole of a roasting pit. This pit was a long narrow trench a foot or more deep with Y-shaped sticks at either end as supporters for the top pole, which was placed horizontally in the crotches, after a fire of saplings and sticks had been reduced to a mass of glowing embers [*see* pl. 21]. The ears were then leaned at an angle against the pole, drawn out and roasted. Watchers turned them as they were parched sufficiently while other helpers gathered them up when done and shelled the kernels into a bark barrel.

The meal from this roasted corn was called odjis'tănondä'. If the parched corn was boiled it was called ona^{n}dă'ono^{n}'kwă'.

It should be noted that this dish is prepared from roasted green corn and not from ripe dried corn as is o^{n}so^{n}'wä.

Parched corn coffee, O'nīs'tagi'. Corn was well burnt and parched on the coals, scraped from the cob and thrown in a dish. Upon this boiling water was thrown and the dish or kettle placed over the fire again. To produce the burnt corn drink the boiling was continued for about five minutes.

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1 Heckewelder. History, Manners and Customs of the Indian Nations. Hist. Soc. Pa. 12:195.

2 This is the Nocake or rockahominy of the New England Indians. *See* Williams. Key. Narragansett Club Reprint, 1:40.

3 History of Virginia, p. 155.

Roasted corn, Gani'stē^{n}'dā. This was the husked ear of green corn baked in hot embers.

It is related that one of the old methods was to dig a long trench and place the ears across two slender green saplings and allow the heat of the hot coals to cook the corn. The ears could easily be turned over and the roasting made uniform (*see* pl. 21).

Sometimes a husked ear of corn was incased in clay and baked. This was called Oga'goäk'wa or gago^{n}dŭk. For roasting ears[1] singly a sharpened stick was shoved into the stem and the ear held in the embers.

If kernels of the corn prepared in this way were sufficiently dried and parched the entire ear or the shelled kernels were capable of long preservation. The writer has found roasted corn on the cob, several centuries old, buried in pits which evidently once had been bark lined cellarettes. Parched shelled kernels are commonly found in caches in Indian village or lodge sites.

Pop corn pudding, Watatoñ'gwŭs odjis'kwa. Corn was popped in a metal or clay kettle and then pulverized in a mortar and mixed with oil or syrup. The writer has often seen the modern Iroquois run their corn popped in a modern popper through a chopping machine and eat the light white meal with sugar and milk or cream.

Ceremonial foods

Bear's pudding, Niagwai''täto^{n} odjis'kwa.[2] This was a ceremonial food prepared from yellow meal unseasoned and mixed with bits of fried meat. The meal was boiled into a pudding and the meat thrown in afterward. Bear dance pudding was only used as a ceremonial food in the Bear Society meetings or by members performing some of the rites.[3]

Buffalo dance pudding, Dĕgi'yago^{n} odjis'kwa.[4] Squaw corn is pounded to a meal, boiled as a pudding and sweetened with maple or corn sugar. This pudding is harder than Bear dance pudding, its proper consistency being like the mud where the buffa-

[1] Beverly says, "They delight to feed on roasting ears, that is *Indian corn*, gathered green and milky, before it is grown to its full bigness." History of Virginia.

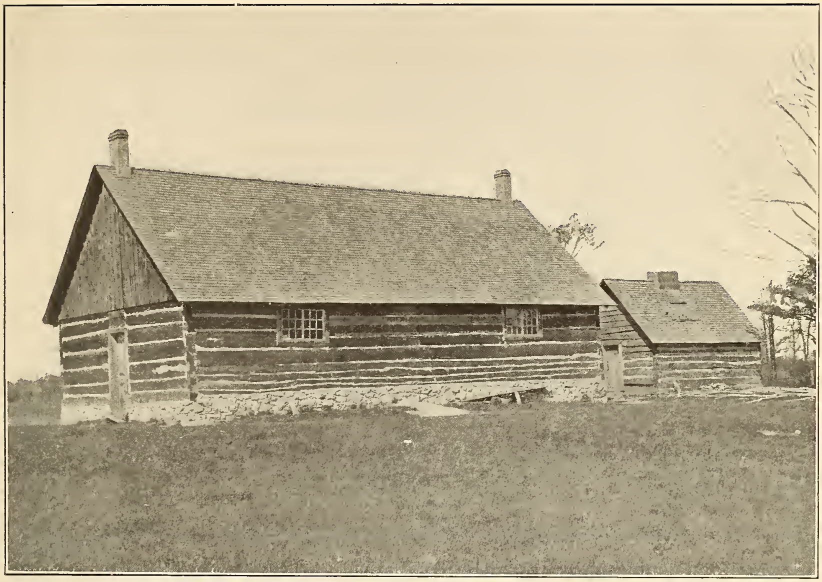
[2] O'kwa'rhi odjis'kwa is the Mohawk form.

[3] *See* Parker, A. C. Seneca Medicine Societies. Am. Anthropologist. New ser. v. XI, no. 2.

[4] Dege'lhiyagon odjis'kwa is the Mohawk form.

Plate 21

Corn is roasted on a frame or pole placed over a pit filled with glowing embers. The roasted corn is used for parched meal.



1 Long House of the Canadian Onondaga, Grand River Reservation. It is here that the feasts and thanksgivings for the products of the fields are held by the Canadian Onondaga.

2 Cook house of the Canadian Seneca. The architecture of the building follows the lines of the bark house. Note the smoke hole in the roof.

loes go when they dance off the flies. This pudding is used only by members of the Buffalo company, a "medicine" society.[1]

Ball players pudding, Gadjis'kwae' odjis'kwa.[2] This is a charm pudding and made like false face pudding except that it is a little sweeter and contains more meat. A woman afflicted with rheumatism or some like disease prepares this pudding and presents it to a ball player, who, eating it, is supposed to charm away the disorder by his activity. He sets at defiance the spirits which have crippled the patient. If her case is very severe she bathes her limbs in sunflower oil and drinks it with the pudding.

False face pudding, Gago^{n}'sä odjis'kwa.[3] This was a ceremonial pudding eaten at the False Face dances, at special private lodge feasts or in the ceremonies of healing the sick. It was composed of boiled parched corn meal mixed with maple sugar. Sunflower or bear oil was used with it in special cases. This pudding is considered a most delicious food and believed to be a very powerful factor for pleasing the masks. No one must make a disrespectful remark while eating this pudding as the mysterious faces were thought to be able to punish the offender by distorting their faces, and cases are cited to prove this assertion.

Unusual foods

Decayed corn, Utgī'onäo'. A corn food of which the Iroquois of today have no memory is described by Sagard who calls it *bled-puant.* To prepare this viand the ear of corn before it was fully mature was immersed in stagnant water and allowed to "ripen" for two or three months at the end of which time it was taken out and roasted or boiled with meat or fish. The odor of this putrid corn was so frightful that the good father either through imagination or from good cause relates that it clung to him for a number of days from simply touching it. Nevertheless he adds that the Indians sucked it as if it were sugar cane.[4]

It is safe to say that among the Iroquois no knowledge of this food remains. An Iroquois whom the writer interrogated said that

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[1] *See* Parker, A. C. Seneca Medicine Societies. Am. Anthropologist. New ser. v. XI, no. 2.

[2] Dehajĭ'gwa'es odjis'kwa is the Mohawk form.

[3] Ago^{n}'hwarha odjis'kwa is the Mohawk name.

[4] Sagard. Le Grand Voyage du Pays Des Hurons, p. 97; Tross ed. 1865, p. 140; orig. ed. Paris 1632.

he could imagine that the Huron would eat such food but that he was sure that Iroquois never used anything so questionable.

Another writer mentions a variety of bread mixed with tobacco juice. He says: "When they were traveling or laying in wait for their enemies they took with them a kind of bread made of Indian corn and tobacco juice, which says Campanius was a very good thing to allay hunger and quench thirst in case they have nothing else at hand.[1]

X USES OF THE CORN PLANT

1 **The stalk.** Stalk tubes, gŭshē″dă' or deyus'wände', were made for containing medicines. A section of the stalk was cut off at a joint, the pith removed, plugs were inserted at each end and the tube complete. Tubes were made from 2 to 8 inches long. Syrup, oshēstă', was extracted by boiling or evaporating the juice of young and green cornstalks. The top of the corn above the corn sheaths was cut, the stalk bruised and then thrown in a kettle and boiled, the juice was then strained off and evaporated. A metal polish, yestä'tedă'kwa, was made from the pith. The outer covering was stripped from a dry stalk and the pith used for rubbing copper and silver ornaments to a polish. Absorbent, ne″dĕskŭk, qualities of the dry pith were recognized and it was employed accordingly. A lotion, yago'găthă, of the juice of the green cornstalk and root was employed for cuts, bruises and sores. Fish line floats, hĕtgĕsho^{n}iodyĕ', were made from sections of the dry stalk. Cornstalk war clubs and spears, gadji'wa, were used by boys in sham battles. Counter or jack straws, gasho'wēdă, were cut from the tassel stems and used with bean counters in games. Children were taught to count with these "straws."

2 **Uses of corn husks.** Single husks or strips pressed or folded together and dried were used to convey lights short distances, much as the rolled paper "lamp lighters" are used where matches are scarce. The Iroquois indeed now use husks for lighting lamps, calling them yedjistoñda″kwa. A larger quantity of dried husks was used in kindling a fire. Husks are shredded and used for pillow, cushion and mattress fillings, onion'nya'gago^{n}'shä'. For making "bride's bread" the corn pudding or grated green corn is wrapped in the green husk and baked or boiled as the case may require. Another use for the simple husks is as the water sprinklers

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[1] Vincent. History of Delaware. Phil. 1870. p. 74–75.

used by the Otter company, Dowäändo^n', in their winter ceremony [*see* fig. 17]. In this instance the husks are pulled back over the stem and the cob broken midway as a handle. The sprinklers are called dionĕgo'gwŭtă'.

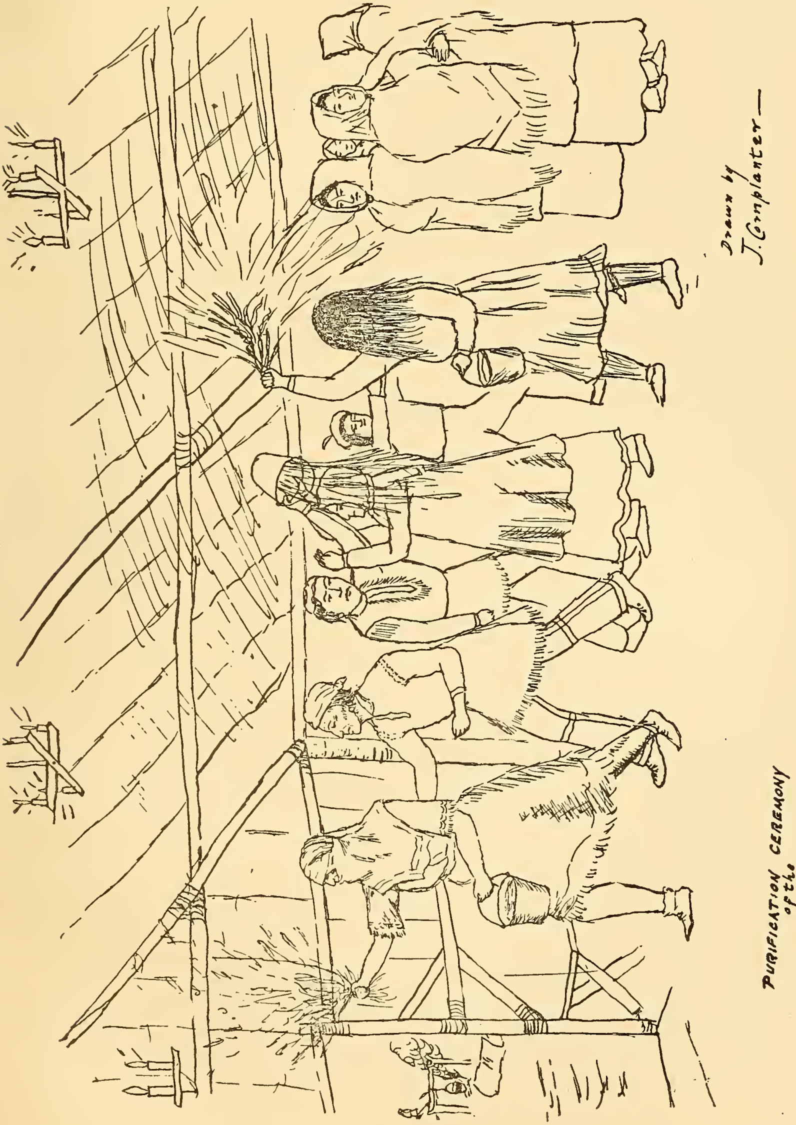


Fig. 17. Purification ceremony of the Society of Otters, a Seneca women's winter ceremony

Husks were sometimes braided in long strands and used for clothes lines, gäo^n'gä', in the houses. The loosely braided husks from the strings of corn, ostĕ^{n}sĕ^{n}'gäs'skĕ^{n}doni, were used by the "buffalo head" (Hade'yeo^{n}) announcers of the midwinter thanksgiving. A crown is arranged for the head and trailers tied to each ankle. Braided in fine ropes, the husk was coiled up into the masks, gatci'sha, used by the husk face (Gatci'sha'oäno') company [*see* pl. 23]. The braided coils are sewn with thread. An outer binding is fastened to the face, from which long shreds of the husk hang to represent hair [*see* pl. 23, fig. 1].

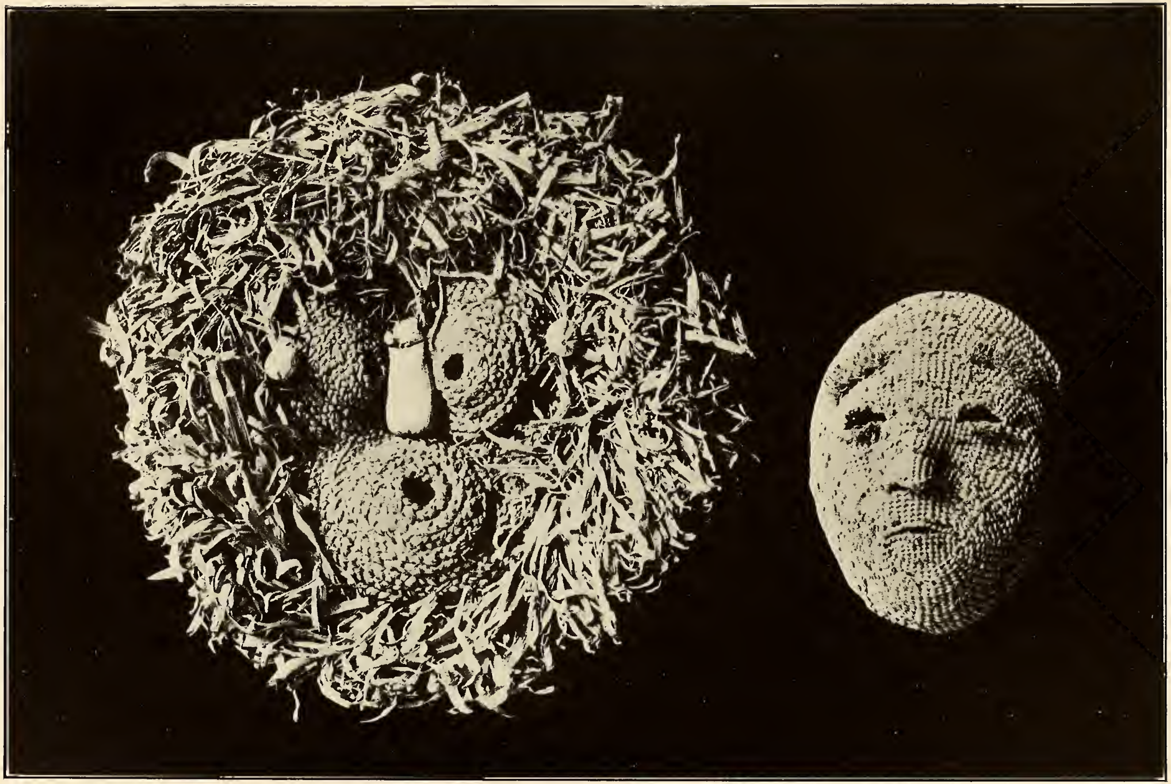
Another variety of the husk mask is woven entirely and is not sewed [*see* pl. 23, fig. 2]. These particular masks are used mostly on the Allegany Reservation. Husk bottles, trays and baskets are woven in the same manner as the woven mask as also are sandals and moccasins although the latter are about obsolete now [*see* pl. 24].

Another interesting article manufactured from corn husk is the lounging mat, onō'nya' gĕska'a or yiondyädĕ^{n}kwă'. This is made of short lengths of the husk neatly rolled and folded at the ends, into which other lengths were inserted and tied in place by a warp of basswood cord. A specimen of this mat is shown in plate 25. It was collected by the author in 1907 on the Tonawanda-Seneca Reservation. It was claimed that it was the old form of the Iroquois sleeping and lounging mat. It can easily be rolled up and is of no great weight. The writer is not aware of another specimen in any museum. No great age is ascribed to the State Museum specimen, the owner, Lyman Johnson, *Gaiĕnt'wakĕ'*, claiming it had been made in about 1900 by his mother.

Probably the corn husk article most familiar to white people surrounding Indian reservations is the husk door mat, gadji'shă'. This mat is braided in such a manner that tufts of the husk are left protruding from the top of the braid. The braid then is coiled so as to form an oval or round mat and the thick tufts of still husk trimmed off evenly, and the flat braids sewed securely with threads of husk. Mats of this kind are common on all the reservations. The details of the foot mat are shown in plate 26.

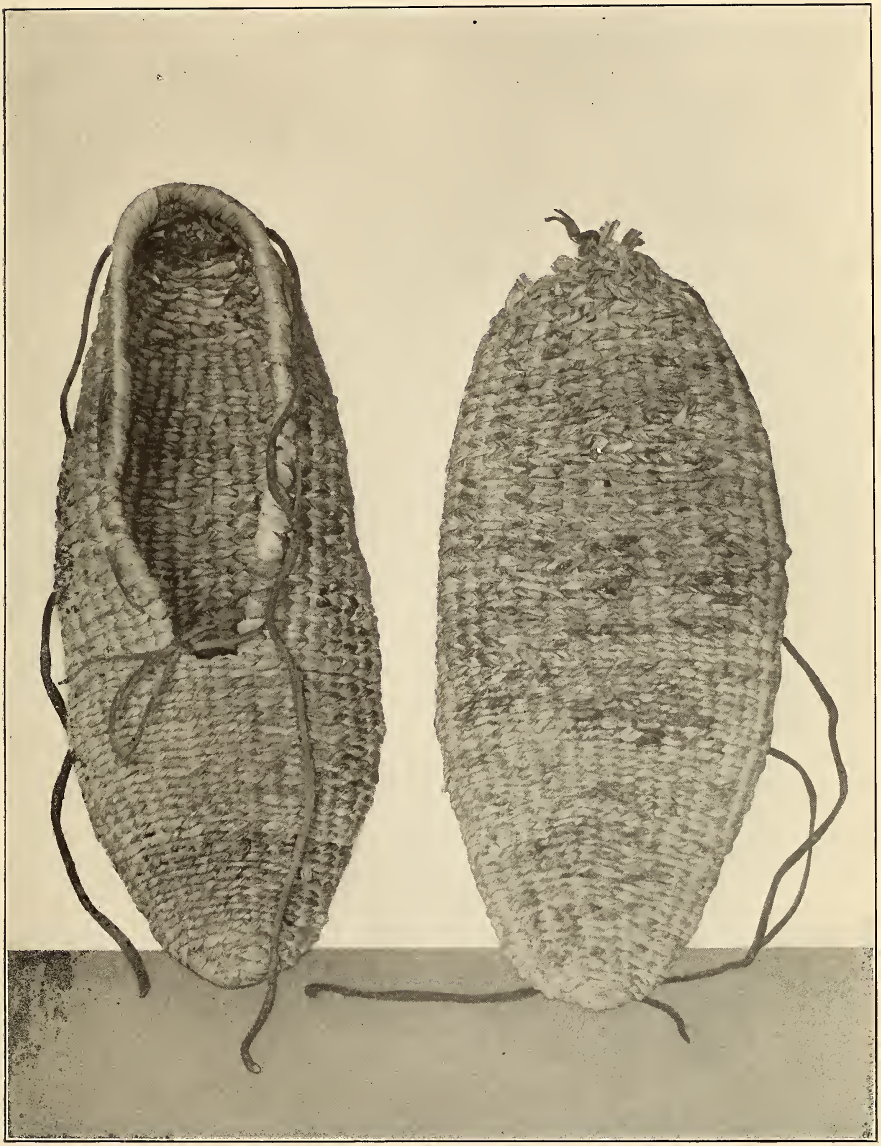
Dolls, gayă''dă', are made by folding the husk in a pestlelike form for the neck and body. Room is left for the head and neck and the central core is pierced to allow a wisp of husk to be pulled through to be braided into arms. The lower portion is pierced in the same way and the husk for the legs pulled through. Husks are rolled around the upper portion of the neck and the head is formed.

Plate 23



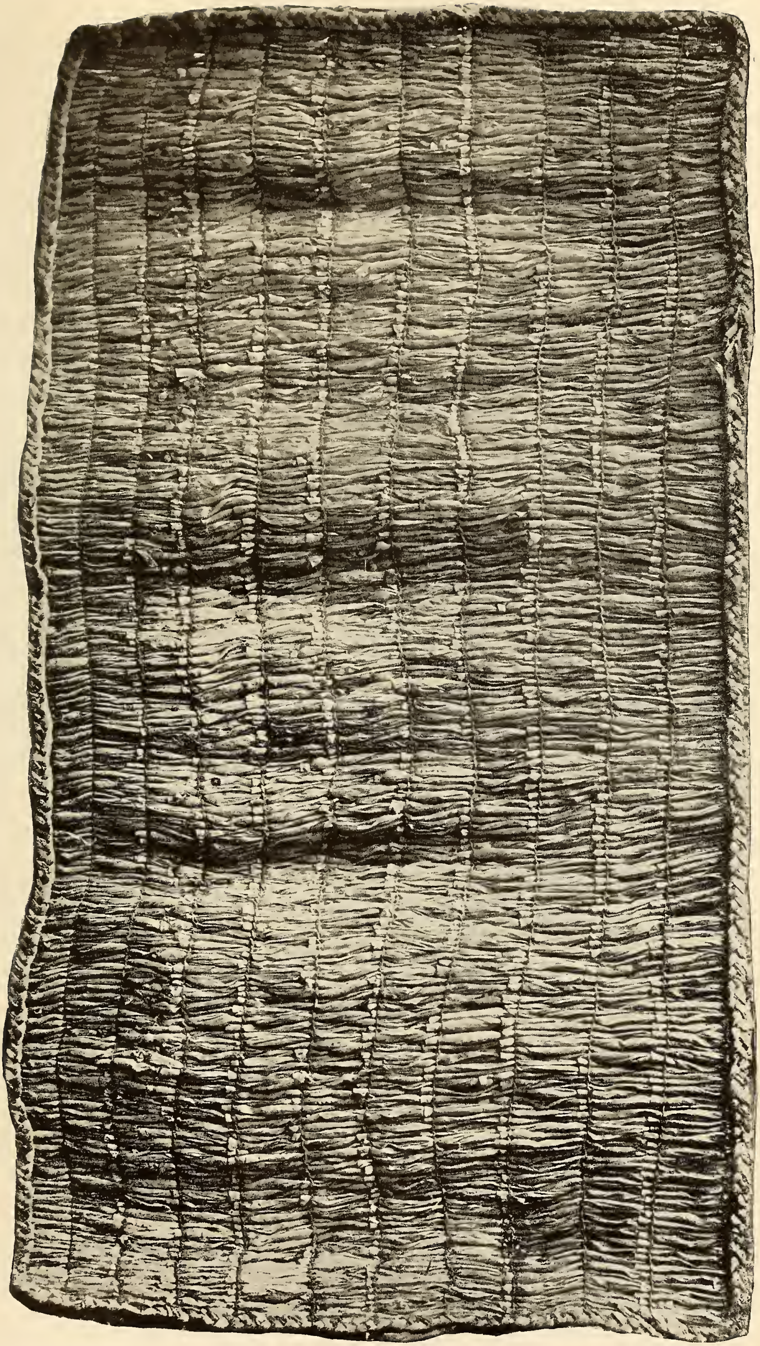
Masks made from shreds of braided husk, used by the Husk Face Company

Plate 24



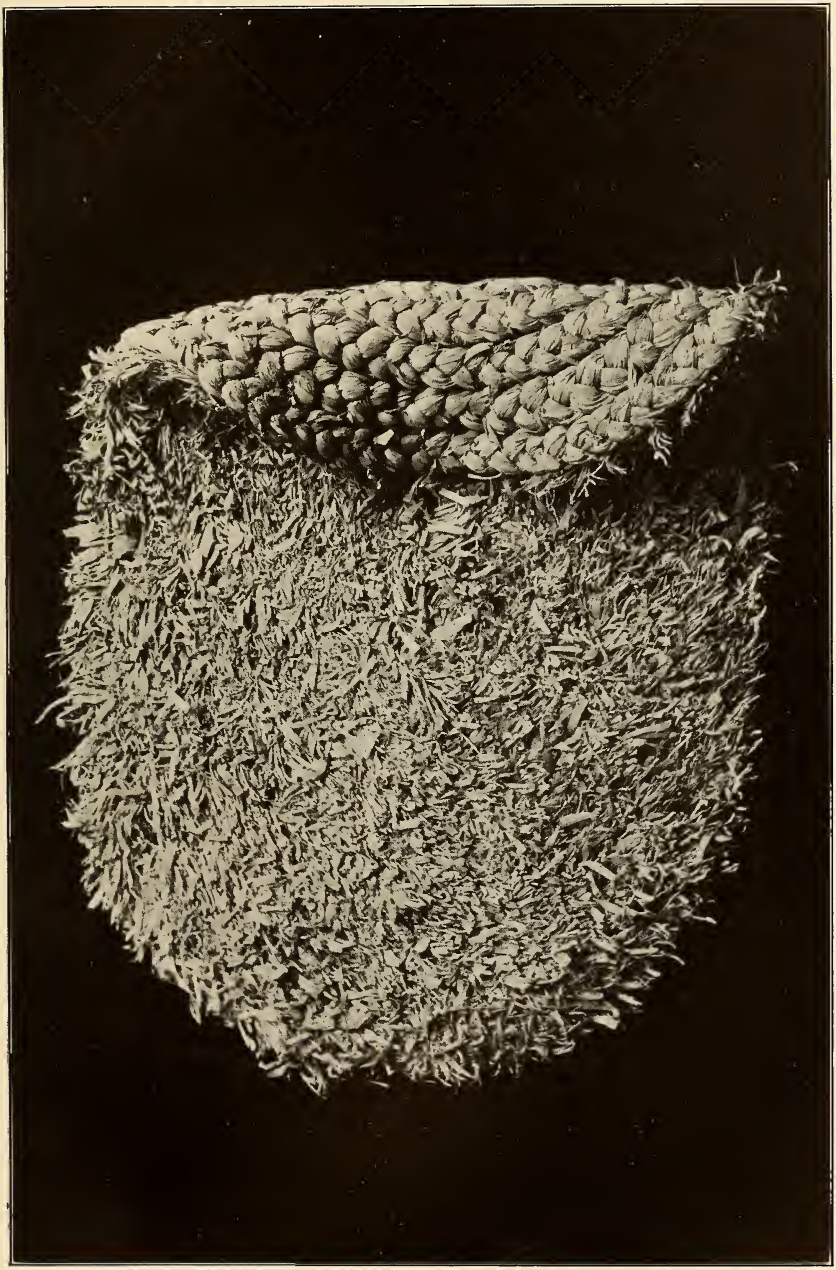
Seneca husk moccasins. Once common, these articles are now obsolete among the Iroquois. Collected by A. C. Parker, 1910

Plate 25



Husk bed mat. A rare Seneca specimen. Collected 1907 by A. C. Parker

Plate 26



Husk foot mat, Seneca specimen

Husks now are placed over the back of the neck and carried diagonally across the chest from either side. The same process is repeated from the front and the husk drawn diagonally across the back. This produces body and shoulders. The legs are then braided or neatly rolled into shape, wound spirally with twine and tied tightly at the ankle. The foot is then bent forward at right angles to the leg and wound into shape. The arms undergo a similar process but no attempt is made to simulate hands. The head and body are now ready for covering. For the head the wide husks are held upward against the top of the head and a string passed around them. The husks are then bent downward and the string tightened. This leaves a little circular opening at the top of the head. The head cover husks are drawn tightly over the form and tied at the neck, which is afterward wound neatly with a smooth husk. More diagonal pieces are placed over the shoulders fore and aft and drawn tightly down to the waist. A wide band is then drawn around the waist and tied. The doll is now ready for corn silk hair which may be sewn on, and its face may be painted on. These dolls are sometimes dressed in husk clothing but more often cloth or skin is used. Dolls are dressed as warriors and women and are given all the accessories, bows, tomahawks, babyboards or paddles, as the sex may require.

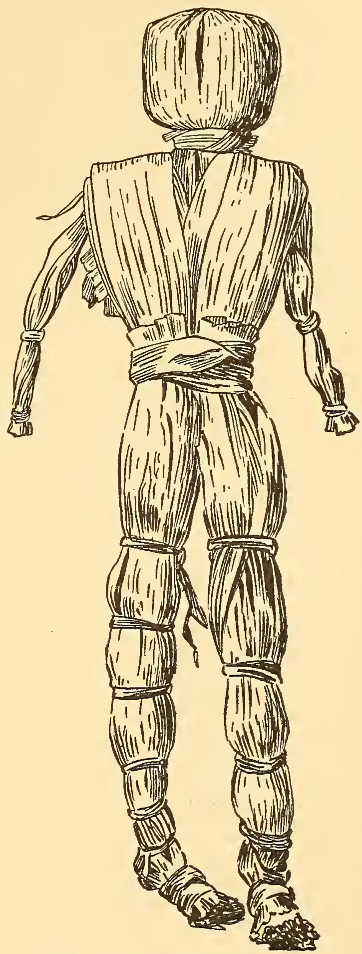


Fig. 18 Common type of the husk doll made by the Iroquois of New York and Canada. Figure is half size.

Among the articles made from husks, moccasins are perhaps as uncommon as any. Morgan collected a pair for the State Museum in 1851, but the specimens are not now to be found. In 1910 the writer succeeded in getting two pairs on the Cattaraugus Reservation from a husk worker who spent some time in finding among the old women one who remembered the art. She was successful in her inquiries and was able to make two pairs for the State Museum. They are most ingeniously woven but are as snug as any slipper ever made. The details of these moccasins are shown in plate 24.

Fig. 19 Doll made in obedience to a dream and cast aside to carry away some malady. Specimen is actual size

Small baskets were woven from twisted corn husks. Trays, table mats and salt bottles were similarly made. The basket was commenced by tying two rolled husks together with another single husk inserted, and then starting two oppositely placed husks about them by the twining process as the width of the warp increased, as it radiated from the center others were inserted and the twining process repeated. When the desired size of the bottom was reached the warp was bent at right angles upward and the twining continued until the hight wished had been achieved. The warp was then bent over along the top and braided, in a three strand plait. This stiffened and protected the top. Husk baskets are called onōnya' gaŭs'hä' (= husk basket).

Husk bottles for containing salt or ashes or other substances are called onō'nya' gŭs"heda' (= husk bottle) or yedji'kedä"kwă (= salt dish, from *ye*, feminine affix, and odjike"dă, salt, and iäkwă', meaning *container*, in compounding words). Salt bottles were tightly woven and some are said to be water tight. The Iroquois prize them, believing that the husk absorbs the moisture before it reaches the salt which is thereby kept dry.

Husk trays are used for containing small objects or food and are designed to be kept on a flat surface only. They are called o'dion'hä' iäkwă' (= crumb dish).

Baby hammocks, onō'nya' gao^n'wo^n', or gao^n'yoñ, (onō'nya'

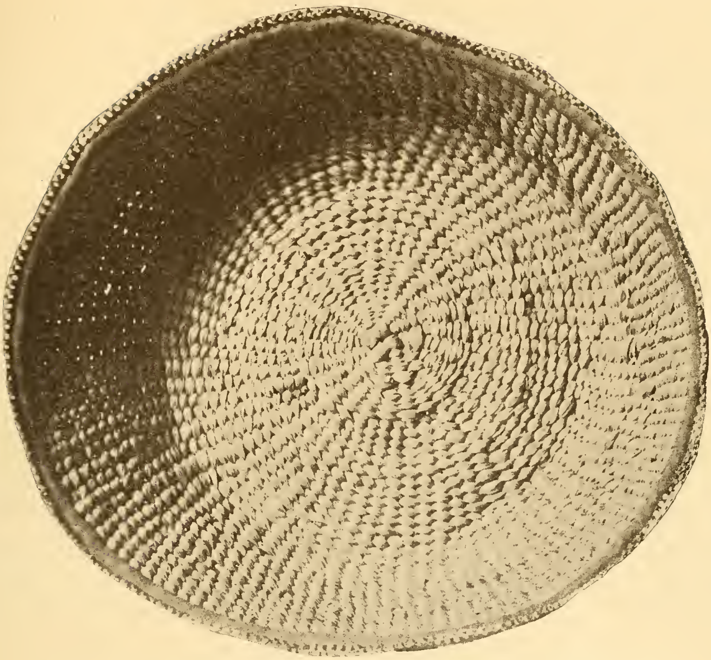


Fig. 20 Corn husk basket. Collected by Lewis H. Morgan, 1850. Specimen is 12 inches in diameter.

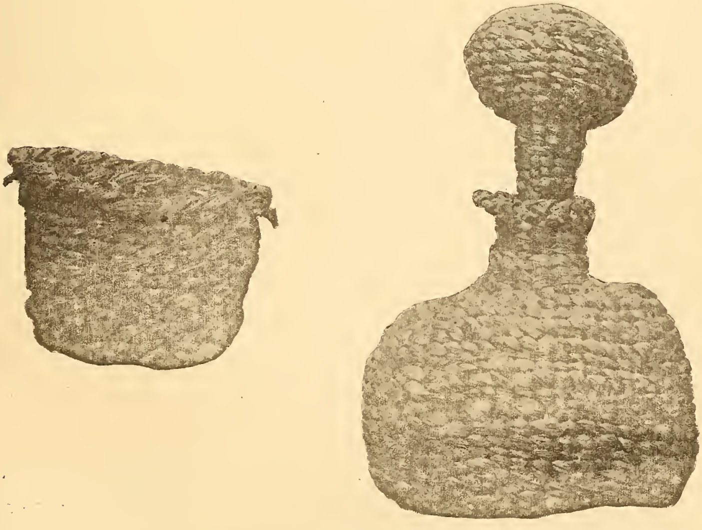


Fig. 21 Corn husk salt basket and bottle, about ⅔ actual size. Collected 1908 by A. C. Parker. Seneca specimens

+ gao^n'wo^n' = boat, or gao^n'yoñ[1] = hanging boat). Hammocks are woven like the sleeping mat but they are shaped so that they will hang properly and hold a baby in safety. These hammocks are suspended over the beds of the parents where they can be swung and the babies easily cared for. Hammocks are now made by suspending a blanket or a quilt in the same manner. These modern contrivances are called iyōs'gashâ^n' niă'do^n gao^{n}wo^n', *blanket, it is made from boat,* (a hammock).

Husk pudding wrappings are called deyĕ''hodyĕ^n'yĭktă' (= a wrapping). Husks were braided for ropes and clothes lines, gäo^n''gä (= rope).

A woman unable to deliver the placenta is held over a pan in which a couple of handfuls of husks are burning. The smoke rises and exercises a medical function, it is thought, which facilitates the delivery. This was widely practised by the Iroquois as late as 1875, and now to some extent.

To stop "nose bleed" a small strand of husk is tied about the little finger. A wad of husk or kernel of corn was placed under the upper lip next to the gum and just over the middle incisors.

There are references to clothing of corn husk and Father Dablon in 1656 wrote of the brother of his host who arrayed himself to impersonate a satyr, "covering himself from head to foot with husks of Indian corn."

3 **Uses of corn silk.** Corn silk (when on stalk = odiot'; off = ogä'') was used commonly for the hair of husk dolls. It was rarely used for adulterating tobacco. Another use of the dried corn silk was an adulterant for certain medicines. The dried silk was pulverized and kept in cornstalk bottles.

4 **Uses of corn cobs.** Cobs (Ono''gwĕ^{n}ä^n) were used for smoking meats and hides. A slow fire of cobs was built under the meat and then smothered so that the cobs merely smoldered and smoked. In smoking skins the skin was folded into a tentlike cone, suspended from a limb or crane and smoked on the underside from a small pit beneath, in which was a smoldering fire of cobs. The skin was then reversed and smoked. Cobs were not the only substances used for smoking.

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[1] Gani'yōn = hanging, gao^n'wo^n' = boat; gao^{n}yoñ, hanging boat = hammock. The earlier form is gao'wo^n'niyoñ, hanging boat. *Cf.* Awĕ^n'o^n'niyoñ = hanging flower; Awĕ^n'o^n' = flower. Gano''djaniyoñ = hanging kettle, gano''dja = kettle + (ga)ni yoñ = hanging.

Segments of cob are used for stoppers for husk salt bottles and for the openings in gourd rattles. Cobs were and still are used for hand and flesh scrubbing brushes, oyĕn'nyĭ'tă', and for pipe bowls. Cobs were "singed" and used as combs, ĕ^{n}yĕskĕ^{n}ĕ^{n}wai', with which to clean pumpkin and squash seeds. Singed cobs were also used as back scratchers, yiontgĕ^n''dătă'.

The ashes, o'gä^n', of the cob in quantities were used to make a lye, o'gä^n'gi', that induced vomiting. In small quantities cob ashes were used as a seasoning for food. "They killed stomach worms and prevented dyspepsia."

5 **Uses of the Caryopsis.** Besides their use as food, corn kernels were used as beads and decorations, as a medium for trade for the oil, for rattlers in gourds, and for sacrificial purposes.

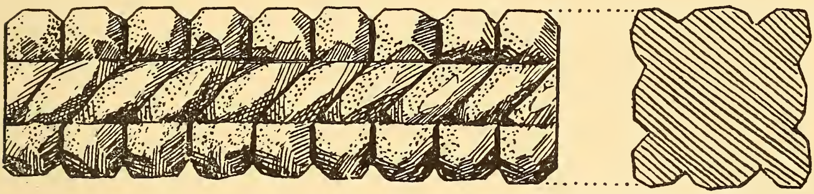

Fig. 22 Section of ceremonial cane showing the use of kernels of corn as a decorative motive

When used as decorations the various colored corns were soaked in water until soft and then strung, sometimes with beads alternating upon thread. Such strands could be used as necklaces and the writer has seen them strung as portieres. Oil, Onä'o^n ono'', was extracted from the kernels and used for a rubbing oil and various poultices, oyĕ^n'sä',[1] were made of corn meal. There are a number of references to the sacrifices to various spirits.

White Tuscarora corn kernels were parched on the stove and pulverized on a hot stone. The powder, onä'o ot'on'yoshä, was used as a compress on the navel of a baby from whom the dried navel chord (hoshet'dōt, masc., goshet'dot, fem.) had just been removed. It was thought to be a nonirritating absorbent and a valuable healing agent.

[1] Iroquois use poultices of boiled maize flour and apply them hot to the cheek. "I have found that this remedy has been very efficacious against a swelling," says Kalm, "as it lessens the pain, abates the swelling, opens a gathering if there be any, and procures a good discharge of pus." Kalm. Travels in North America, p. 514; Pinkerton. Voyages, p. 13.

In notifying people of the death feast an ear[1] or kernel of corn is given as a token. The person receiving it is bound to attend the ceremony.

The pulp of crushed green corn has been used effectively by the Iroquois as a substitute for deer's brains as a filler in tanning skins.

At the unveiling of the Mary Jemison monument in Letchworth Park on September 19, 1910, a Seneca girl threw handfuls of Tuscarora corn upon the grave and Mrs Thomas Kennedy, a Seneca and descendant of Mary Jemison, made a short address, saying that as the corn which Mary had so often planted sprang into life again, so it was hoped that her spirit would blossom in the heaven world.

6 **Uses of corn leaves.** Corn leaves, odio^{n}'să', newly torn from the stalk are used as wrappings for green corn tamales, or boiled cakes, oniă''tcidă' (= folded braid of hair). The green corn cut from the cob is thrown into a mortar and beaten into a paste and wrapped in corn leaves which are doubled over and tied three times laterally and once transversely.

In the *Jesuit Relations of* 1652–53, a Jesuit Father relates that his finger, the end of which has been cut off, was wrapped in a corn leaf to staunch the flow of blood.[2]

[1] Beauchamp. Am. Folk Lore Jour. 11:3.

[2] Jesuit Relations. 40:153.

Plate 27

The feast of Mandamin, from an engraving by F. B. Mayer in Schoolcraft's *Indian Tribes.* This picture is reproduced as a suggeston as to the widespread veneration of the corn plant among the Indians of America.

Plate 28

Interior of modern Mexican Indian kitchen, from a photograph by Prof. Marshall H. Saville. Note the clay pots, the scattered ears and cobs and the metates before the women

Part 2

NOTES ON CERTAIN FOOD PLANTS USED BY THE IROQUOIS

XI BEANS AND BEAN FOODS

Beans next to corn were regarded as a favorite food and quantities are still eaten. The Iroquois have 10 or more varieties of beans which they claim are ancient species which have long been cultivated. Some are said now to be cultivated only by the Iroquois.

The cornstalk bean,[1] oä''gēka, is thought by the Seneca to be the most ancient bean and perhaps the species which grew from the Earth-Mother's grave.

The bean is an indigenous American plant, at least it grew here in Precolumbian times. Explorers and early writers have left us many references to it and most agree that it is an American plant.

Varieties of Iroquois beans

Beans, osai''dă'

Bush beans	dega'gahă'
Wampum	o'tgo'ä osai''dă'
Purple kidney	awe'oñdago^n
White kidney	o'sai''dăgän
Marrowfat	osai''dowanĕs
String	otgo^n'wasäga^{n}oñ odji'stanokwa
Cornstalk	oä''geka
Cranberry	hayuk'osai''dăt
Chestnut lima	onii'stă'
Hummingbird	djŭtowĕndo^n
White (small)	osai''dagä'n
Wild peas	owĕndo'ge'ă' osai''dă'
Bean vines	oo^n'să'
Poles	yoäno'dă'kwă'

Bean foods

Among the varieties of bean foods may be mentioned:

Bean soup, osai''dă'gĭ'. This was made in several ways: from string beans cooked in the pods, from shelled green beans and from dried beans. Often sugar was put in as a seasoning.

[1] *Cf.* N. Y. Hist. Soc. Proc. Ser. 2, 1:189.

Fried cooked green beans (none′′owi = *it is done*). The cooked green beans were fried in sunflower or bear oil and eaten with salt.

Mashed bean pudding (osai′′dă' odjiis′kwa). Dried beans were put in a mortar and pounded coarsely, soaked in cold water and boiled down to a pudding with bear meat or vension.

Boiled beans (osai′′dŭk odjis′kwa). These were mashed and mixed with sugar and grease.

Beans and squash "together" (Ganiŭ′′sŭk osai′′dă' kho). Cook cranberry beans with the pods and when beans are almost dry serve in the shell of a boiled squash. This dish is served at the Green Corn Thanksgiving ceremony and is called Onon′deikwawas, *cooked together food.*

Beans with corn (Gai′nondä). Green shelled beans were boiled with green sweet corn, meat or fat. The red beans were preferred.

XII SQUASHES AND OTHER VINE VEGETABLES

The squash plant is indigenous to America and was cultivated to a large extent by the Iroquois and other eastern stocks. The word *squash* is derived from the Algonquin *akuta squash* or *isquouter squash* (colonial spelling). Roger Williams[1] writing on the agriculture of the New England Indians says: "Askuta squash, their vine apples, which the English from them call squashes, are about the bigness of apples of several colours, a sweet light wholesome refreshing."

Van Curler in the same year wrote in his journal: "We had a good many pumpkins cooked and baked that they called anansira."

This was in December which of course shows the use of squashes in winter. Van Curler attests the hospitality of the Mohawk when he writes: "A woman came to meet us bringing us baked pumpkins to eat." [*See* Am. Hist. Soc. Trans. 1895. p. 91–92]

The squash was one of the principal foods of the Iroquois who even yet regard it as a favorite. The records of early travelers[2] abound in references to the uses of squashes and pumpkins. Some of them praised "pompions" for their goodness while others

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[1] Williams. Key. 1643. p. 125. Narragansett Club Pub. *Cf.* Wood. New England Prospect. 1634: "In summer when their corn is spent Isquoter squashes is their best bread, a fruit like young Pompion."

[2] Heckewelder, p. 194–95; Jesuit Relations, 10:103.

affirmed that the "citrules" were hard tasteless things. Hunger and mood largely govern descriptions of food.

Lahontan[1] records that the *citruls* (pumpkins) of this country are sweet and of a different nature from those of Europe. ". . . and I am informed," he writes, "that the *American citruls* will not grow in *Europe*. They are as big as our *Melons;* and their Pulp is as yellow as Saffron. Commonly they are bak'd in Ovens, but the better way is to roast 'em under the Embers as the Savages do. Their Taste is much the same with that of the marmalade of Apples, only they are sweeter. One may eat as much of 'em as he pleases without fearing disorder."

Charles Hawley in his *Early Chapters of Cayuga History*[2] quotes Dr Shea's translation of de Casson's *Historie de Montreal* which gives the account of the journey of Trouvé and the Catholic fathers to Kenté. A part of the narrative reads:

> Having arrived at Kenté we were regaled there as well as it was possible by the Indians of the place. It is true that the feast consisted only of some citrouilles (squashes) fricasseed with grease and which we found good; they are indeed excellent in this country and can not enter into comparison with those of Europe. It may even be said that it is wronging them to give them the name citrouilles. They are of a very great variety of shapes and scarcely one has any resemblance to those in France. They are some so hard as to require a hatchet if you wish to split them open before cooking. All have different names.

A favorite way of preserving pumpkins and squashes for winter use was to cut them into spirals[3] or thin sections and hang them on the drying racks to evaporate. Sometimes even now this method is used but the modern way among the Seneca and Onondaga at least is to cut off thin sections and string the pieces on cord. A string would hold about half a pumpkin or squash and be suspended perpendicularly to pegs back of the stove or near the fireplace.

Varieties of squashes

The Iroquois generally planted their squashes in the same hills with corn and some kinds of beans. Beside the land and labor saved by this custom there was a belief that these three vegetables were

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1 1:151.

2 Early Chapters of Cayuga History. Auburn 1879.

3 *Cf.* Adair, p. 408.

guarded by three inseparable spirit sisters and that the plants would not thrive apart in consequence.

Crook neck squash	onya'sa'
Hubbard squash	odaint'dowaně'
Scalloped squash	onya'sǎo^{n}'wě^{n}
Winter squash	gai'dowaně'
Hard pumpkin	nyo'sowaně'

Squash foods

Baked squash (wandenyo^{n}soñdŭk). Squashes were baked in ashes and the whole squash eaten, the shell and seeds included.

Boiled squash (Ganyu''sō). Squashes were split and cleaned and boiled in water salted to taste.

Boiled squash flower (ojaint'dŭk).[1] The infertile flowers of the squash were boiled with meat and the sauce used as a flavoring for meats and vegetables.

Melons

Cucumber	onios'kwäe'
Musk melons	wa'yais
Water melons	o nyut'sŭtgus

Other vine foods

" Husk tomatoes "	dji'wewa'yas

Melons were planted in patches in the woods cleared by burning, the leaf mold furnishing a good medium for growth. Those who planted melons in cleared woodland tracts set up poles upon which were painted the clan totems and the name signs of the owners. The totem sign signified that while, according to the communistic laws, the patch belonged, nominally, to the clan, and that any clansman might take the fruit if necessary, yet by virtue of the fact that the garden was cleared, planted and cultivated by the individual whose name was indicated, the individual claim and right should be recognized as actually prior, though not nominally.

Before the frost the melon vines that still had unripe fruit were often dug up without disturbing the roots, and replanted in a basket of sand to be taken to the lodge and kept under the beds or in small cellars. During the winter months, so several informants said, the melons would mature and were reserved for the sick.

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[1] Bartram in his *Observations,* page 16, writes of "one kettle full of young squashes and their flowers boiled in water and a little meal mixed."

XIII LEAF AND STALK FOODS.[1]

Wild pea	*Lathyrus maritimus*	awĕndo‘ge’a osai‘’dă’
Berry sprouts		wasē‘’oik’da’ (= new sprouts)
Sumac sprouts	*Rhus glabra*	o‘tgo‘’dă’
Wild asparagus	*Asparagus officinalis*	deo’dai‘ho
Sorrel	*Oxalis* (var. sp.)	deyu‘’yu‘djis (= sour)
Yellowdock	*Rumex crispus*	iye‘t (= she stands)
Mustard	*Brassica* (var. sp.)	djitgwä’ä niayawĕno‘’dä (= yellow blossom)
Dandelion	*Taraxacum officinale*	odjisshondă’ (=yellow star)
Pokeberry plant[2]	*Phytolacca decandra*	o‘’sheä onĕ’’ta’ (= crimson leaves)
Milkweed	*Asclepisa syriaca*	onaos’kän
Cowslips	*Caltha palustris*	ganon’now’s (=it wants)
Pigweed	*Chenopodium* (var. sp.)	gwis’gwis ganĕ‘’das
Burdock	*Arctium lappa*	onondowa’nĕs (= big comb)

Berry and sumac sprouts newly grown and sorrel are eaten raw and esteemed an excellent alterative. In the spring new stalks of wild asparagus, peas, yellowdock, poke and milkweed are cooked as greens. The plants must be young and tender and not more than 6 to 10 inches high. All greens are supposed to be good for the liver, for the blood and as a remedy for rheumatism. Young dandelions, cowslips and mustard were cut at the ground and boiled as greens. Fat meat was generally cooked with greens.

XIV FUNGI AND LICHENS

Mushrooms	onĕn’să’
Puffballs	onĕn’să’wa’nĕ‘
Lichens	gŭstaot onĕ’’ta’

Mushrooms, puffballs and other edible fungi were esteemed as good materials for soup. The fungus is first peeled and then diced and thrown in boiling water, seasoned with salt and grease. Sometimes bits of meat are added. The Iroquois like edible fungi quite as well as meat.

[1] Adair, p. 415.
[2] *Ibid.* 412.

Puffballs were peeled and sliced and mushrooms peeled and fried entire in grease, sunflower or bear oil, though sometimes deer tallow was used.

Rale[1] mentions the use of tree fungi and says that they were "white as large mushrooms; these are cooked and reduced to a sort of porridge, but it is very far from having the flavor of porridge."

Lichens have been eaten but rarely within the memory of my oldest informants. Hunters when pressed by hunger, they remembered, had sometimes scraped the lichens from a tree or rock and boiled them with grease. In preparing them the lichens were first washed in a mixture of camp ashes and water to remove the bitterness. In times of great emergency, however, with hunger pressing, the cook did not stop to soak the lichens but cooked them as they were. The Jesuit Rale, in his letter to his brother mentions lichens and calls them "rock tripe." [2] When cooked, he says, they made a black and disagreeable porridge.

In Iceland for centuries lichens have been an important food and other peoples have not despised them. The nutritive value lies in the lichenin and starch which the plant contains.

XV FRUIT AND BERRYLIKE FOODS

The Iroquois considered fruits and berries a necessary part of everyday diet. Long before the Revolutionary War they had, in many places, extensive orchards of apples, peaches and plums. It is probable that at that period they cultivated fruit trees to a greater extent than any other native American people. The Iroquois loved the apple above other fruits, a fact which several writers mention.[3] General Sullivan in his famous raid against the hostile Iroquois cut down a single orchard of 1500 trees.[4]

A list of the principal fruits used by the Iroquois follows:

Apple	*Pyrus* (var. sp.)	{ ganyŭ"oyă oyă"odji'yă
Crab apples	*Pyrus coronaria*	djoik'dowa
Thorn apples	*Crataegus* (var. sp.)	ăwe'owek

[1] Jesuit Relations, 67:223.

[2] Jesuit Relations, 67:223.

[3] *See* Schoolcraft. Senate Document 24. Albany 1846. "The apple is the Indian's banana."

[4] History of New York during the Revolutionary War. New York 1879. II:334. Life of Brant. Albany 1865. v. II, ch. I.

Cherry, wild	*Prunus* (var. sp.)	oyă'gane gowa
Cherry, choke	*Prunus virginiana*	gane', or dyagyonyă'-täs
Peach[1]	*Prunus persica*	gai'däe' odji'yă'
Plum	*Prunus americana*	gä'e'
Grapes	*Vitis* (var. sp.)	oñiŭng'wisä'
Pawpaw	*Asimina triloba*	hadi'ot
Pear[1]	*Pyrus* (var. sp.)	odji'djo'gwa
Quince[1]	*Cydonia vulgaris*	odji'ju oyă''dji
Mandrake	*Podophyllum peltatum*	odä''onoshä'

Terminology

Tree	gē'it
Fruit skin	oä'wistă'
Fruit seeds or pits	oskä''eⁿ
Core	oă''dă'
Stem (also tree trunk)	oondă'
Cluster	wa'gwais'hänion

Apples were generally eaten raw but they were often boiled entire or cut up for sauce. The favorite way, however, was to bake them in ashes. The camp fire was brushed aside and the apples laid on a layer of hot gray ashes, covered with the same material, the hot embers raked over these and the fire rebuilt. Baked apples are called wada'gondŭk and the boiled sauce ganyaoyă' odji'skwa. The latter was eaten with roasted meats or bread.

Apples were stored in bark barrels and buried in winter pits with other vegetables. Apples were cut up in thin slices, strung on twine and dried. Even now it is a common thing to see apples strung up over the stove or hung on a pole at the top of the room in the houses of the more primitive Iroquois.

Cherries were dried for winter use and pulverized in a mortar and mixed with dried meat flour for soup.

Small fruits. Of the smaller fruits and berries the list which follows includes those most commonly used:

Blackberries	*Rubus* (var. sp.)	otgä'ashä'
Black raspberries	*R. occidentalis*	toñ'dâktho'
Red raspberries	*R. strigosus*	dagwă''dannĕ'

[1] Postcolumbian.

Blueberries	*Vaccinium* (var. sp.)	getdatge′a
Huckleberries	*Gaylussacia baccata*	oyādji′′
Thimble	*Rubus odoratus*	
High cranberries	(*Vac. macrocarpon*)	onaoⁿshä′′
	Viburnum opulus	ha′nonŭndjŭk
Nannyberries	*V. lentago*	ga‘nē′sā‘ wanunda
Mulberries	*Morus rubra*	odji‘nowŏⁿ′wadisiyas djo′yesshăyes
Strawberries	*Fragaria virginiana*	odjistondas′hä‘
Elderberries	*Sambucus canadensis*	oniot′sŭtgŭs
Gooseberries	*Ribes* (var. sp.)	nŭⁿ′′gwussōt
Dewberries	*Rubus viliosus*	ogau‘o′′gwă′
Wintergreen	*Gaultheria procumbens*	djisdă′′geă′
Partridge vine Squaw vine Oneberry	*Mitchella repens*	oshaistă′′wayas
June berries	*Amelanchier oblongifolia* *A. canadensis*	hä′doⁿ
Currants	*Ribes* (var. sp.)	djoägă′′wayas
Sumac berries	*Rhus glabra*	o′tgo′′dă′

Terminology

Bush	oi′′ktă′
Berries	odji′yă′
Blossoms	awe′oⁿ
Briars	oi′′kdaii‘
Green fruit	ogäⁿ′s‘ä‘
Seeds	oskäⁿ′a‘
Berry time	o‘wai′yai‘
Berry picker	ha′yagwŭs
I pick berries	ga′yagwŭs

Berries when in season were eagerly gathered by the Iroquois and even today berries have not lost favor with them. They were eaten entire raw, crushed and mixed with sugar and water or mixed with various puddings. Blackberries, strawberries, elderberries and huckleberries seem to be the favorite varieties. For winter's use blackberries, black raspberries, huckleberries and blueberries are dried. Strawberries were also dried but required a great deal of care. These dried fruits were either soaked in sugared water and cooked as a sauce or thrown in soups, puddings and breads or other foods. For making an expedition food berries were pounded with meat, parched corn and sugar. This food was eaten sparingly and washed down with quantities of water.

Dried blackberries are soaked in honey and water and used as a ceremonial food by the Bear Society in their rites.

Dried, and in modern times, preserved strawberries are mixed with water and maple sugar and used as a refreshment by the Guardians of the Little Water Medicine[1] during their night song.

Strawberries are eagerly gathered in the spring and eaten by every one as a spring medicine. Handsome Lake, the prophet, commands their use for this purpose in his code, the Gai'wiiu.[2]

Juneberries were considered as a valuable blood remedy, which was given to mothers after childbirth to prevent afterpains and hemorrhages. The smaller branches of the Juneberry bush were broken up and steeped as a tea for the same purpose.

Cranberries were a favorite autumn food and were considered "good" for the blood and liver. Huckleberries were also valued for the same purpose.

Elderberries were eagerly gathered for sauce. They were considered a valuable remedial agent for fevered patients and convalescents.

Partridge berries were not generally eaten as food except perhaps by women. They were supposed to prevent severe labor pains and to facilitate easy delivery. There were other herbs also used for this purpose.

The drying of berries and small fruits in the late summer and autumn was and now to a certain extent is an important item in the domestic economy of the Iroquois.

Blackberries, black raspberries, huckleberries, elderberries and blueberries are easily dried entire if care is taken not to allow them to become damp during the process, which may spoil them. It is said that blackberries were best when dried on the stalk. The stalk or cluster stem was broken and allowed to hang on the bush where the sun could dry down the fruit with all its natural juices. The smaller pulpy berries were dried in shallow basket trays [*see* pl. 30]. The juicy berries such as strawberries and red raspberries were mashed

[1] Parker, A. C. Secret Medicine Societies of the Seneca. Am. Anthropologist. New ser. v. 11, no. 2.

[2] Translated by Parker & Bluesky. Manuscript in New York State Library.

in a wooden bowl and with as much juice as the mass would hold placed on basswood leaves on slabs of slate or other flat rocks. The juice that remained in the bowl was given to the children who even in those days loved to " lick out the bowl."

For winter's use the dried berries were soaked in cold water and then heated slowly, maple sugar being thrown in as a seasoning. The berries were then either eaten as a sauce or mixed with bread meal or onon'dā', hominy.

The gathering of the autumn berries was regarded more of a pastime than work. In fact, work with these people in many lines was made easier by its social character, and seemed more like a game where the thrill of it all kept the thought of fatigue away.

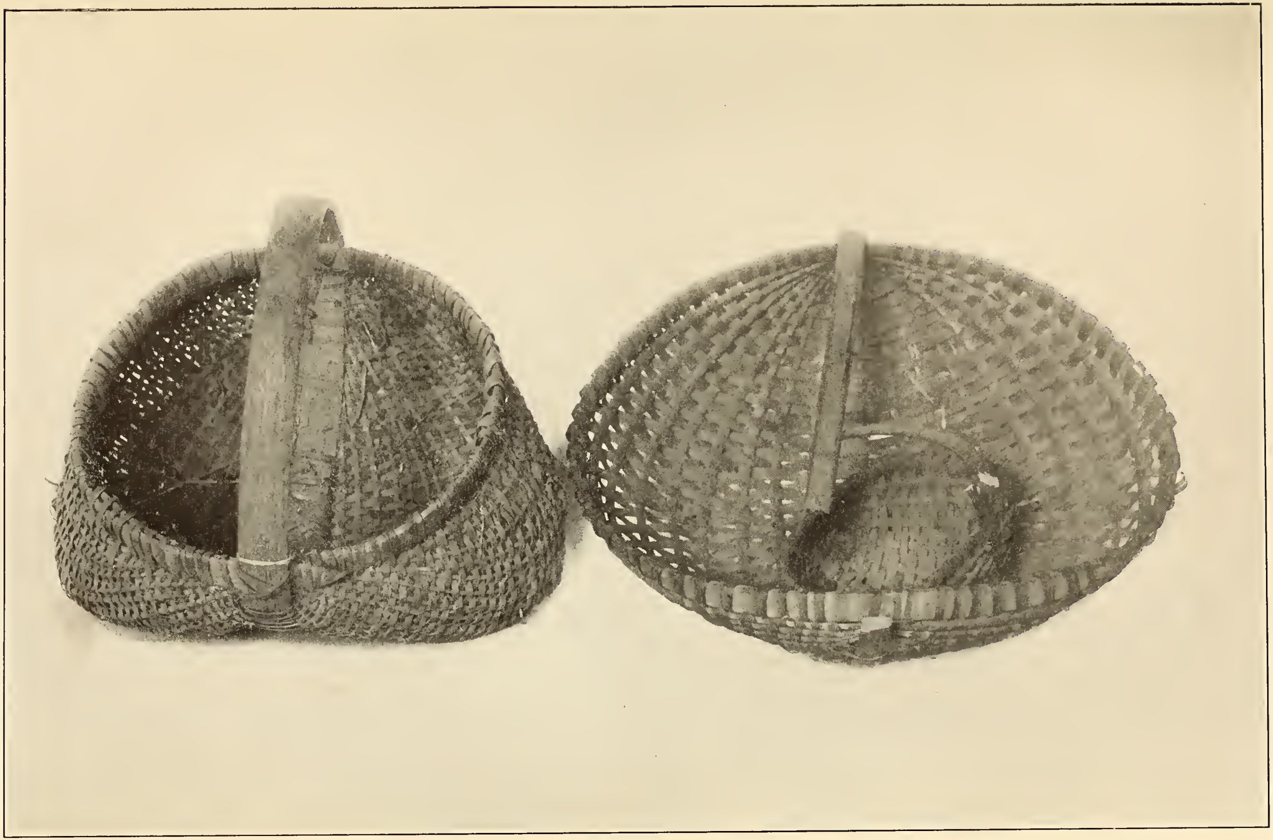
The work of berrying was left of course to the women and girls. They would go in groups to the places where patches of the vines and bushes grew and sing their folksongs as they gathered the fruit. Every one laughed or sang and picked as fast as their two hands could touch the berries. The picking baskets yiondasste''ñondakwa' held about 5 quarts. They were suspended from the back of the neck and the chest, one fore, the other aft. The forward basket lay against the abdomen so that it was within easy reach. This being filled the berries were covered with sumac or basswood leaves held in place by two sticks, slung to the rear, the rear basket brought forward and filled. The two baskets were then carried to a larger basket holding about ½ bushel. One large basket and the two picking baskets full of berries constituted a load for a woman to carry.

Huckleberries were raked from the bushes with the fingers. Swamp huckleberries, bushes that grew along streams running through marshes, were bent over into a canoe and stripped of their berries which fell into large containing baskets. In picking mountain huckleberries or those which grew in snake infested places the moccasins were smeared with lard to frighten away the rattlers. The snakes, scenting the hog fat, would think that pigs were scouting for them.

This description of the berry-picking industry applies to a large extent to the Iroquois of the present day, especially the Seneca along the Cattaraugus, Allegany and Tonawanda.

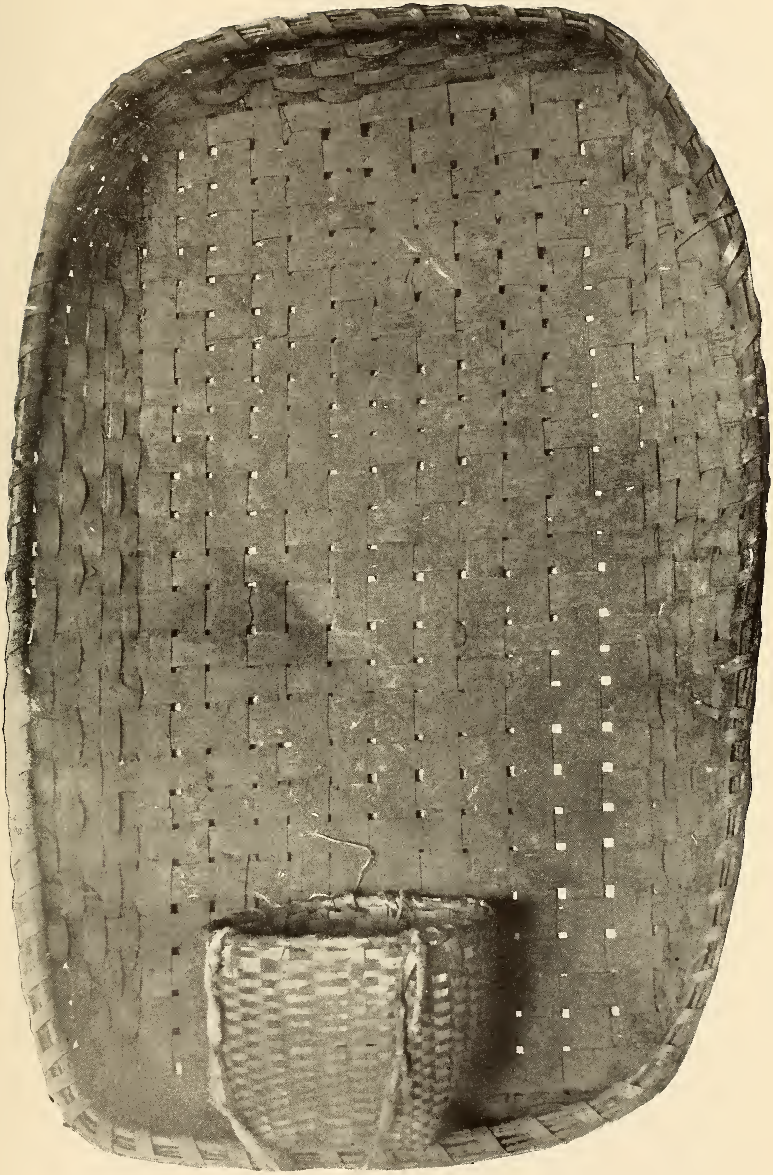
The first fruit of the year is the wild strawberry and this the Iroquois takes as a symbol of the Creator's renewed promise of beneficence. Quantities are gathered and brought to the feast-makers at the Long House for the Strawberry Thanksgiving. This is an annual ceremony of importance though it lasts but a day.

Plate 29



Types of melon baskets, used for gathering berries. 1 Cherokee specimen; 2, 3 Oneida specimens. Illustrations are about one quarter actual size. Collected for the State Museum by M. R. Harrington, 1910

Plate 30



Seneca evaporating tray and berry picker's basket. The evaporating tray is used for green corn, pulpy fruits and berries. The tray is 40 inches in length. E. R. Burmaster, collector, 1910

Cache of charred acorns excavated by Harrington and Parker, 1903 (Peabody Museum of Archeology and Ethnology Expedition) on the Silverheels site, Brant township, Erie county, N. Y.

The thrifty housewife examines the teeth of the June mullet which her husband has caught in the creeks to see if the base of its teeth is black. If so, it is an omen of a good blackberry year. A legend states that frost will never come when blackberries are in blossom in berry. Hă′tho, the frost spirit, once entered the lodge of O‘swi′nodă’, the summer spirit, but a boy entering and seeing the strange cold spirit in his father's house threw a pot of hot blackberry sauce in the frost spirit's face to his intense discomfort. Thereafter Hă″tho never ventured from his hiding place in the north from the time blackberries blossom until the fruit is mature. Blackberry juice makes a fine drink in the winter for it frightens away the cold. "Do not even bears eat berries all summer and defy the blasts of winter?" Blackberry roots are considered an effectual astringent and the tender new shoots as a fine blood remedy.

Thimble berries were eaten in the late summer as a diuretic. Dried for winter use they were valued for the same purpose. Sumac bobs were boiled in winter for a drink.

XVI FOOD NUTS OF THE IROQUOIS

Nuts formed an important part of the Iroquois diet. Great quantities were consumed during the nut season and quantities were stored for winter use. The nut season to the Iroquois was one of the happiest periods of the year[1] especially for the young people to whom fell the work of gathering most of the nuts. The women, however, often went in companies when serious business was meant, for with the failure of other crops, nuts formed an important food source. The nut season was called o‘wadawisa′ho‘^{n}.

The favorite food nuts of the Iroquois were hickory and chestnuts though other nuts were valued: A list of the principal nuts used by the Iroquois follows:

Acorns	*Quercus* (sp)	ogowä″
Beechnuts	*Fagus grandifolia*	oskä^{n}′ä
Black walnuts	*Juglans nigra*	djonyot′gwak
Butternuts	*J. cinerea*	djonot′gwes
Chestnuts	*Castanea dentata*	onye″sta
Hickory, bitter	*Carya cordiformis*	onio^{n}gwadjiwagĕ^{n}
Hickory	*Carya ovata*	djistagä′o^{n}
Hazel	*Corylus americana*	oso′wīshä‘

[1] *See* Relation of 1670, ch. IX.

Terminology

Nut	onio‘′gwă’
Husk or shucks	goktdo^n′tso^n
Shells	oktdă‘′
I shuck them	o‘gekdo^{n}tci‘
Meats	oniä‘′
Burs	osi′gä‘
I crack nuts	degadēnŭt′dyăk
Pitted nut stone	dyiodedă′kwĕ^n
Stone hammer	ye^{n}yĕ^n′dăkwă‘
Entire outfit for cracking nuts	ge′ondeniya‘′dăktă‘
Nut meal	onia‘′degai‘to^n‘
Nut oil	onia‘′deyo^{n}no^{n}go
Nut milk	oniä‘ono^n‘′gwă‘
It is cracked	deganyo‘′dyă‘go^n
Rancid meats	oniät′gä‘
Good meats	ōnye′iu‘
[1]Ripe meats	onie‘′stai‘
Ripe (on tree)	o‘wadawis′a‘
Ripe (on ground)	odawis′sa^{n}o^n
It is not ripe	doodawis′sa’o^n
Nut time	o‘wadawis′aho^n‘
Roasted chestnut	wade′nyistdondŭk
Boiled	ganie‘′stok
Entire nut meat	[2]deyut′hage^n′o^n
I gather nuts	ogeniogwe′oek
They are gathering	hadinio‘gwe′oek

Fresh nut meats were crushed in wooden bowls. The crushed meats were then thrown into a kettle of boiling water and the oil skimmed off. This oil was kept as a delicacy to be used with corn bread and puddings. Hickory and butternut oil was regarded especially palatable, the former being used for feeding infants. After the nut meats and oil were skimmed out the liquid was used as a drink. The crushed meats were often mixed with corn pudding or bread.

Chestnuts were boiled and the mealy interior used for puddings or the dried meats were pounded into a flour and mixed with bread meal to give the bread flavor.

[1] Means also boiled chestnut meats.

[2] Means *Spreads its legs.*

Acorns were boiled in lye and roasted[1] much as corn was to remove the bitterness, and after several washings pounded up in a mortar and mixed with meal or meat and made into soup or pudding. Children even now commonly eat raw acorns but their elders at present seldom use them for cooking. Their former employment remains only a memory.

The name hickory in its original uncorrupted form is derived from the name given by the Virginia Indians to a food or flavoring liquor prepared from a nut meat emulsion. John Smith in 1612 described this nut preparation as follows: "Then doe they dry them againe upon a mat over a hurdle. After they put it into a morter of wood and beat it very small: that done they mix it with water that the shells may sink to the bottome. This water will be coloured as milk; which they call *Pawcohiccora* and *keepe it for their use.*"[2]

The original Lenape form of the word according to William Gerard[3] was patahikareo.

For cracking nuts cuplike depressions, the size of the nut were picked into small boulders or slabs of shale. The nut was placed in the depression and cracked or crushed with a suitable stone. These "nut stones" and hammers were used on the various reservations up to within a few years and there are many Indians in New York State who can remember having used them. These stones are to be found today near large old nut trees and the writer in his childhood days often hunted about for them in his grandfather's back fields and used them for the purpose previously mentioned. In the Cattaraugus valley where black walnut trees once were plentiful these nut stones are common. The Seneca call the pitted nut stone dyiodedă'kwĕ^{n}. The hammer is called ye^{n}yĕ^{n}'dăkwă' and the entire nut cracking outfit deyondeniya''dăktă'.

The Seneca say that in the early days dry butternut and hickory meats were pulverized and mixed with dried bear or deer meat pul-

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[1] " . . . they search for — even acorns, which they value as highly as corn; after having dried these, they roast them in a kittle with ashes, in order to take away their bitterness. As for me, I eat them dry, and they take the place of bread." Rale. 1716–27. Jesuit Relations. 67:215; *cf. also* 1610, p. 243; Lawson, p. 178.

[2] Smith. Map of Virginia (1612) p. 12. *Cf.* Strachey. History of Travile into Virginia (1616); Norwood. Voyage to Virginia (1649), p. 37; Beverly. History of Virginia (1705). Bk 2, p. 16.

[3] Am. Anthropologist, New ser. v. 9, no. 1, Jan.-Mar. 1907. p. 92

verized in a mortar. This powder was thrown in a quantity of boiling water and used as a baby food.

The nursing bottle was a dried and greased bear-gut. The nipple was a bird's quill around which was tied the gut to give proper size. To clean these bottles they were untied at both ends, turned wrong side out, rinsed in warm water, thrown into cold water, shaken and hung in the smoke to dry.

Sunflower oil was used in quantities by the Iroquois, with whom it was a favorite food oil. It was prepared by bruising the ripe seed in a mortar, heating the mass for a half hour and then throwing it into boiling water until most of the oil had been separated from the pulp. The water was cooled and strained and then the oil skimmed off.

The use of this oil is mentioned elsewhere in this work.

XVII SAP AND BARK FOODS

The maple tree was one of the trees venerated by the Iroquois. It was in fact the goddess of trees and the only one to which a stated ceremony was dedicated and to which offerings were made. Pine, hemlock, elm and basswood of the forest trees were esteemed, but the maple was a special gift of the Creator and every spring at the foot of the largest maple tree in each village a ceremonial fire was built and a prayer chanted by the Keeper of the Maple Thanksgiving ceremony as he threw upon the embers pinches of sacred incense tobacco. The maple tree started the year. Its returning and rising sap to the Indian was the sign of the Creator's renewed covenant.

The Iroquois will ever remember the maple tree, but few now even remember the tradition of how it was, during the maple sap season, that the Laurentian Iroquois[1] struck their blow for freedom from Adirondack domination and fled into northern and central New York.[2]

Trees were probably tapped in early times by sawing a slanting gash into the trunk with a chert knife or saw. A flat stick was driven

[1] The Mohawk, the Oneida and Onondaga.

[2] One Mohawk tradition relates that the women flung hot maple sap into the faces of the Algonquin chiefs and thus helped their people in the fight for independence.

into the gash and the sap run down over it into bark tubs. For boiling the sap the Iroquois had in early times only their clay vessels but these were suitable receptacles though their capacity was small.

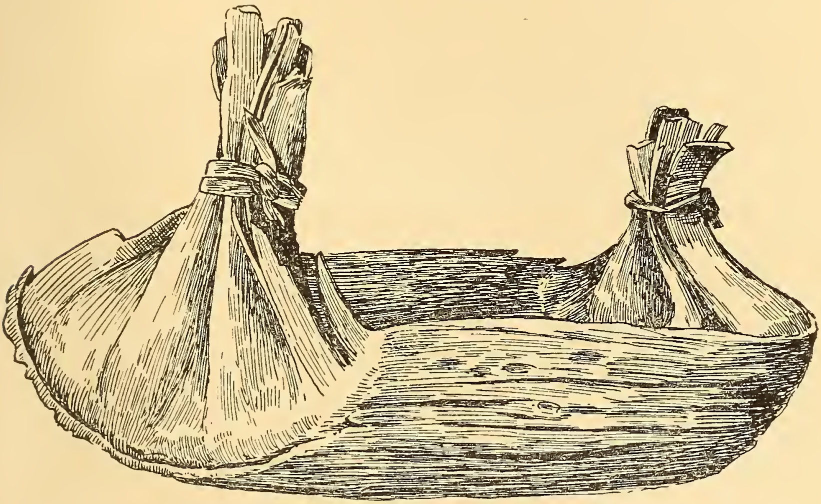

Fig. 23 Seneca sap basket or tub of elm bark, collected by L. H. Morgan. Specimen is 18 inches in length.

Maple sap was drunk as it came from the tree[1] and, fermented, was some times used as an intoxicant, the only record of such a thing which the writer has been able to find as used anciently by the Iroquois. When fermentation went too far a vinegar was produced which was highly esteemed. It was called wat′dă dyono^{n}ga′yotdjis.

The sugar syrup was sometimes poured into the empty shells of quail and duck eggs and these sugar eggs were valued by travelers.

One of the best early descriptions of maple sugar making has been left us by Lahontan whose description follows:

The maple-tree . . . yields a sap, which has a much pleasanter Taste than the best Limonade or Cherry Water, and makes the wholesomest Drink in the World. The Liquor is drawn by cutting the Tree two Inches deep into the Wood, the cut being run sloping to the Length of ten or twelve Inches. At the lower End of the Gash, a knife is thrust into the Tree slopingly so the Water running along the Cut or Gash, and falling upon the Knife that lies across the Channel, runs out upon the Knife, which has Vessels placed underneath to receive it. Some Trees will yield five or six Bottles of this Water

[1] Lahontan, 2:59.

a Day; and some Inhabitants of Canada, might draw twenty Hogsheads of it in one day, if they would thus cut and notch all the Mapples on their respective Plantations. The gash do's no harm to the tree. Of this Sap they make Sugar and Syrup, which is so valuable that there can't be a better Remedy for fortifying the Stomach.[1]

Bark was eaten by certain Indian tribes but seldom if ever by the Iroquois. Their ancient enemies and captors, the Adirondacks,[2] (in Seneca, *Hadi'ondas*, in Mohawk, *Adirhōn'daks*, meaning, *tree eaters*) ate bark in quantities. They were especially fond of the inside bark of the top of the pine especially in the spring when it was full of sweet sap.

The Iroquois in emergencies ate elm and basswood bark[3] and perhaps other barks but it was never a general article of diet. Sassafras bark and root as a carminative and aromatic was regarded with favor, as were several other spicy barks.

Maple	wat'dă'
Sap	owän'nongi'
Sugar	owän'non
Syrup	owän'nongi'
Boiling sap	goste''don
Saptime	o'gä'not
Sap runs	o'gä'not
He taps	ha'ge'o'tă
Sap spout	nion'geodă'kwa

XVIII FOOD ROOTS, Okdea

Root foods were not despised by the Iroquois but with few exceptions they were seldom used unless the scarcity of other foods made it necessary. It is difficult at this time to enumerate all the food roots used by the Iroquois since they have long since ceased to use wild roots and tubers as food, preferring, of course, cultivated

[1] Lahontan. New Voyages to America. Lond. 1735. 1:249.

[2] Tree Eaters, a people so called (living between 300 and 400 miles west into the land) from their only *Mihtuchquash*, that is trees: They are Meneaters, they set no corne, but live on the *bark* of *Chestnut* and *Walnut* and other fine trees: They dry and eat this *bark* with the fat of beasts, and sometimes men . . ." Roger Williams. Key. Reprint R. I. Hist. Soc. Col. Providence 1827. vol. 1.

Rale mentions the use of green oak bark and "a kind of wood" which he was compelled to eat for want of anything better while among the Indians of the north St Lawrence valley. Jesuit Relations, 67:223.

[3] *See* Swetland. Captivity.

varieties. Even wild onions and artichokes are now seldom used. There is a dim recollection of food roots, however, and the writer succeeded in getting the list which follows:

Artichokes	*Helianthus tuberosus*	otwĕ^{n}'ä'
Ground nuts	*Apios tuberosa*	yoandjago^{n}'
Wild onions	*Allium canadense*	gähadago^{n}ka'
Wild leek	*A. tricoccum*	o'no'sao^{n}
Yellow pond lily	*Nymphaea advena*	owä^{n}'osha'
Cat-tail	*Scirpus validus*	ono^{n}''gwĕ^{n}dă
Arrowhead	*Sagittaria latifolia*	oo^{n}wa'ho'no^{n}'
Indian turnip	*Arisaema triphyllum*	gä'oshä'
Milkweed	*Asclepias syriaea*	ono'skä'
Solomon's seal	{ *Polygonatum biflorum* { *P. commetatum*	ga'ga'wiyas (= crow eats it)
Potato	*Solanum tuberosum*	onon'o^{n}'dă'
Skunk cabbage	*Symplocarpus foeditus*	niagwai''igas (= bear eats it)

Terminology

ENGLISH	SENECA
Root	okde'ä'
I pull roots	o'gik'teodagok
Root gatherer	hakde'ogwas
Root eater	[1]hakde'äs

Artichokes were valued for their tasteful tubers which were edible raw as well as cooked. The boiled artichokes formed a dish which if properly seasoned with oil had some degree of palatability. Artichokes as food was early noted by explorers[2] and later writers mention their use. Champlain is the first writer to note their cultivation.[3] The Iroquois so far as it has been possible for the writer to

[1] Hak-de'-äs, from *h,* masculine affix; okde'ä', root; initial *o* changes to broad *ă,* terminal *ä'* is elided; iäs or ias, in compounds meaning *eater of,* loses initial *i* after *e* thus h-akde-äs, *he root eats.*

[2] On September 21, 1605, Champlain wrote of his explorations along the New England coast, ". . . We saw . . . very good roots which the savage cultivate, having a taste similar to that of chards." Elsewhere it was stated that these roots were Jerusalem artichokes. The Rev. Edmund F. Shafter commenting on this subject says that the Italians had procured these tubers for cultivation before Champlain's time, calling them girasole, corrupted and anglicized to Jerusalem.

[3] Champlain. Voyages. 11:112 footnote. Prince Soc. Bost. Pub. 1878.

inquire, never cultivated the plant but it frequently grew in their cornfields on flat lands along streams, and roots, raw or roasted, furnished food for the camp dinners of husking parties. Some women became especially fond of the tubers and were called otwäĕ^{n}yas, *artichoke eaters,* a name which survives today among the Seneca.

Ground nuts, yoändjago^{n}'o^{n}', were used in considerable quantities up to within the past 25 years. Their use early attracted the attention of explorers.[1] The ground nut was the favorite root food of a captive tribe, according to a tradition, and became the totem name of a clan.[2]

The plant grows on the rich alluvial bottom lands and the tubers which are strung along on the roots are easily dug and when boiled or roasted furnish a food which can be made palatable.

Several early writers mention the ground nuts used by the Indians, among them Peter Kalm, whose account follows:

> Hopniss or hapniss was the Indian name of a wild plant which they ate at that time. The Sweedes still call it by that name and it grows in the meadows in good soil. The roots resemble potatoes, and were boiled by the Indians, who eat them instead of bread. Some of the Sweedes at that time likewise ate this root for want of bread. Some of the English still eat them instead of potatoes. Mr Bartram told me that the Indians who live further in the country not only eat these roots which are equal in goodness to potatoes, but likewise take the pease which lie in the pods of the plant, and prepare them like common pease.[3]

In the Paris Documents of 1666, is an account of the Iroquois who are there said to be divided into nine tribes the sixth of which was the Sconescheronon, or Potato People. A drawing is appended showing a string of potatoes as the tribe's totem. There is now only a dim recollection of this clan whose name and symbol was the ground nut rather than the potato.

Indian turnips,[4] gä'osha, at first though, scarcely seem an inviting food. The acrid repugnant taste of the fresh root leaves an impression not soon forgotten. The juice is an actual poison if used

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[1] Ground nuts are probably what the French called "des chaplets, pource qu'elle est destingue par noends en forme de graeaes." Jesuit Relations 1634. p. 36.

[2] *See* Documentary History New York. 1:10.

[3] Kalm. Travels in North America. Lond. 1772. *See* Pinkerton. Voyages. Lond. 1812. 13:533.

[4] Synonyms: Jack-in-pulpit, wake-robin.

even in a small quantity and yet there seems to be good historical[1] evidence of the use of the root as food, not only by Indians but by white men as well. Harris has made a special study of this root and embodied a most interesting account of it in the Proceedings of the Rochester Academy, volume 1.

To prepare the roots they were sliced and dried and pulverized. Harris by inquiries among the old residents of the Genesee valley, found that the pioneers of that region had used the powdered roots of the Arum triphyllum as a substitute for flour and that they had obtained the receipt from the Seneca.[2]

Wild onions and leeks though often eaten raw with meat were a favorite substance for making soups. The onions were boiled and seasoned with oil. The writer was unable to find that onions were used as a flavoring for other soups or foods. The Iroquois seemed to like their onions in an unadulterated form.

The Iroquois have about forgotten the ancient use of yellow pond lily roots but a few old people were able to describe their use as food. The tuberous roots were gathered in the fall by treading them out with the toes and then scooping them up. When it is realized that the roots generally grew in 5 or 6 feet of water the difficulty of procuring them may be realized. A few Indians filched them from muskrat houses[3] but for superstitious reasons the practice never became general. Water animals were considered powerful magic agents and were thought to visit frightful vengeance when outraged. They might be killed for their meat or pelts but never robbed of their roots without special ceremonies.

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1 "Cos-cus-haw groweth in very muddy pools and moist ground. The juice is poison, and therefore heed must be taken before anything be made therewithal; either the roots must first be sliced and dried and then being pounded into a flour, will make good bread; or else while they are green they are to be pared, cut in pieces and stamped [pounded]; loaves of the same to be laid near or over the fire until sour, and then being well pounded again, bread or spoonmeat, very good in taste and very wholesome, may be made thereof." Thomas Hariot, Virginia 1585.

"The chief food they have for food is called loc-ka-whough. It grows in the marshes . . . and is much of the greatness and taste of potatoes . . . Raw it is no better than poison, and being roasted, except it be tender and the heat abated, mixed with sorrel or meal, it will prick and torment the throat extremely; yet in summer they use this ordinarily for bread." Smith. Virginia. 1606. *See* Harris. Root Foods. Rochester Acad. Proc. 1:111 et seq. *Cf. also* Carver's Travels; Kalm, *see* Pinkerton. Voyages, 13:534.

2 Harris. Root Foods. Roch. Acad. Proc. Rochester, 1891. 1:113.

3 Harris, page 115, says it was the usual custom when hunting the little animals (muskrats) to search their houses for roots. This was probably the case only when the muskrats were killed.

The roots of the yellow pond lily are porous and somewhat sweet and glutinous. They were either boiled with meat or roasted. Early explorers frequently mentioned the use of these roots and left interesting descriptions. Few, however, agree as to their taste. Some say that they tasted like the liver of a sheep,[1] others that they tasted like licorice and still others possibly in the throes of starvation enthusiastically describe their fine flavor. Pond lily roots are one of the most widely known food roots on the continent and were eaten from eastern Canada to the Pacific coast.

The roots of the cat-tail were often used. Dried[2] and pulverized the roots made a sweet white flour useful for bread or pudding. Bruised and boiled fresh a syrupy gluten was obtained in which corn meal pudding was mixed.

My Abenaki informants told me that the juice from the bruised roots was eaten raw with bread within very recent years.

Arrowhead tubers[3] were esteemed as good if boiled. Sometimes they were eaten raw but in this state the bitter milky juice made them repugnant to any one but a starving person.

Kalm says that the Swedes of New Sweden called the root Katniss after the Indian name and that the Indians boiled the root or roasted it in ashes.[4]

The potato is a native American plant[5] but it seemed to have

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[1] "The Indians eat the roots which are long aboiling. They taste like the liver of a sheep. The moose deer feed much upon them; at which time the Indians kill them when they have their heads under water." Josselyn. New England Rarities Discovered. London 1672. p. 105–238. Reprint Am. Antiq. Soc. Trans. v. IV. Bost. 1860. *Cf.* Pickering. Chronological History of Plants. Bost. 1879; Le Jeune. Relation 1633–34, p. 273.

[2] *See* Palmer, E. U. S. Dep't Agric. Rept. 1870. Washington 1871. p. 408.

[3] *Ibid.* p. 408.

[4] Pinkerton. Voyages, 13:533.

[5] The potato was certainly indigenous. Sir Walter Raleigh, in his efforts to colonization, had it brought from Virginia, under the original name of *openawg.* But none of the North American tribes are known to have cultivated it. They dug it up, like other indigenous edible roots from the forest. But it has long been introduced into their villages and spread over the northern latitudes far beyond the present limit of zea maize. Its cultivation is so easy and so similar to that of the favorite corn, and its yield so great that it is remarkable it should not have received more general attention from all the tribes. Schoolcraft. Census of the Iroquois. 1845. p. 12–13. Senate Document 24, Albany 1846.

Hariot who came to Virginia with Raleigh in 1584 described potatoes as Openawk, "a kind of root of round form, some of the bigness of walnuts." In 1586 the openawk were carried back to England and later in 1597 were figured by Gerard under the name of Potato of Virginia. *Cf.* Harris, p. 109.

been cultivated but little before the colonial period. After and during that time however the Iroquois began to plant potatoes in increasing quantities until now as a food they are consumed in greater quantities than corn. To give the Indian method of preparing potatoes for food now would be merely to repeat what every modern cookbook gives. Their favorite recipes, however, were potato soup, boiled and baked potatoes. Distinctive flavoring was given by mixing in bear oil, sunflower oil and white ashes. Potatoes were sometimes dried and made into a flour.

The Seneca cultivated the potato long before the Revolutionary War. To them it was known as onon′nondă′ while groundnuts were often called onon′nondă′oñ′wĕⁿ, original potatoes.

The root of Solomon's seal is said to have been used for food. The mature roots were gathered in the fall, dried, pounded and worked up into bread. Harris cites that a Seneca Indian in passing through Highland Park, Rochester, called the attention of his white companion John Nott to the plant saying it was once highly prized for its root.

The roots of skunk cabbage *Lymplocarpus foetidus* were also used being dried and pulverized. Harris says it was sometimes roasted or baked to extract its juice. The modern Seneca call it bear root.

The stalk of the milkweed rises from a tuberous root of considerable size. Western Indians it is said boil these roots for food. One writer[1] says that the Sioux gather the roots early in the morning while the dew is on the plant and prepare a crude sugar from them. He also states that the young seed pods are eaten after boiling them with buffalo meat and that the young stalks were used as white men use asparagus.

Wild rice was an important food of the Indians of the eastern portion of the continent, especially along the great lakes and the Mississippi valley. It was little used by the Iroquois however, although there are records of its employment. The Seneca some 40 years ago gathered a great quantity of it but the writer does not know of its use subsequently.

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[1] Palmer, Dr E. U. S. Agric. Com'n Rep't 1870, p. 405.

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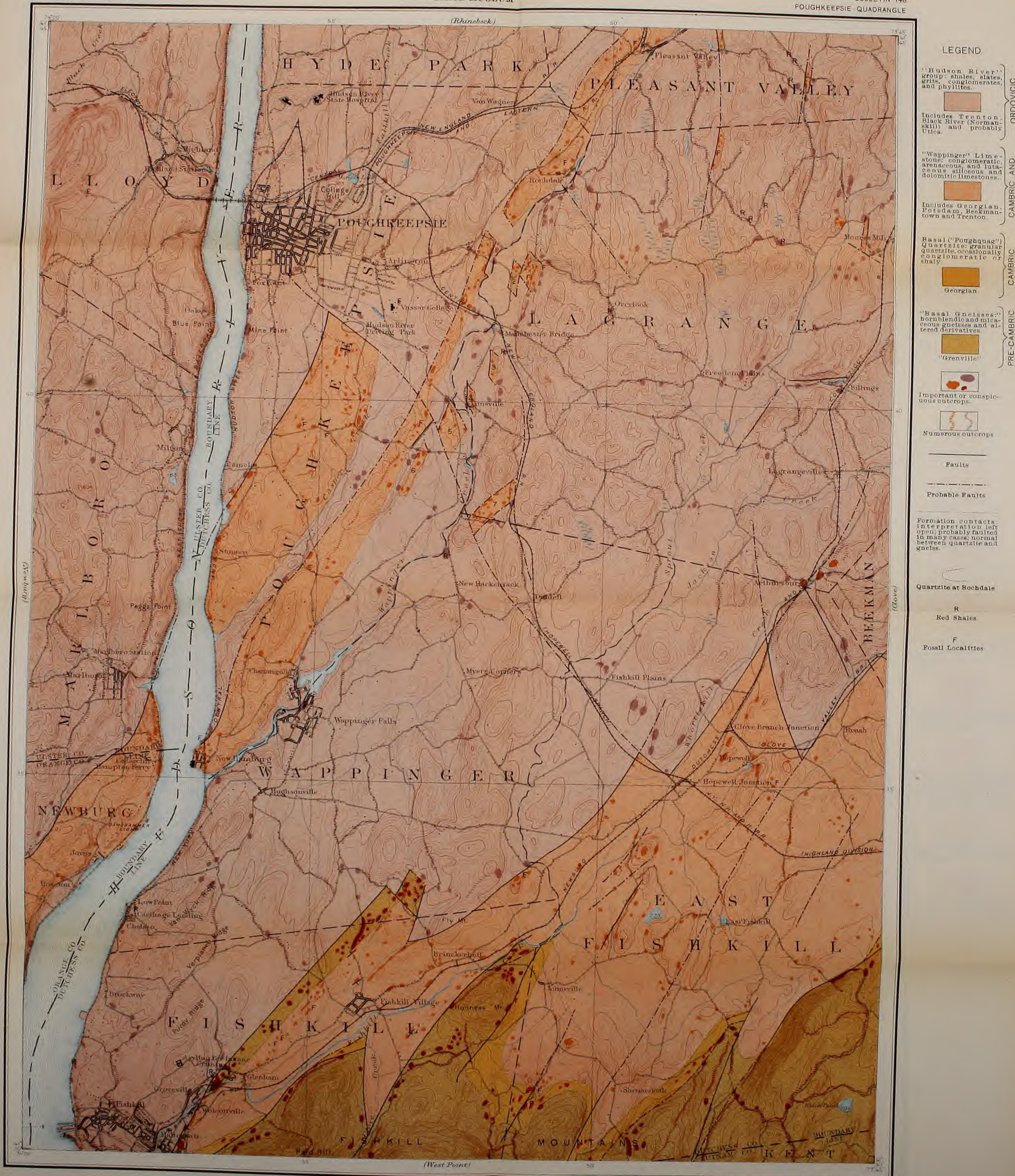

Geology by Clarence E. Gordon

Scale 1/62500

Contour interval 20 feet.
Datum is mean sea level

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Geology by D. D. Luther
1909–10

Contour interval 20 feet

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LEGEND

Rock outcrops along highways

Glacial scratches

Swamps or partially drained areas; mainly vegetable debris.

Modern river and stream alluvium.

Dunes of sand well defined.

Wind-blown sands more or less heaped into dunes.

Mohawk flood deposits of glacial age, mainly clays of alluvial origin.

Mohawk flood deposits of glacial age; coarse gravels (northwest of Scotia) grading to fine gravels and sands.

Rocks formerly laid bare by powerful currents of water; now mostly thinly covered by rock detritus or residual clays; boulders large when present.

Glacial till more or less washed and eroded by powerful currents of water; boulders mostly of large size.

Glacial till more or less covered and mingled with marginal lake deposits or with glacio-fluviatile deposits or with wind-blown sands.

Clays or sandy clays deposited in Lake Alplaus; stratified.

Clays or sandy clays, grading into overlying sands; stratified; deposits made in Lake Albany.

Unmodified glacial till.

Geology by J. H. Stoller, 1910.

Scale $\frac{1}{62500}$

Miles

Kilometers

Contour interval 20 feet

Datum is mean sea level

MUSEUM BULLETIN 148

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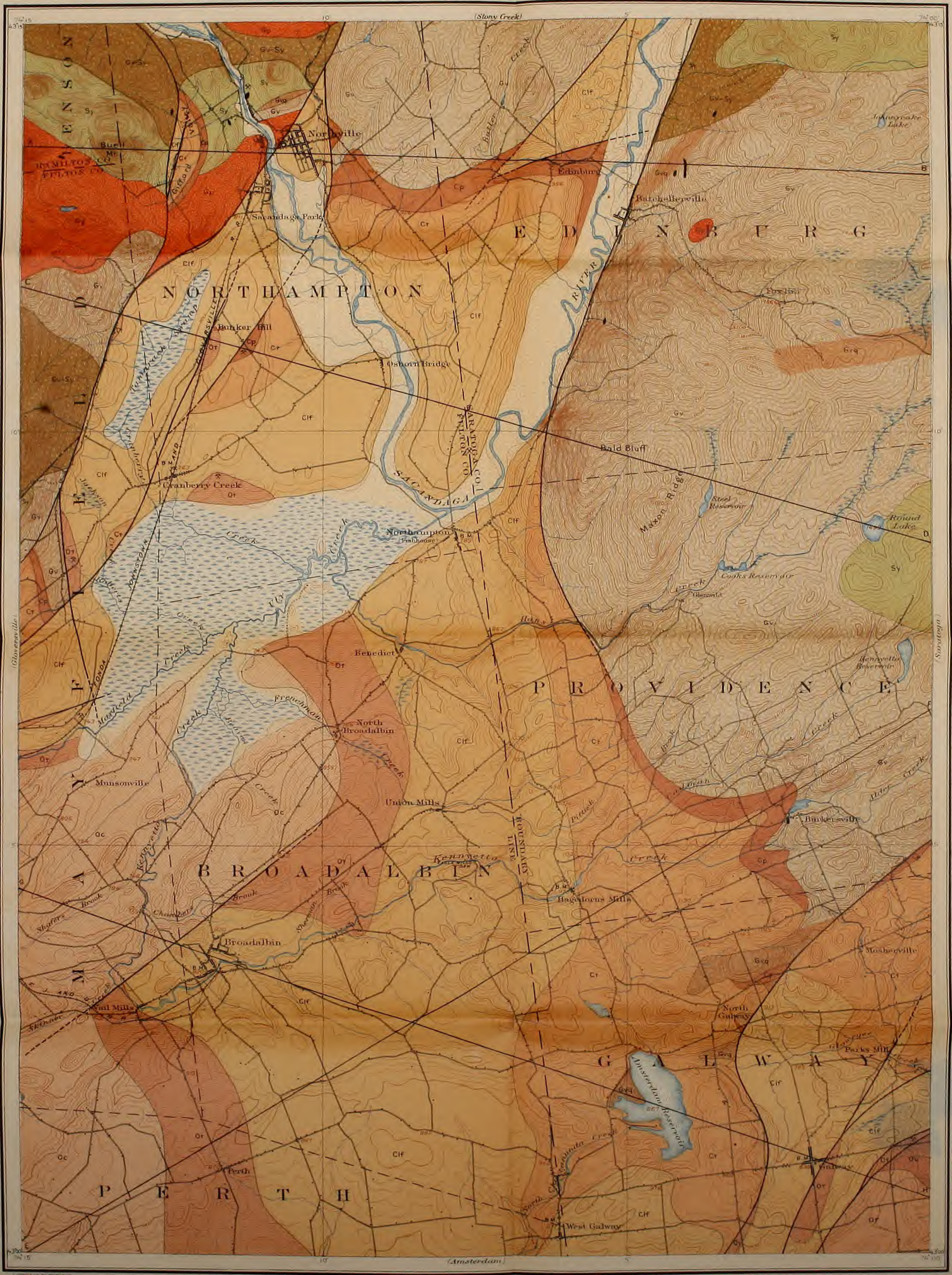

LEGEND

RECENT

Mostly modern alluvium and river deposits.

ORDOVICIC

Of — Frankfort shales and sandstones in alternating thin layers.

Ou — Utica black shale.

Oc — Canajoharie black shale.

Ot — Trenton and Black river limestones.

CAMBRIC

Clf — Little Falls dolomite.

Cr — Theresa formation. Alternating sandstone and dolomite beds.

Cp — Potsdam sandstone.

PRECAMBRIC

Diabase or gabbro dikes. Late Precambric and mostly non-metamorphosed.

Gv-Sy — Grenville-syenite mixed gneisses. Chiefly Grenville much cut up by intrusions of syenite.

Gp — Granite porphyry. Coarse grained, distinctly gneissoid and probably the same in age as the syenite.

Sy — Syenite. A distinctly gneissoid igneous rock which is younger than the Grenville.

Gvq — Grenville quartzite.

Gv — Grenville. Gneisses and schists representing highly metamorphosed sediments.

Faults.

Stone quarries.

AB, CD, EF and GH are the lines of structure sections shown in figures 1, 2, 3 and 4.

Scale 62500

Contour interval 20 feet

Datum is mean sea level

Geology by W. J. Miller.
1909.